



The Passive House standard

Energy Efficiency

+

Comfort

+

Quality Assurance



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Certified Passive House Consultant / Chair Passive House Rocky Mountains

Owner Baosol Design

Author [ours] Hyperlocalization of Architecture

Designed and built first certified International Passive House in Colorado



40% all
human
carbon
emission
from
building
operations

WTF?

5-8% all
human
carbon
emissions
from
building
materials

What is Passive House?

A voluntary international **Performance Standard**

Rigorous Design Process

Rigorous Certification Process

Encourages integrated design

Provides an optimizable design process



What is Passive House?

Certified through static energy modeling and verification

High-performance continuous thermal envelope

High-performance windows and doors

Thermal bridges eliminated or accounted for

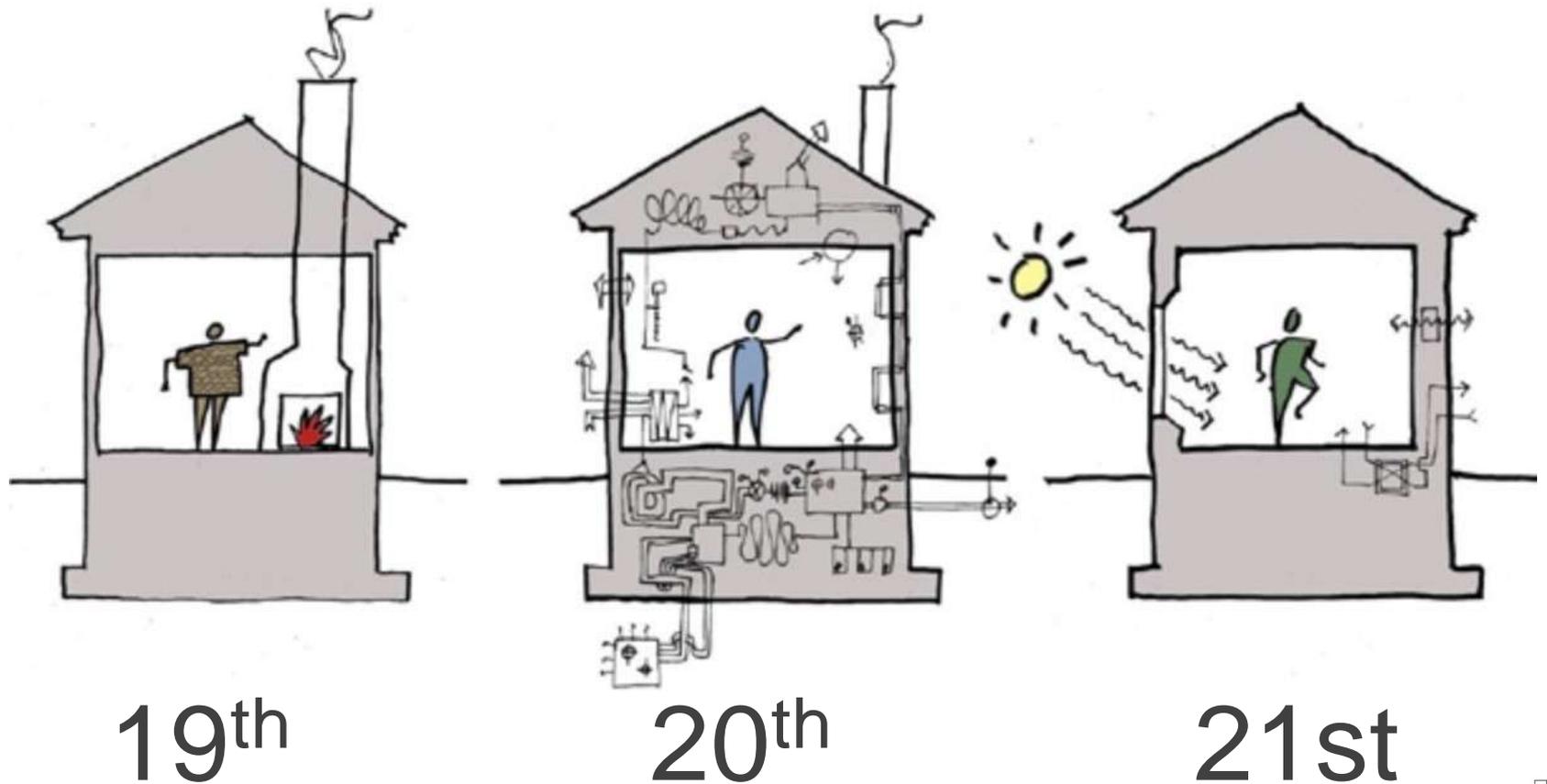
Airtight building envelope

Ventilation system with high-efficiency heat recovery

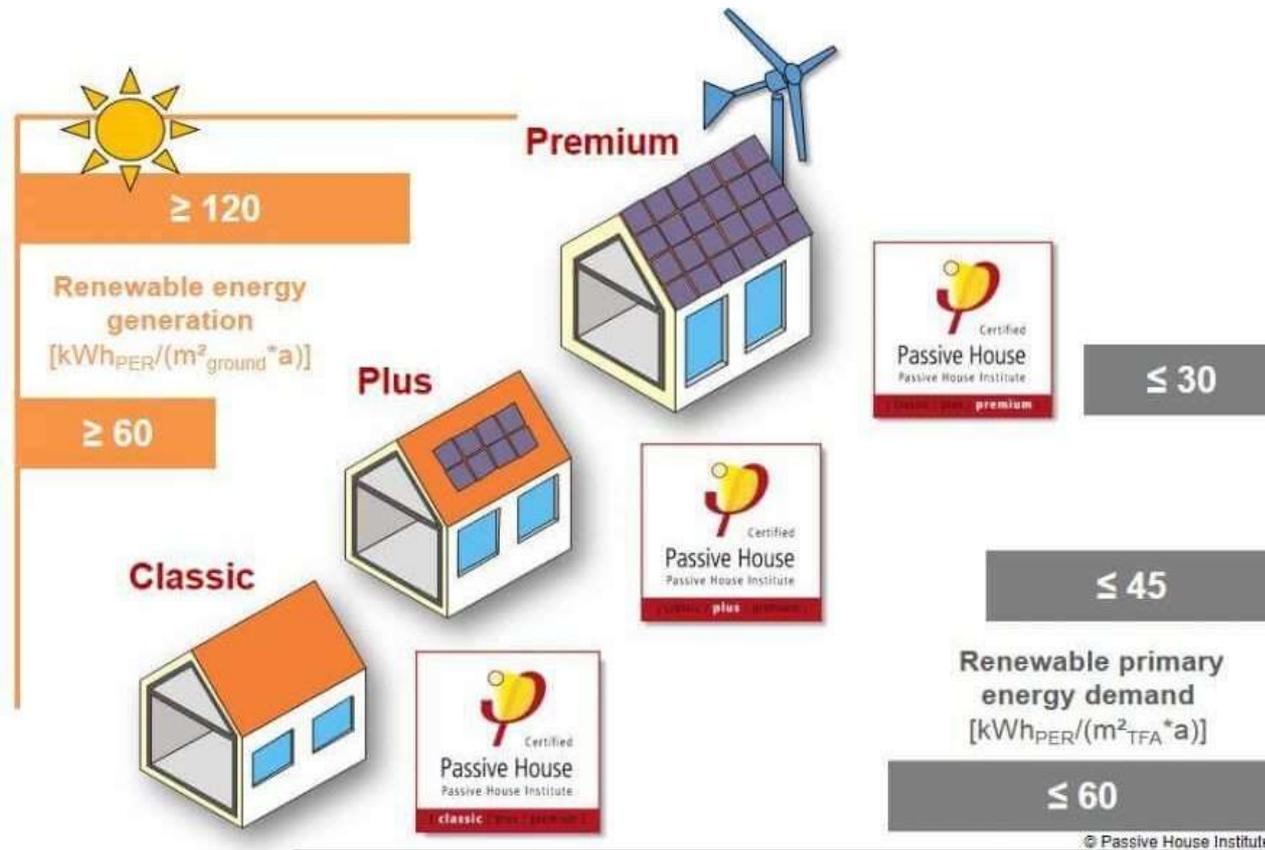


“Passive” is to make use of first sources of heat before introducing artificial means. (works in reverse for cooling too)

Innovation of building through the centuries



Passive House goes beyond net zero energy



Why Passive House?

Too many 'Eco' but uncomfortable buildings

Design solution to provide ideal indoor conditions for people with least amount of energy input

Deep cut in carbon emissions for life of building

Physics based feedback

Make zero energy grid friendly (renewable primary energy)



Some points of Passive House

Air tightness is as important as insulation

Comfort is as important as energy savings

Envelope > Complex Equipment

Near zero > “Net zero”

A systems approach demands Integrated Design Management

The performance gap is very real



“In Britain, an evaluation of 50 ‘leading-edge modern buildings,’ from supermarkets to health care centers, reported that they ‘were routinely using up to 3.5 times more energy than their design had allowed for’ — and producing on average 3.8 times the predicted carbon emissions”

Why Don't Green Buildings Live Up to Hype on Energy Efficiency?- Yale Environment 360, May 25, 2017

The performance gap is very real

Some points of Passive House

Passive House measured performance less than 5% variance from modeling

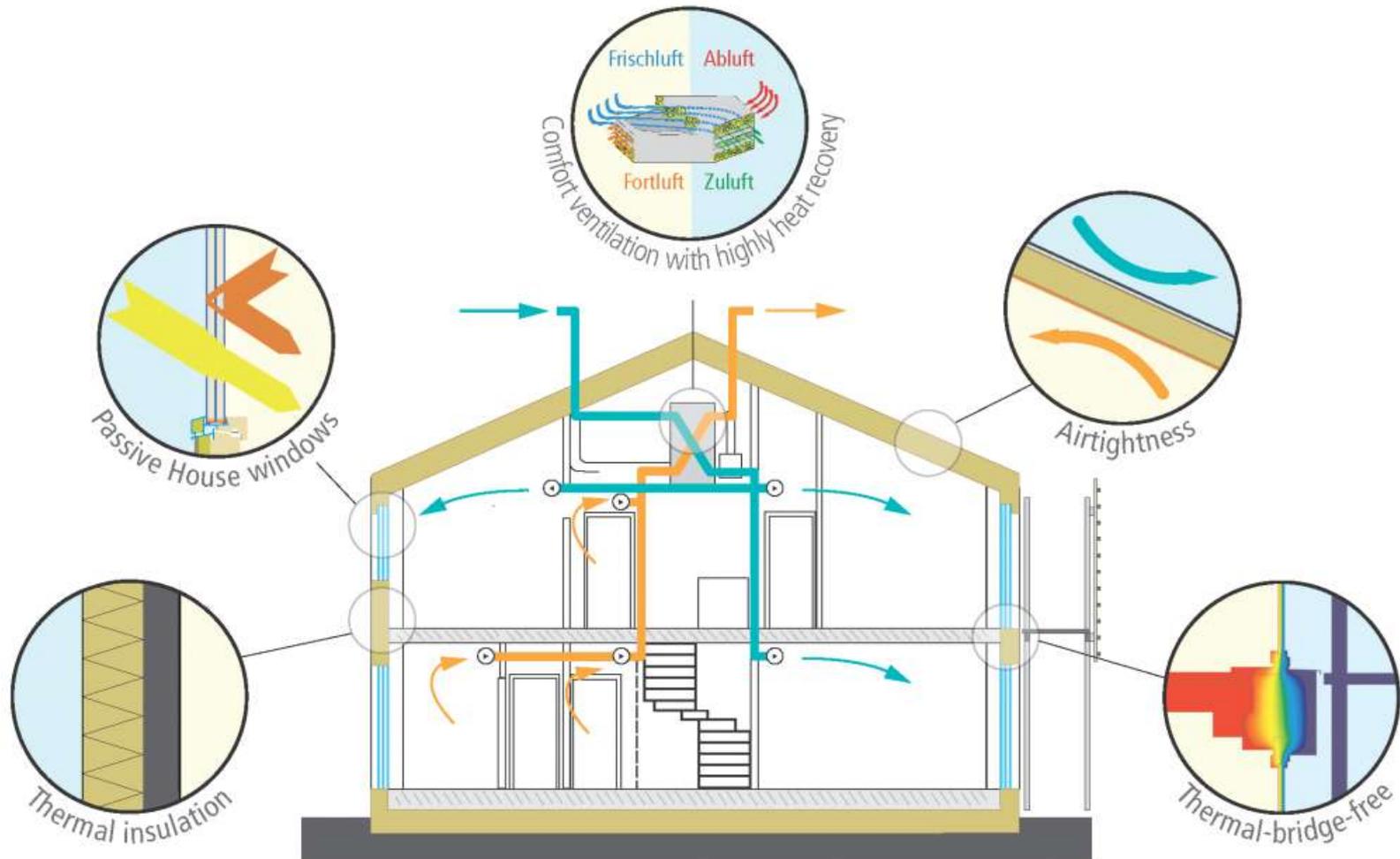
Cascading effects throughout the building process from design to durability.

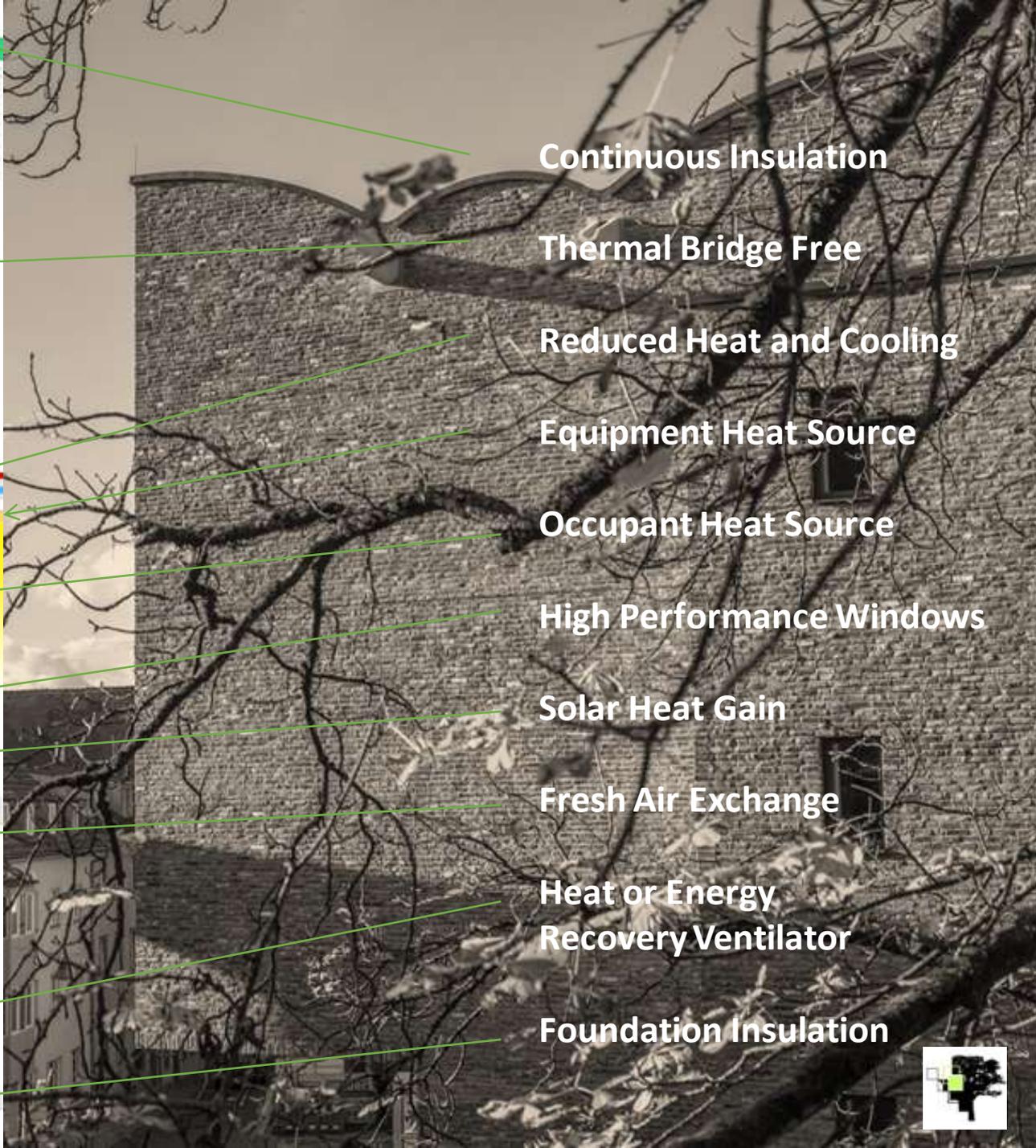
Provides high value to investment to building owner.
Costs 5-10% over code for homes, 0-5% commercial.

Makes you a better designer



Passive House as a thermal battery





Continuous Insulation

Thermal Bridge Free

Reduced Heat and Cooling

Equipment Heat Source

Occupant Heat Source

High Performance Windows

Solar Heat Gain

Fresh Air Exchange

**Heat or Energy
Recovery Ventilator**

Foundation Insulation



Passive House requirements

Metrics – Energy

Heating Demand: 4.75 kWh/(f².yr)

OR Heating Load: 3.15 W/f²

Cooling Demand: 4.75 kWh/(f².yr)

OR Cooling Load: 3.15 W/f²

Airtightness n50: 0.6 ach

Primary Energy: 37 kWh/(f².yr)



Passive House requirements

Metrics – Comfort

Air temperature:	design set point 68 F
Overheating:	less than 10% of the year over 78 F
Surface temps:	min 62 F
Fresh Air:	Effective ventilation required for all rooms
Indoor RH:	Not below 30%
Moisture:	must rule out excessive buildup in elements
Habitable rooms:	at least one opening window
Controls:	users must be able to operate
Sound:	≤ 25 db(A) from the ventilation system
Draughts:	no draughts to be perceived



Passive House Certification

Use Passive House Planning Package energy modeling (Passive House Consultant)

Passive House certified components- particularly Heat Recovery Ventilation

Airtightness test (third party)

HRV commissioning report

Third party verification (Passive House Certifier)

Passivhaus Institut verification

Passive House outcomes

Meaningful energy demand reductions **75 - 90%**

Meaningful CO2 emission reductions **60 - 75%**

Exceptional comfort – even ambient and radiant temps

Free from condensation, dampness and mold issue

Constant fresh air at a comfortable temperature

Quiet



Passive House success

10,000 certified projects and estimated 50,000 total projects (both certified and not)

Projects in every climate zone- from Dubai to Antarctica

Can be made with almost any material

Can be built at almost any scale

First Passive House functions with no degradation of performance after 25 years



Passive House Press



Pueblo

Northern New Mexico has one of the oldest design traditions in the United States. A mix of cultures intersecting for the past 500 years has led to distinctive architecture that speaks as much to the arid Southwest region as it does the people who live there. The oldest building still intact here in the United States is the Taos Pueblo (taospueblo.com), built with a stepped, long form and massive adobe brick walls. When the Spanish entered the region, they brought the hacienda, with long front porches, tall windows, and intricate woodwork. The railroad brought manufactured materials like corrugated metal and mass-produced lumber and steel, leading to the Territorial style. Many new buildings in the region are a mash-up of these influences. It is in this rich backdrop that Northburn Inc.—a design firm where I work under my colleague, architect Joseph Stanford—built three certified Passive Houses—the Balance House, the Taos House, and the Olsen House. For these projects, we were looking for a robust, energy-efficient system for building homes that would also be highly adaptable. We prefer a contemporary design approach that draws on traditional qualities like the passive roof, natural materials, and, of course, the graciously thick walls that are ubiquitous in the Southwest. We have found that we can



Passive House History



The first fully functioning Passive House was actually a polar ship and not a house: the Fram of Fridtjof Nansen (1883).

“... The sides of the ship were lined with tarred felt, then came a space with cork padding, next a deal panelling, then a thick layer of felt, next air-tight linoleum, and last of all an inner panelling. The ceiling of the saloon and cabins . . . gave a total thickness of about 15 inches. ...The skylight which was most exposed to the cold was protected by three panes of glass one within the other, and in various other ways. ... The Fram is a comfortable abode. Whether the thermometer stands at 22° above zero or at 22° below it, we have no fire in the stove. The ventilation is excellent, especially since we rigged up the air sail, which sends a whole winter’s cold in through the ventilator; yet in spite of this we sit here warm and comfortable, with only a lamp burning. I am thinking of having the stove removed altogether; it is only in the way.”

(from Nansen: “Farthest North”, Brockhaus, 1897)



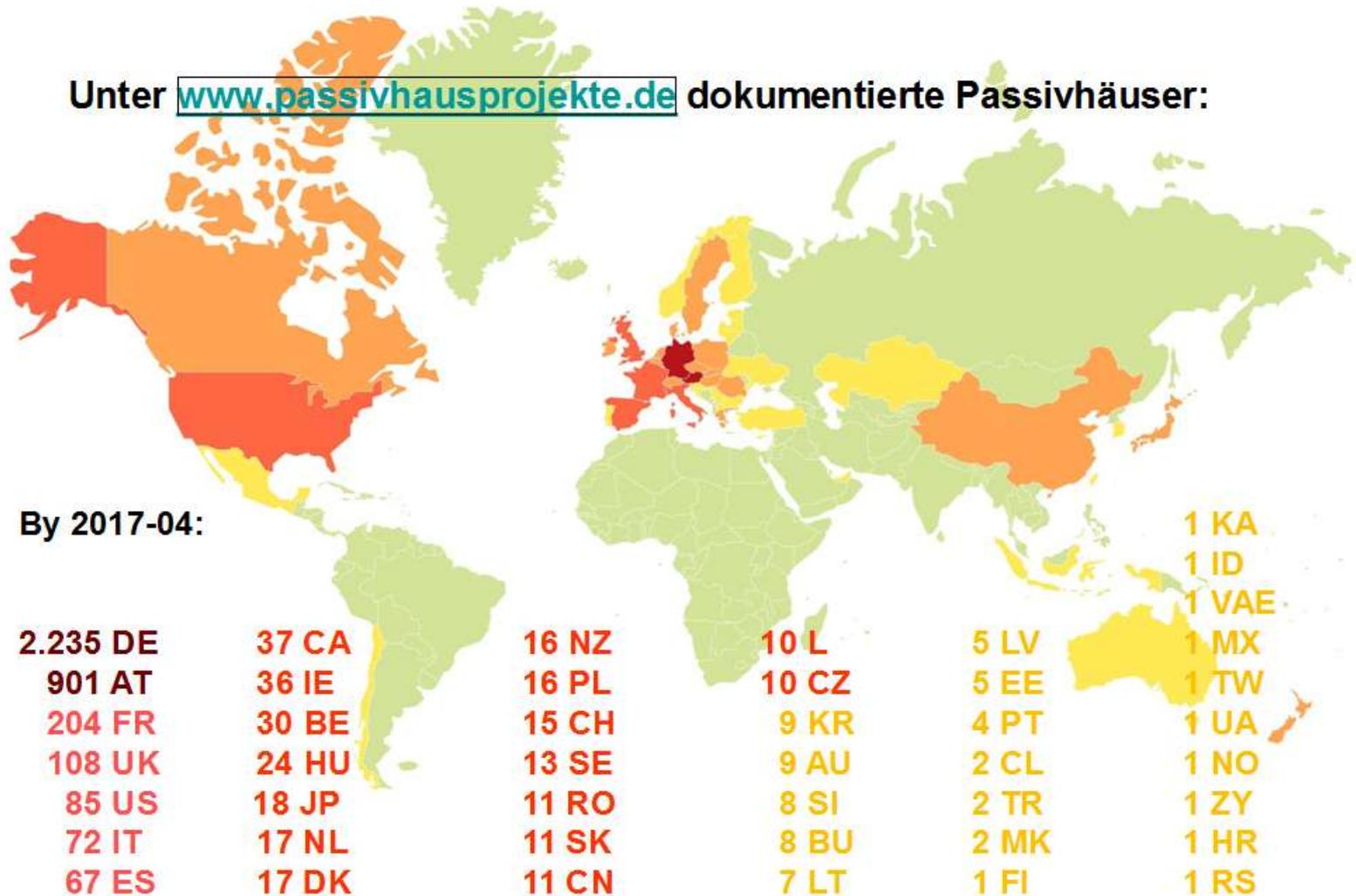








Unter www.passivhausprojekte.de dokumentierte Passivhäuser:

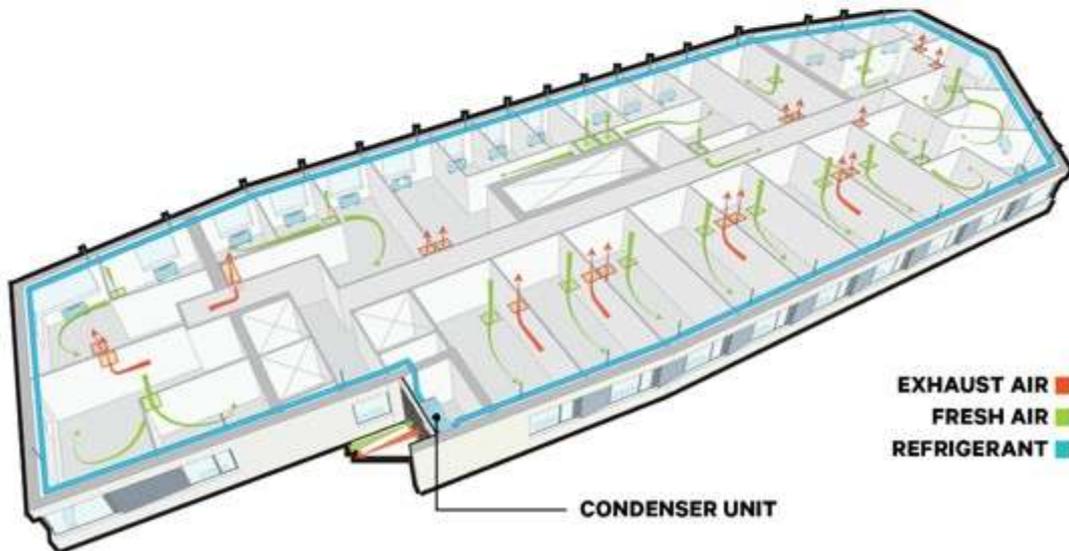
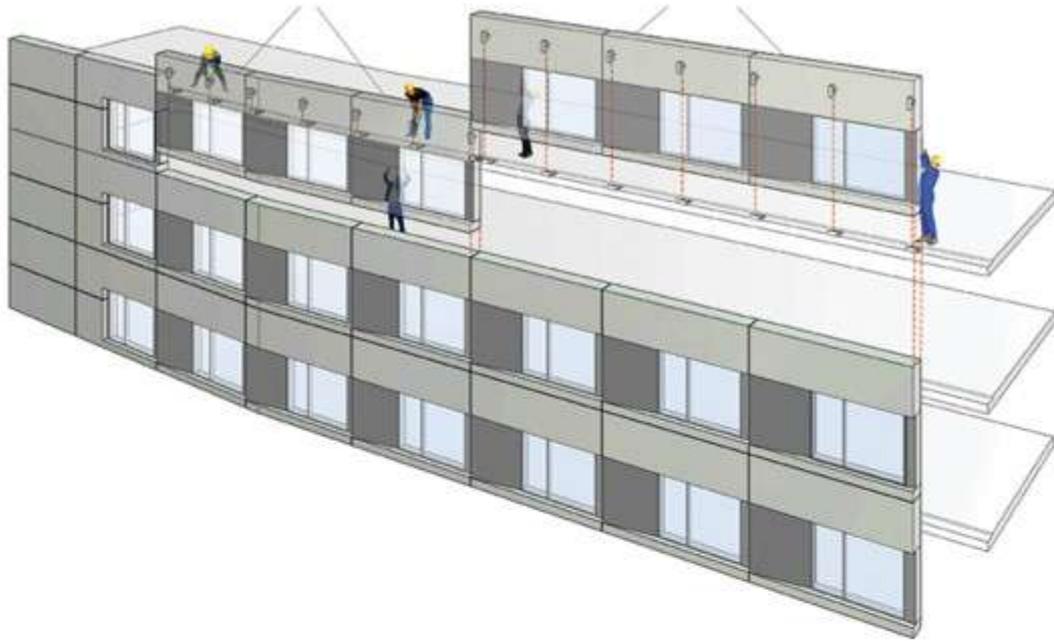




Raiffeisenhaus Bank Tower
21 stories (78m) high with 6 levels (20m) below ground

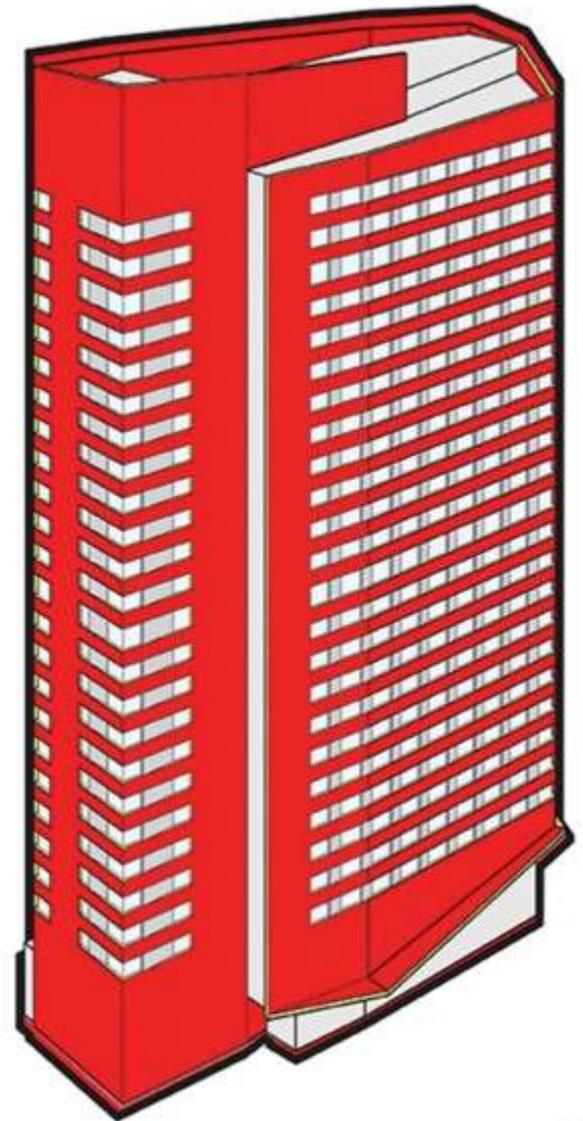
scaled





EXHAUST AIR ■
FRESH AIR ■
REFRIGERANT ■

CONDENSER UNIT

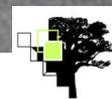




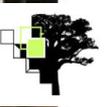


A modern, dark grey school building with a gabled roof and several windows. The building is surrounded by a paved area and some greenery. The sky is clear blue. The word "unique" is overlaid in large white letters at the bottom of the image.

unique



sensitive





creative

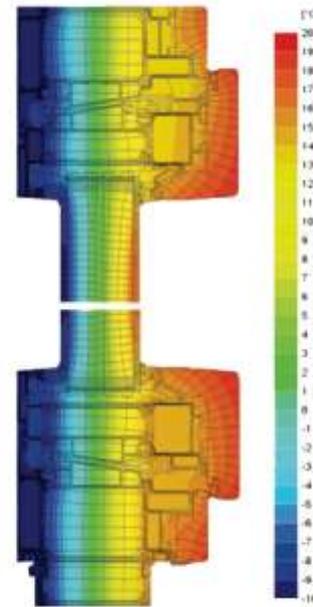






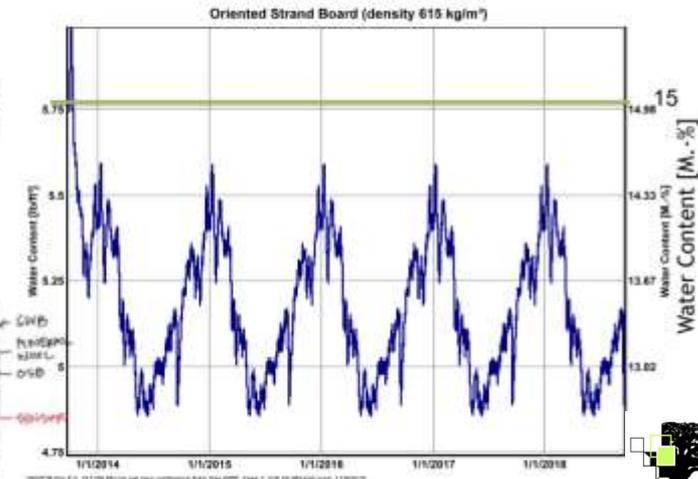
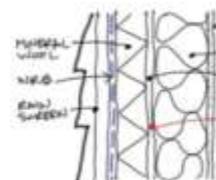
technical





Mineral wool: 2" rigid, OSB outboard/ 2x6, GWB inboard

- Mineral wool does the job
- Diagram of assembly:





urban



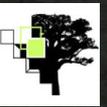


**BahnStadt
Heidelberg Mixed Use Passive House Community
5000 live, 7500 work**





Eurogate Neighborhood
Passive House District
5000 residents, 8000 workers





THE ORCHARDS





innovative



The image shows the Enterprise Centre, a modern building with a unique, textured facade made of foamless concrete. The building features a series of vertical, ribbed columns that create a rhythmic pattern. A large window is visible on the left side, and a glass entrance is at the bottom. The sky is blue with some clouds, and a few people can be seen walking on the sidewalk in the background.

Enterprise Centre
Foamless
Architype

healthy





comparable





Bullitt Center
Living Building Challenge NZE
Miller | Hull Partnership





passive house+ eco build & upgrade

Cabin fever
Japanese-inspired passive mountain lodge

Straw bale house
Near passive, no heating system

Insulation | daylighting | renewable energy | triple glazing | ventilation | green materials | water conservation + more

PASIVNÍ domy nulové údržby

SPECIÁL 2017

ČESKÝ OSTROVNÍ DŮM
VEGETAČNÍ STŘECHA JAKO KLIMATIZACE
PASIVNÍ DŮM LEVNĚ REKONSTRUKCE DO PASIVU

25 REALIZACÍ

AKTIVNÍ DŮM JE LEVNĚJŠÍ

85 Kč

CENTRUM PASIVNÍHO DŮMU

FEJER PASIV

PASSIVE HOUSE DETAILS

Solutions for High-Performance Design

DONALD B. CORNER
JAN C. FILLINGER
ALISON G. KWOK

PASSIVE HOUSE



**faircompanies*





OFF GRID HIDEAWAYS

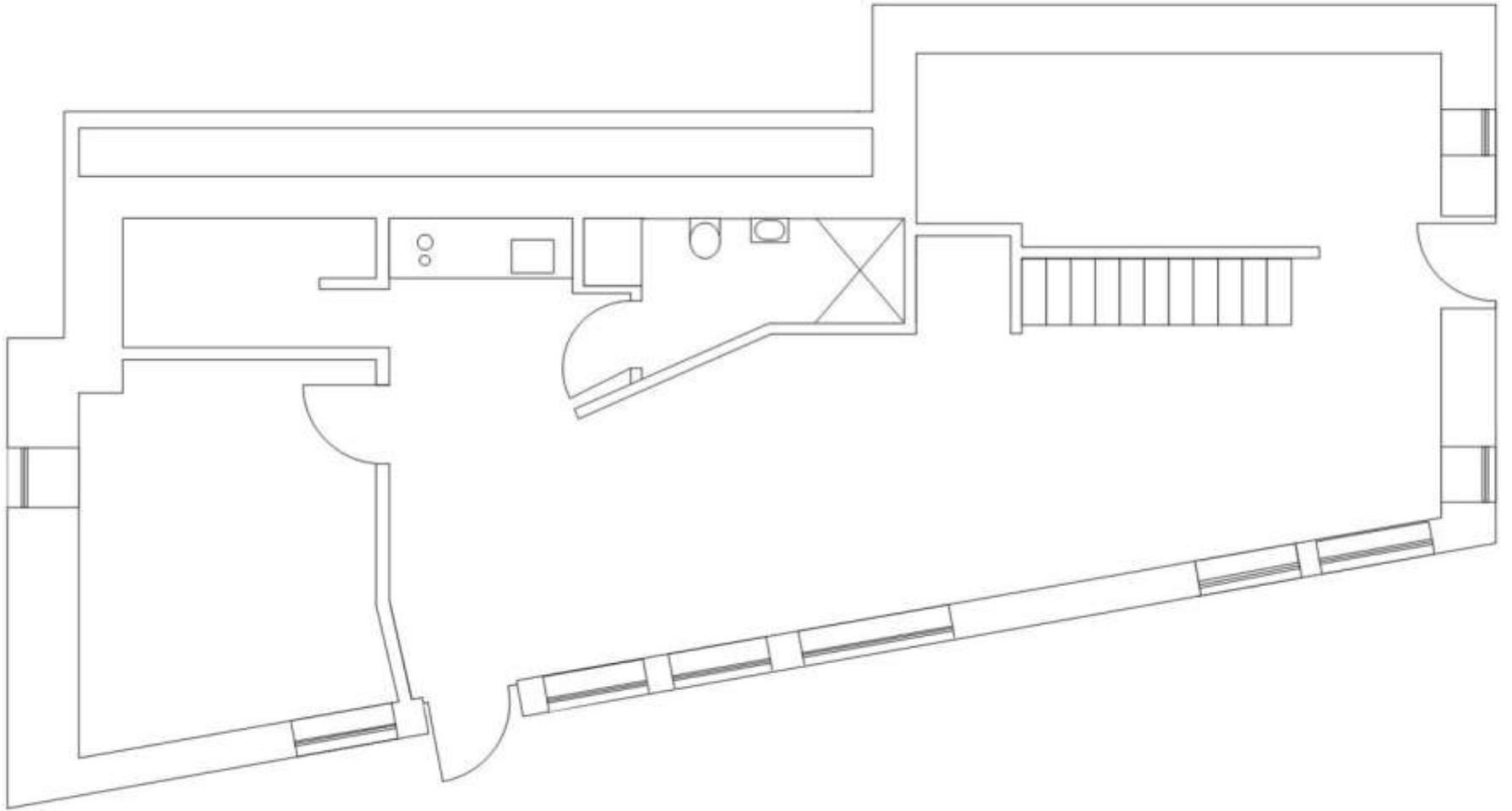
Break Free



Specific building demands with reference to the treated floor area						
				Requirements	Fulfilled?*	
	Treated floor area	1275	ft ²			
Space heating	Heating demand	1.41	kBTU/(ft ² yr)	30% of 4.75 kBTU/(ft ² yr)	yes	
	Heating load	4.00	BTU/(hr.ft ²)	126% of 3.17 BTU/(hr.ft ²)	-	
Space cooling	Overall specif. space cooling demand		kBTU/(ft ² yr)	-	-	
	Cooling load		BTU/(hr.ft ²)	-	-	
	Frequency of overheating (> 77 °F)	9.0	%	-	-	
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	29.1	kBTU/(ft ² yr)	77% of 38.0 kBTU/(ft ² yr)	yes	
	DHW, space heating and auxiliary electricity	16.0	kBTU/(ft ² yr)	-	-	
	Specific primary energy reduction through solar electricity	35.2	kBTU/(ft ² yr)	-	-	
Airtightness	Pressurization test result n ₅₀	0.5	1/h	0.6 1/h	yes	

* empty field: data missing; '-': no requirement













Optimize the envelope early in the development



Costs are based on complexity and experience



There is math behind nearly every decision path



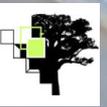
You have to understand things as systems



You link these systems together

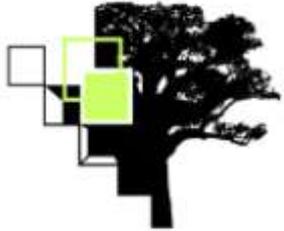


What at first seems very hard quickly becomes second nature



You will never see a building the same way again





Baosol Adaptive Design

www.baosol.com



Passive House Rocky Mountains

www.phrockymountians.com

Passivhaus Days

November 10-12th