KOKA ARCHITECTURE + DESIGN

THE ENVELOPE AND PASSIVE HOUSE

An Architect's Visual Design Process

MARKEN DESIGN + CONSULTING

Slide 1

1 Let us know when you are ready with any revisions and we will download the ppt again and send it off. thx.
Herman Kao, 2016-09-15

1 Thanks, Herman! I have finished updating the PH slides and they should be ready to export to ppt and send off.
Marybeth Welty, 2016-09-15

2 Just exported to powerpoint on windows and it seems to work with the fonts.
Herman Kao, 2016-09-15

3 Hi Marybeth
Herman Kao, 2016-09-15

5 Herman, is this generally a simple enough diagram?
Chenyue Zhang, 2016-09-15

4 Yes looks good. I'll add in some captions.
Herman Kao, 2016-09-15

5 Marybeth, if you can provide the name, designer, year, and location of the reference projects, that would be great!
Herman Kao, 2016-09-15

6 Marybeth, please let us know if the proposed formatting works for you as we are thinking we may not need the grey bar on the bottom.
Herman Kao, 2016-09-15

7 Team, this is a draft, all content can be modified.
Herman Kao, 2016-09-15

Koka architecture + design

Herman Kao, Architect AIBC LEED AP and Joseph Kardum, Architect AIBC LEED AP are Principals in the Vancouver studio of KOKA Architecture and Design Inc, an architectural practice in British Columbia with a special interest in sustainable architecture and healthy living environments. Committed to contemporary, innovative and sustainable architecture, the team focuses on creating healthy and cost-effective architecture, including the Passive House concept, with the ultimate goal of positively impacting the lives of each person within the community.

koka architecture + design inc.

Marken Design + Consult

Marybeth Welty, B.Sc., DID, LEED AP.

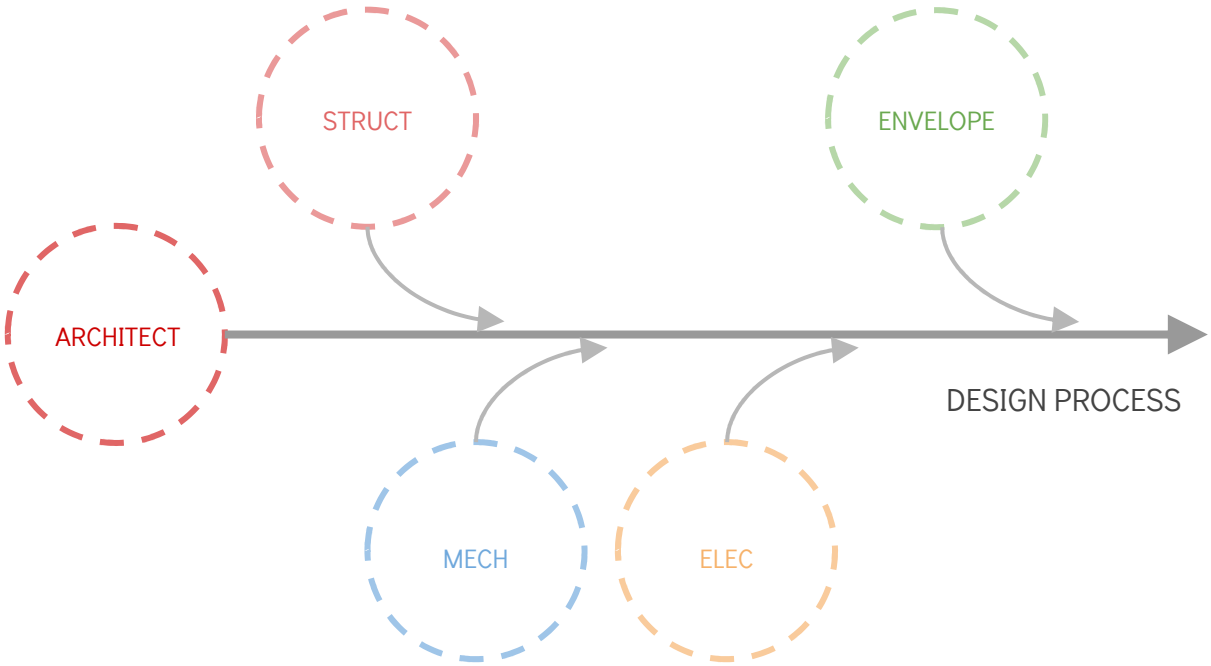
Drawing on her mathematics and pure science background, Marybeth aims to bring optimization, efficiency, and a respect for nature into all of her projects. Combining her art, design, and sustainability experience, Marybeth creates beautiful, healthy spaces in the most environmental, cost efficient, and aesthetically creative way possible. She has worked on several LEED and Passive House projects from both a design and consulting aspect.

marken
Design + Consult

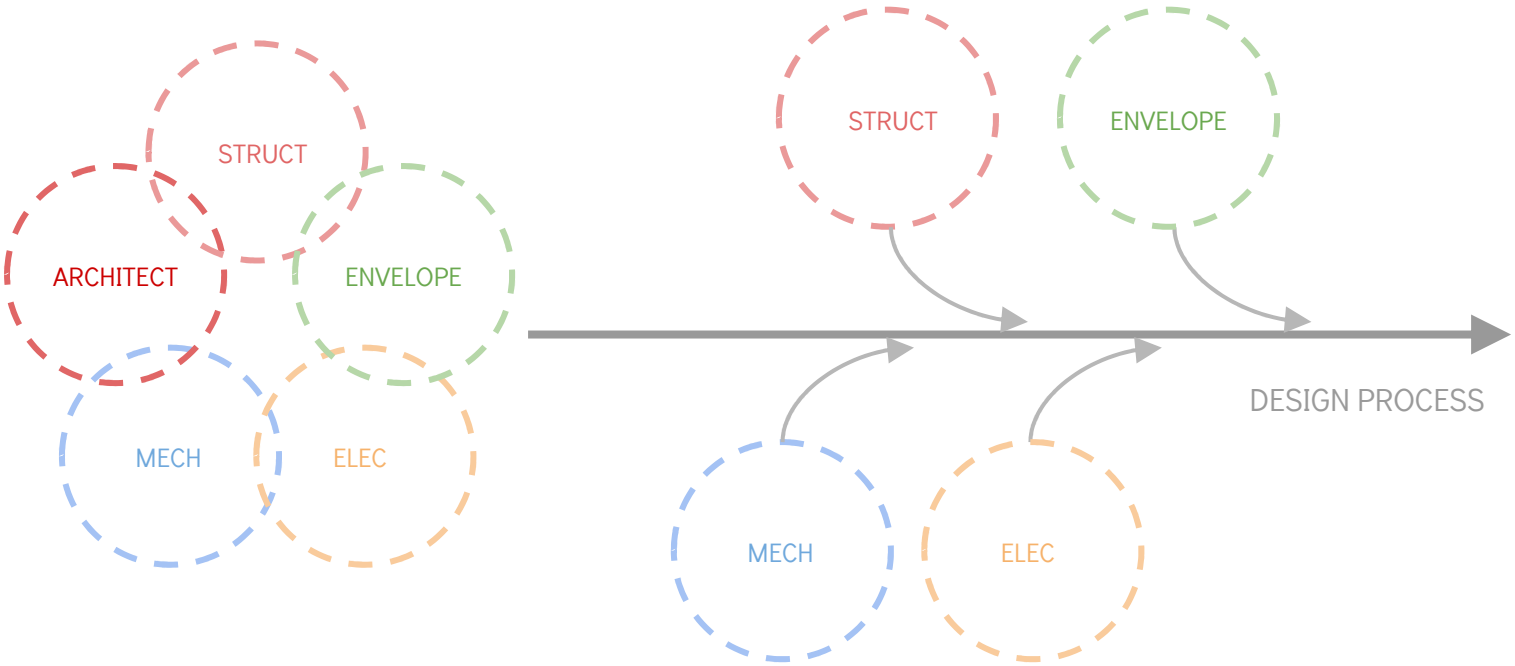
The Envelope and Passive House: An Architect's Visual Design Process

Ideas, Problems, and Collective Solutions... These are the basis of each sustainable building project.

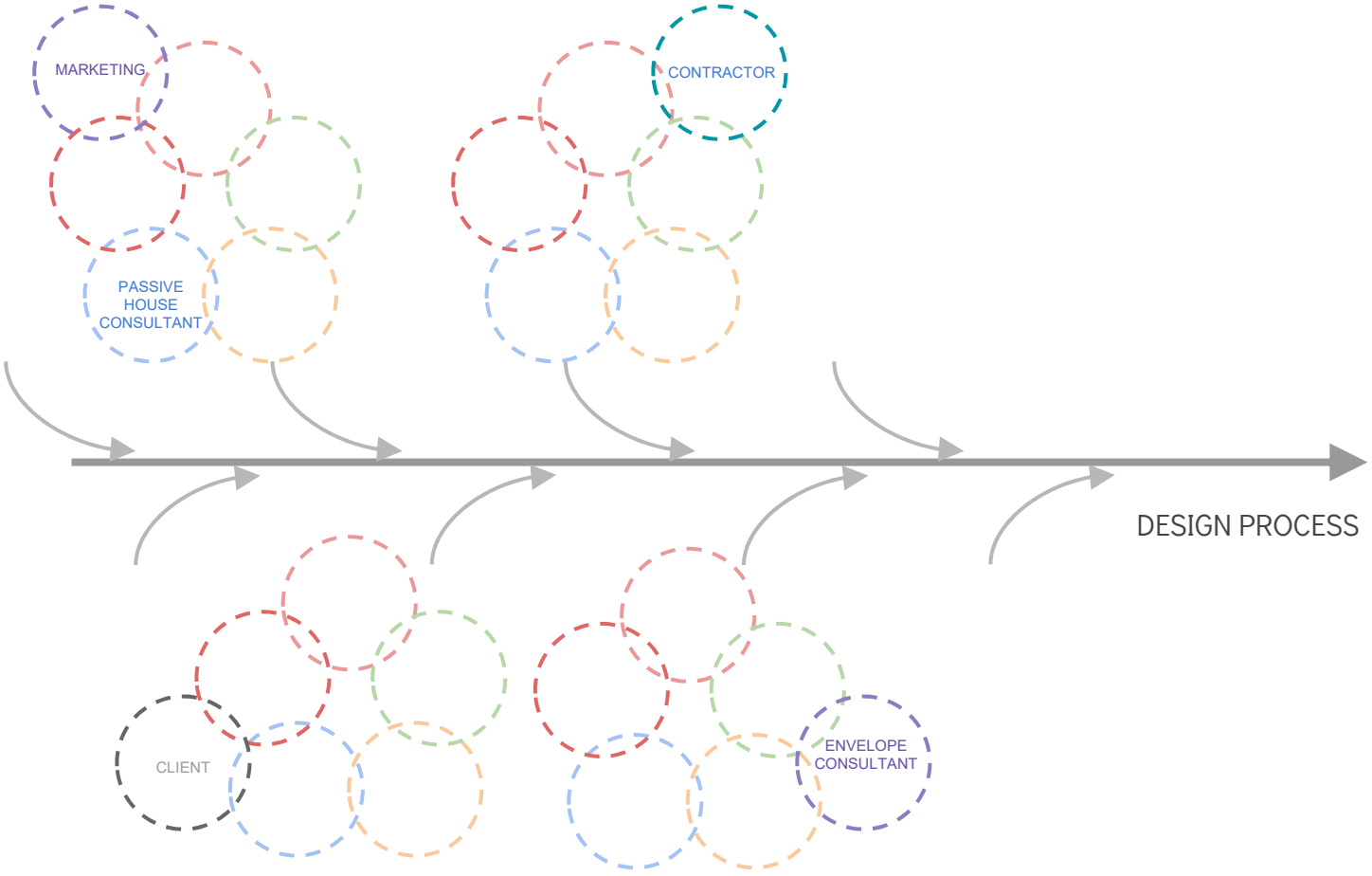
Built forms are being designed with tighter envelopes to address the growing interest in energy savings within single-family and multi-family homes, such as the Passive House standard in Canada. While many factors come into play when designing a sustainable building, all are not evident to all parties during the design process. Therefore this presentation will take a team approach to identify some aspects of the architectural design process as it relates to various building envelope challenges associated with sustainable architecture, and it will pose the question: How can you contribute to the creative commons for sustainable building?



Conventional Approach



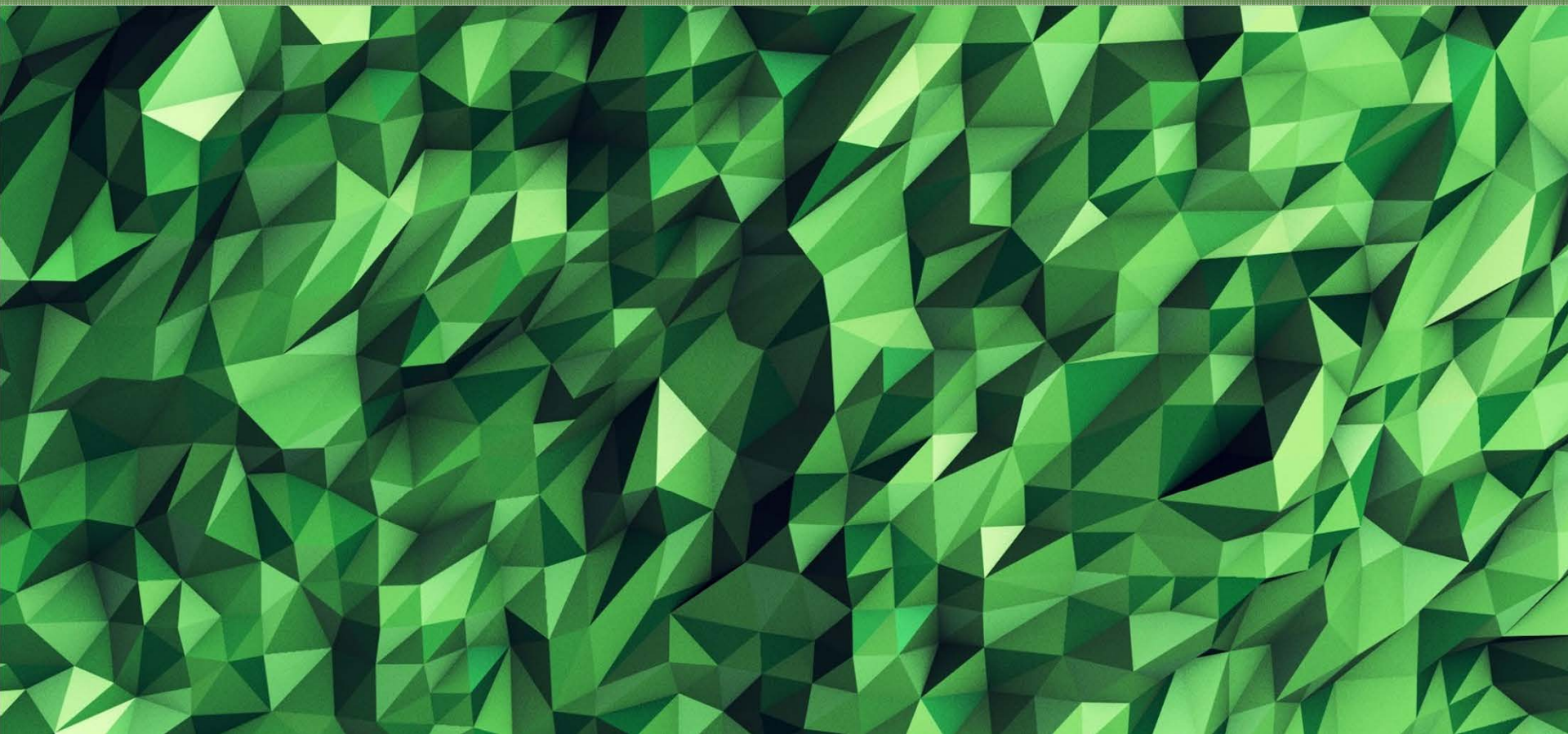
Integrated Approach



Alternative Approaches

PASSIVE HOUSE OVERVIEW

Introduction to Passive House



Location : Regina
Year : Completed in 1977
Designer : Saskatchewan Research Council and Harold Orr

Saskatchewan House

Slide 8

1 Marybeth: Do you like these photos or do you prefer the photo on the left?
Chenyue Zhang, 2016-09-15

2 Just the photo on the left, please.
Marybeth Welty, 2016-09-15

Prof. Bo Adamson
Sweden

Dr. Wolfgang Feist
Germany

Passive House Founders

Designer: Bott, Ridder and Westermeyer
Location: Darmstadt, Germany
Year: 1990

First Passive House

Passive House Institute Founder

Dr. Wolfgang Feist

Darmstadt, Germany

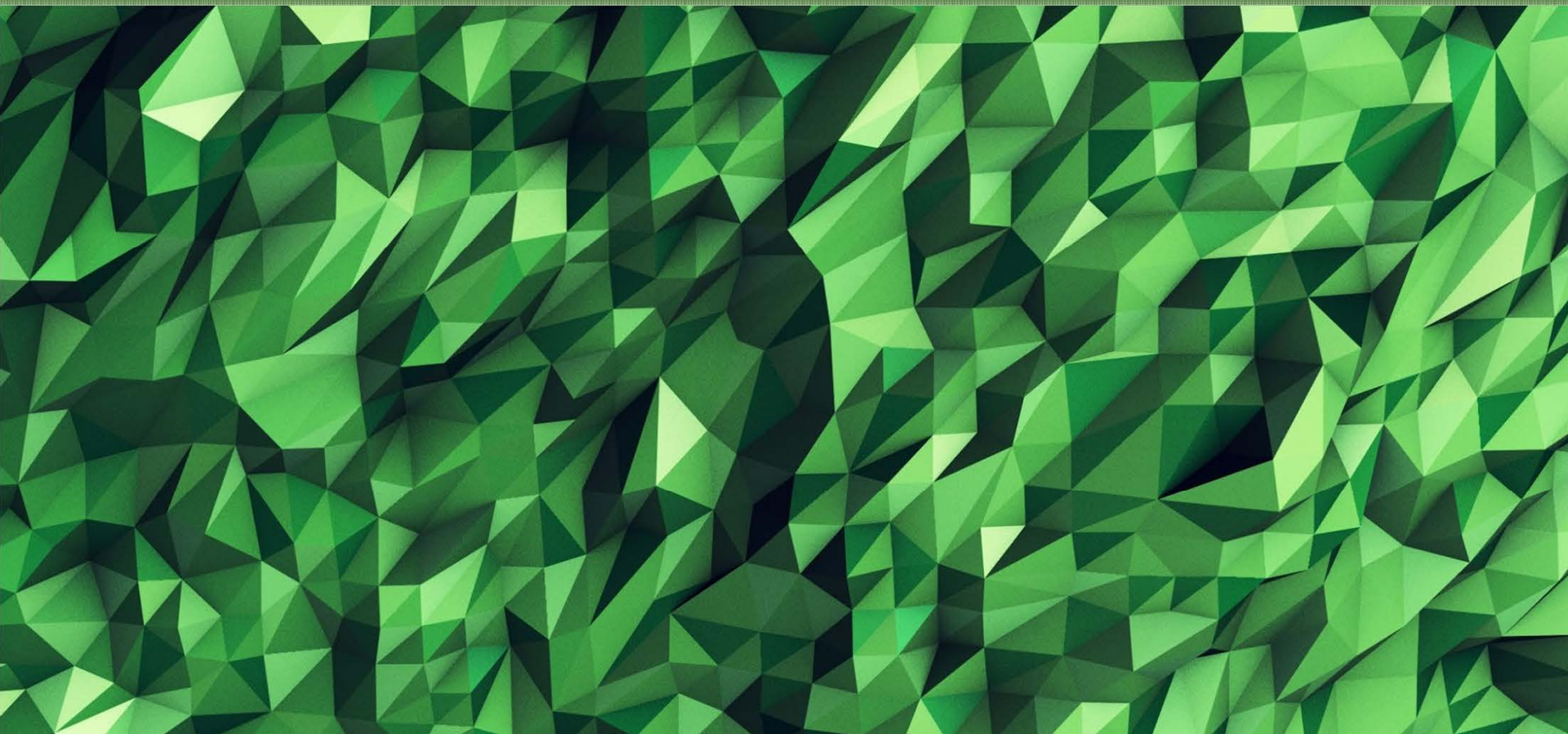
Passive House Institute

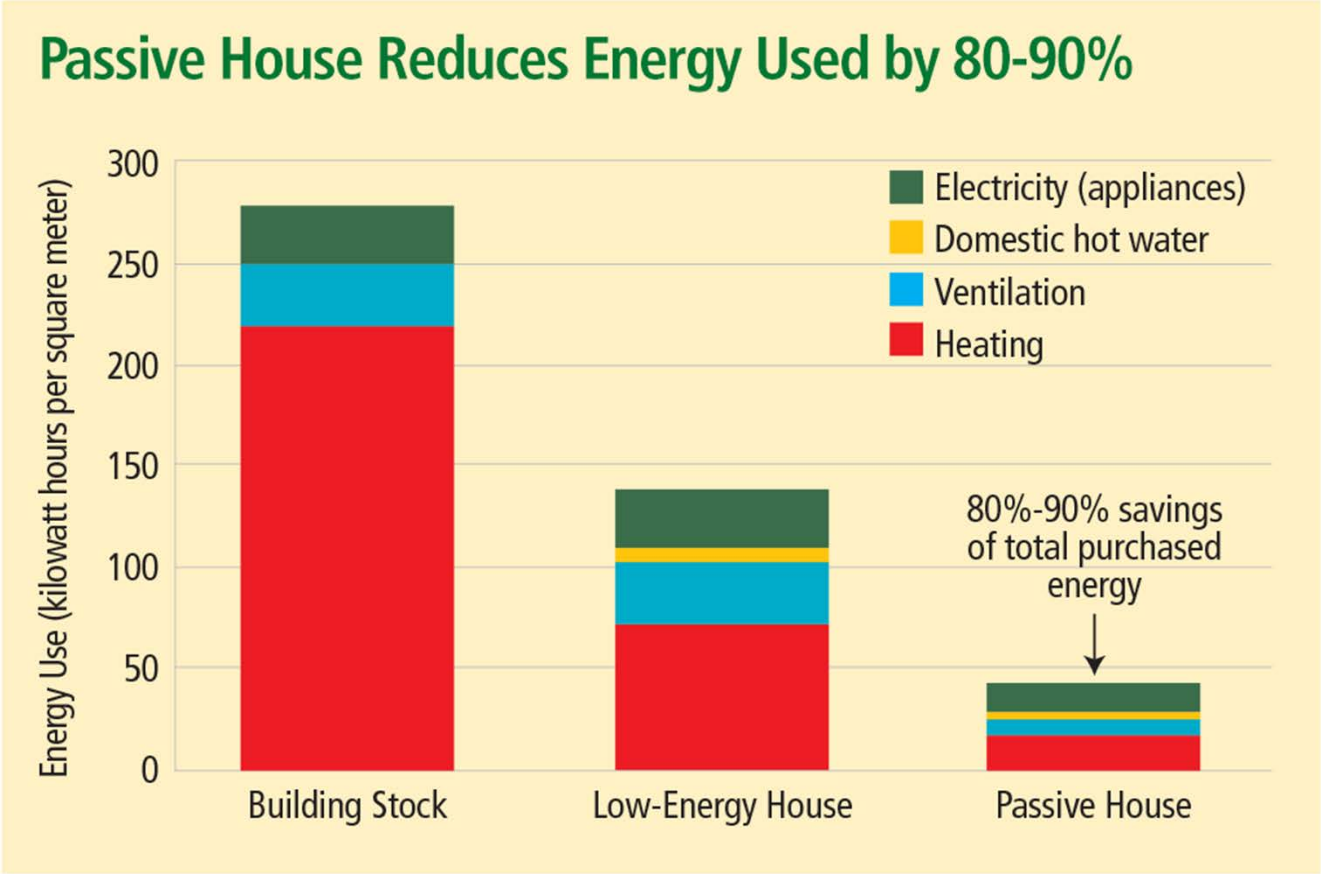
(original image source: http://www.indiawrites.org/tag/pope-francis-white-house-visit/)

The Passive House Pope

PASSIVE HOUSE OVERVIEW

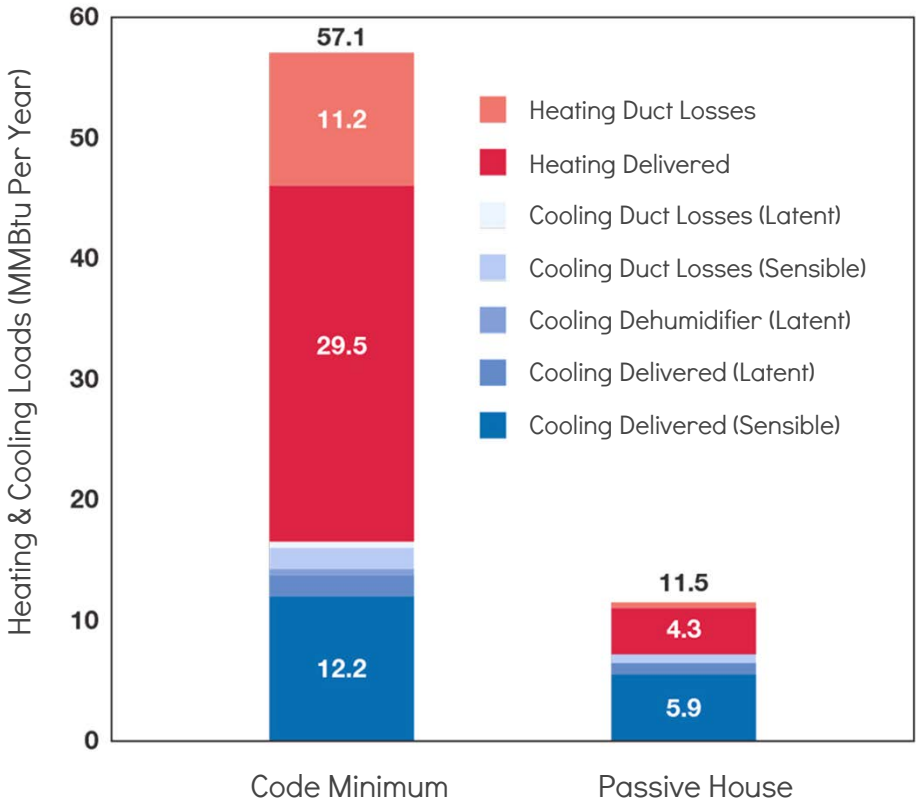
What is Passive House?





Passive House is the Leading Standard in Energy Efficiency

Energy Efficient

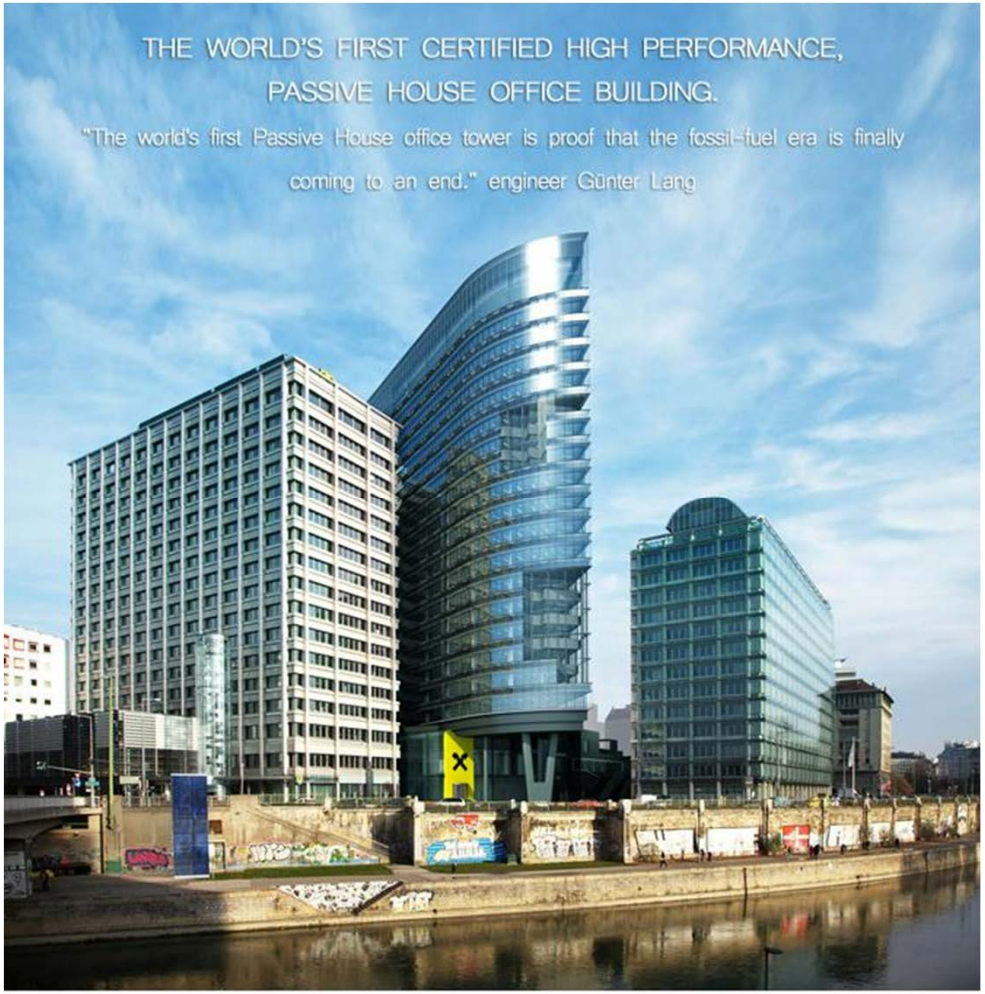


Code-Minimum vs. Passive Houses

PassivHaus =
Passive Building

Name of Project : LCT ONE
Designer : Cree GmbH

Location : Dornbirn, Austria
Year : 2012



Austrian Raiffeisen-Holding

Designer: ARGE Atelier Hayde Architekten und Architektur Maurer
Location: Vienna, Austria
Year: December 2012

Cornell Tech Residential

Designer: Handel Architects
Location: New York City
Year: To be Completed 2017

The Bugginger Strasse

Location: Freiburg, Germany
Year: 2011

Rewe Supermarket Hannover Wettbergen

Designer: Spengler + Wiescholek
Location: Hannover, Germany
Year: 2013

Explorer Hotel Oberstdorf

Designer: Arch. Sieber-Renn
Location: Oberstdof, Germany
Year: 2010

New Rocking House Nursery

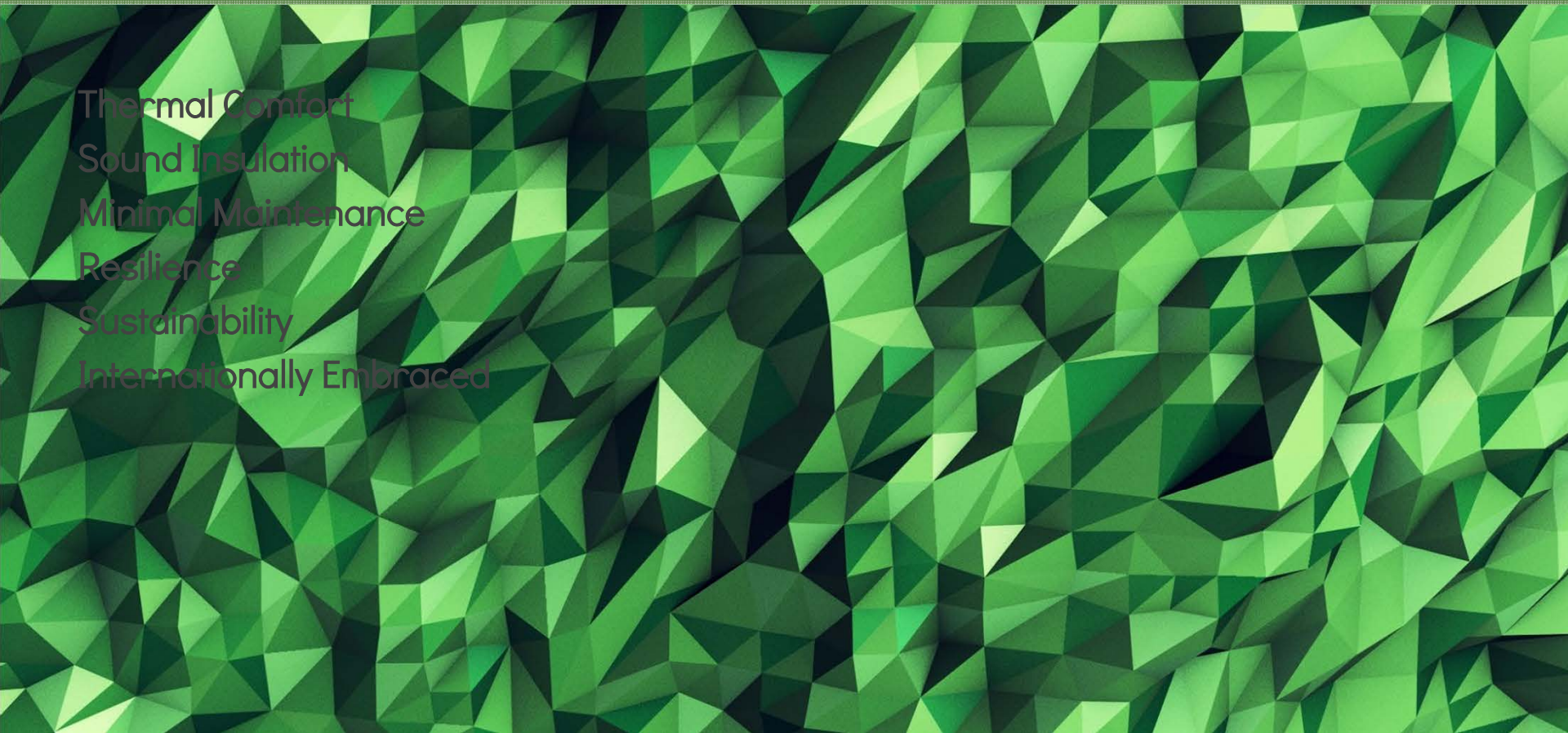
Designer: BMJ Architects
Location: Aberdeen, Scotland
Year: 2015

Klinikum Frankfurt Höchst

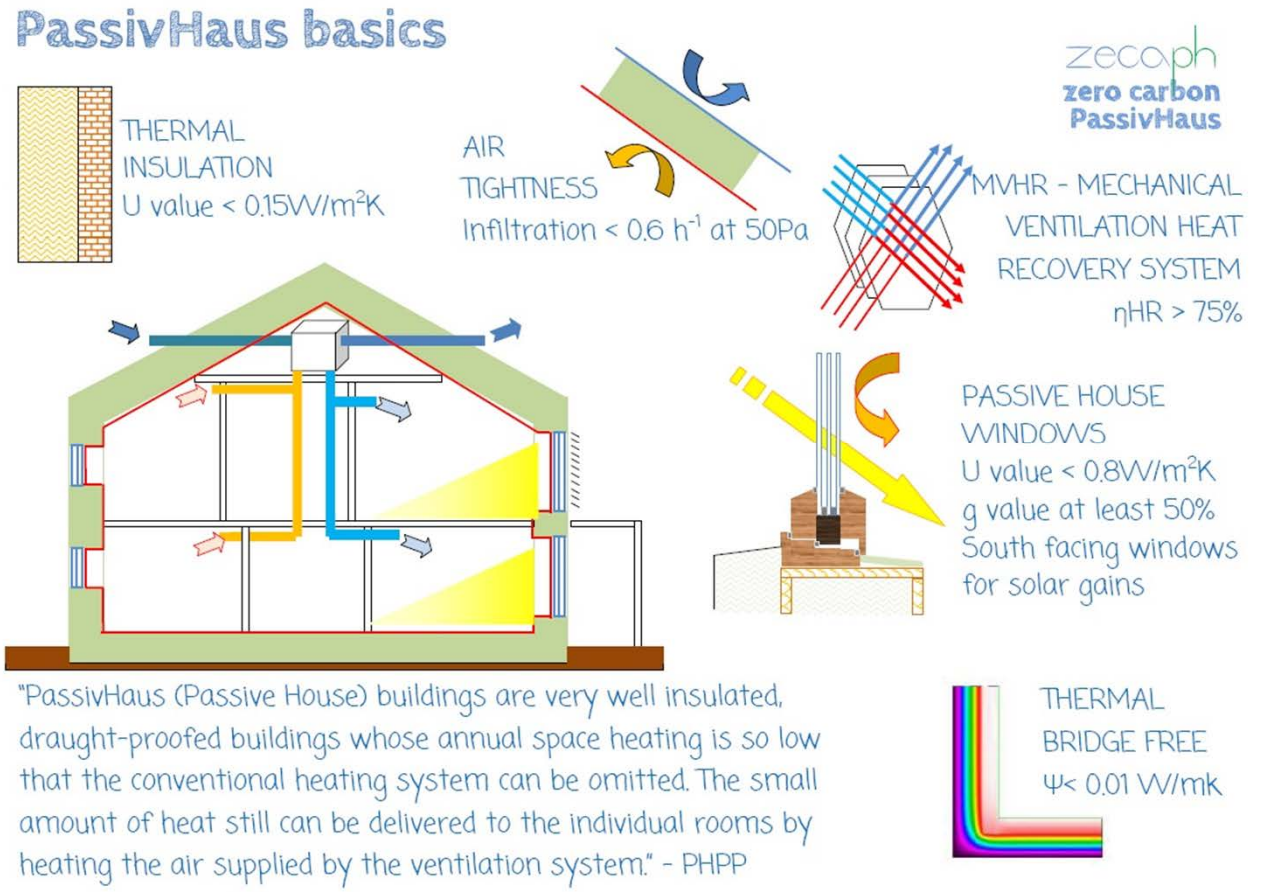
Coordinated by the Federal Government of the State of Hesse
Location: Frankfurt, Germany
Year: to be Completed in Early 2019

PASSIVE HOUSE OVERVIEW

Benefits of Passive House

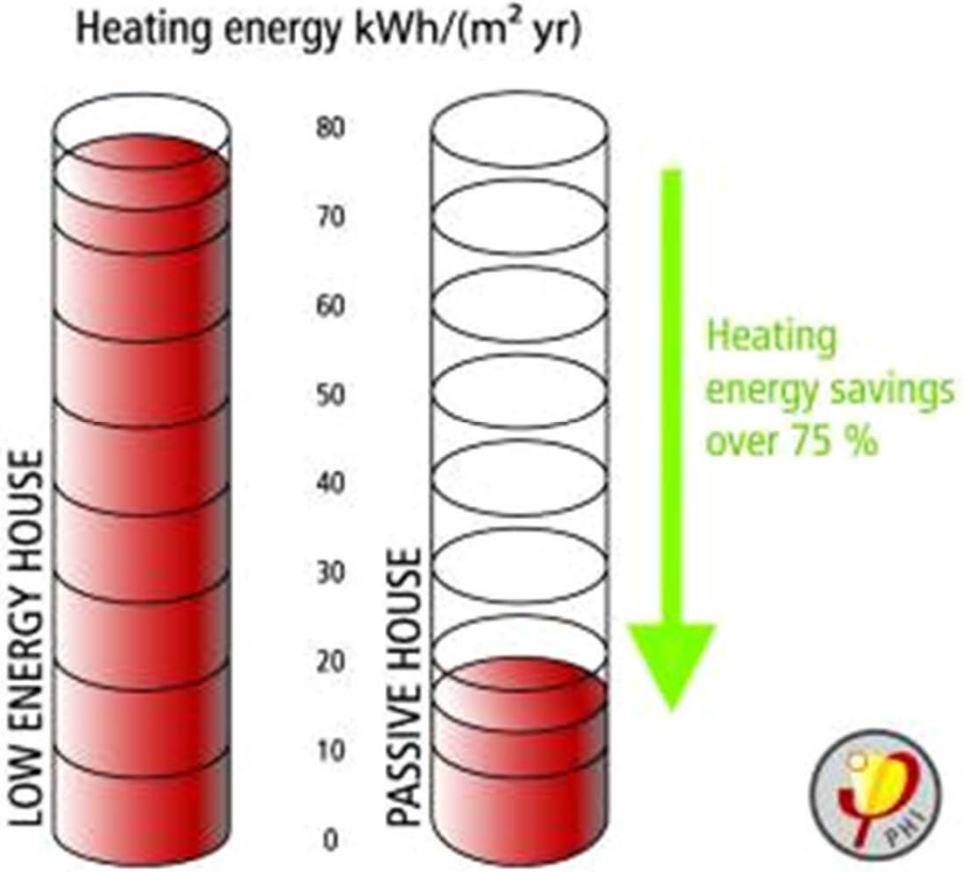


Designed for Thermal Comfort



(Image source: Zero Carbon PassiveHaus http://zecaph.com/building-envelope/)

Sound Insulated



(Image source: Passive House Institute)

Designed for Minimal Maintenance

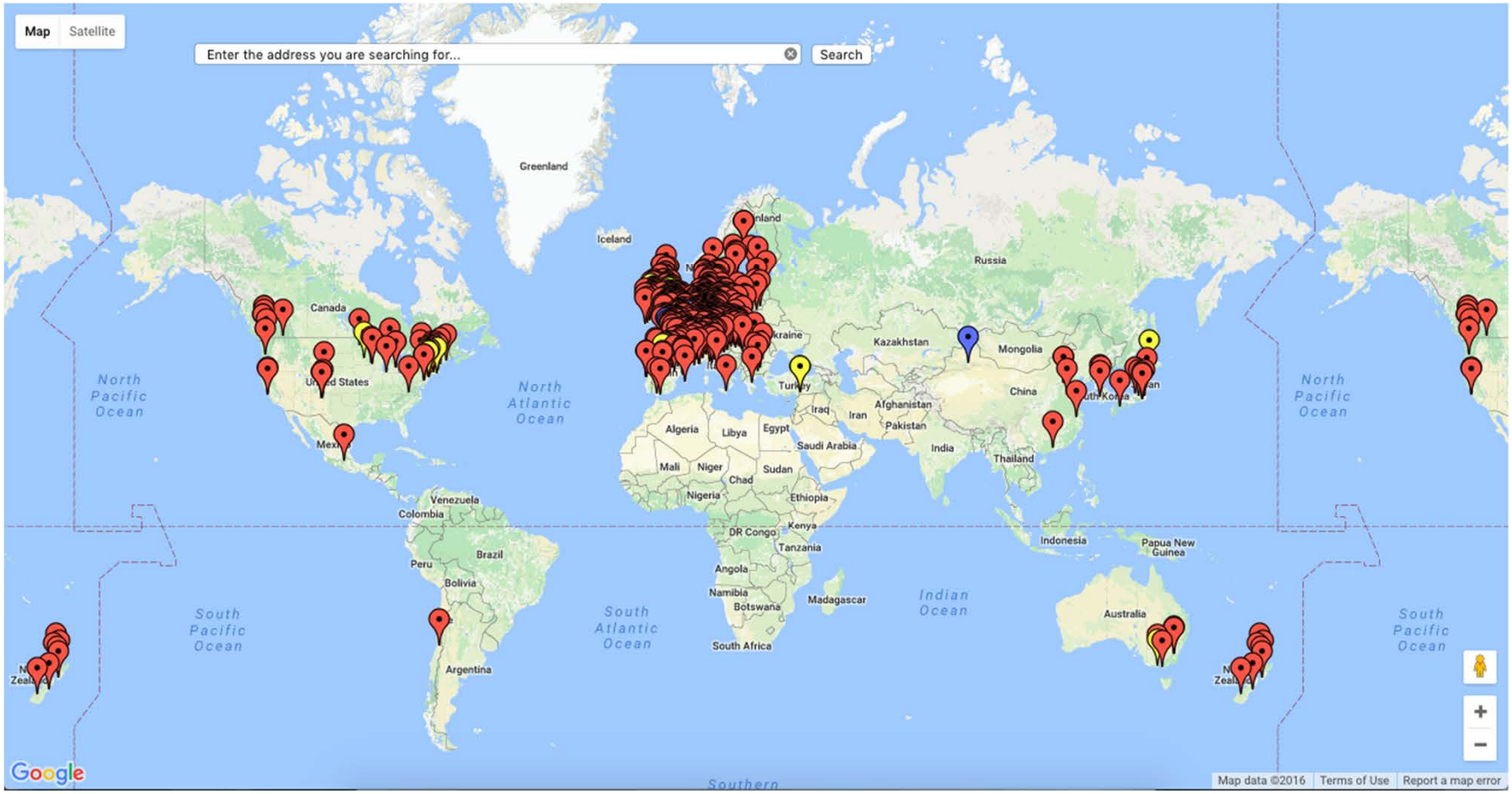
Name of Project : Rainbow Passive House
Designer : Marken Design + Consulting

Location: Whistler, BC
Year: 2012

Designed for Resilience

Name of Project : South Surrey Passive House Location: Surrey, BC
Designer : Marken Design + Consulting Year: 2013

Designed for Sustainability

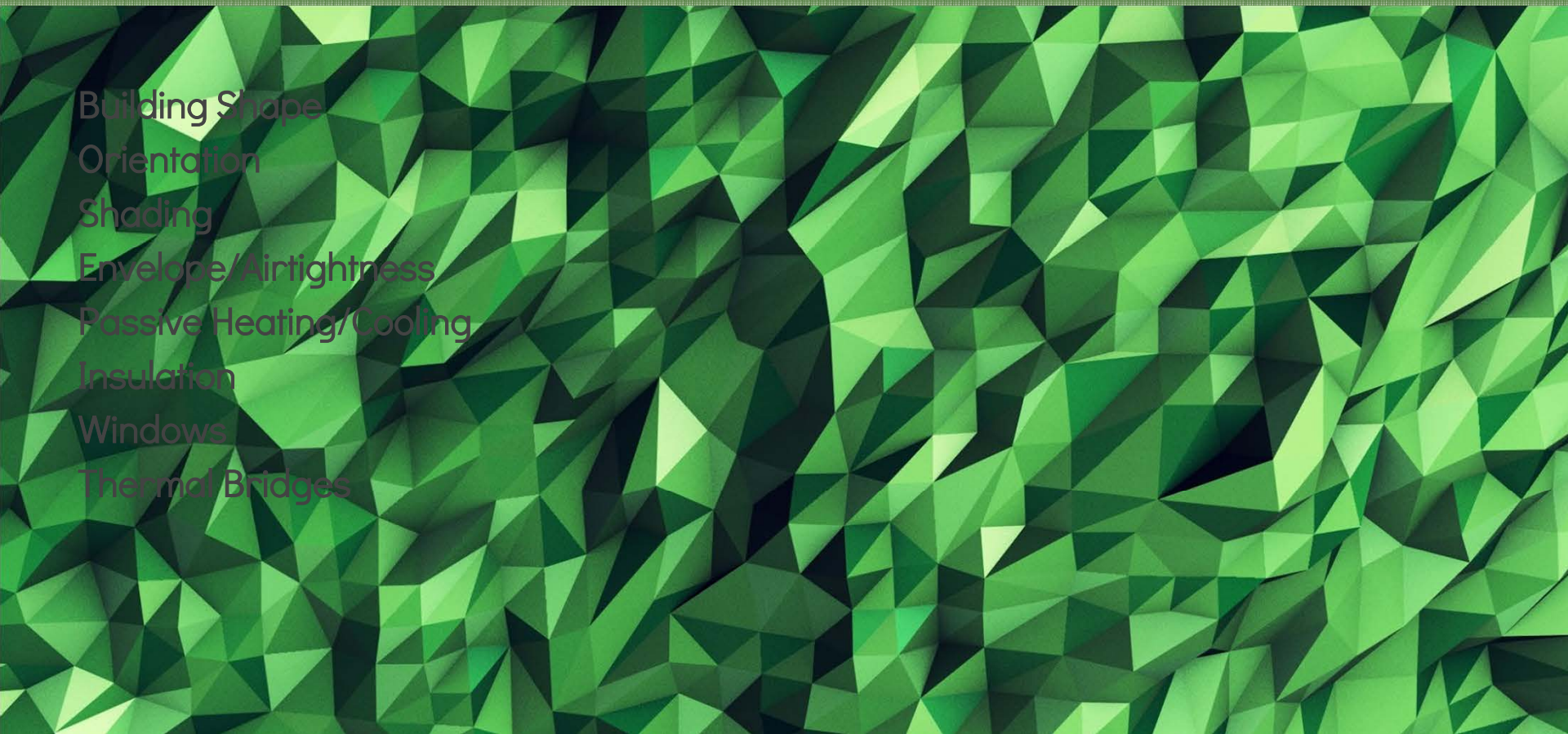


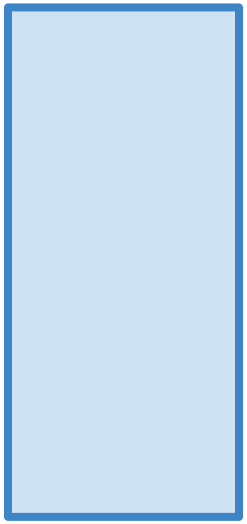
(Image source: database.passivehouse.com)

Internationally Embraced

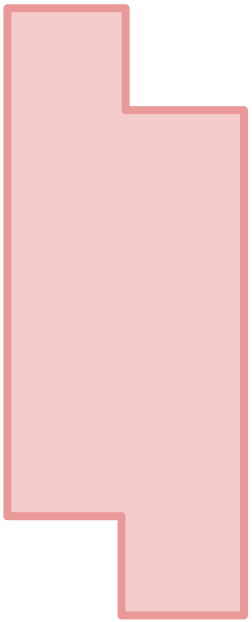
PASSIVE HOUSE OVERVIEW

Passive House Design Criteria

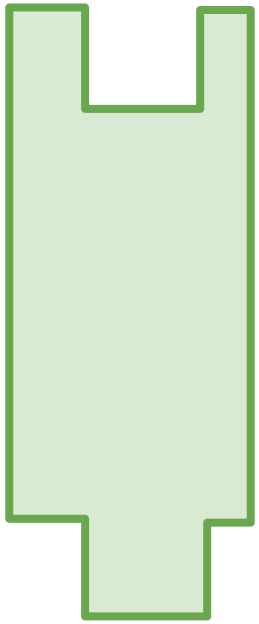




Floor area = 1000sf
Length of walls = 130'

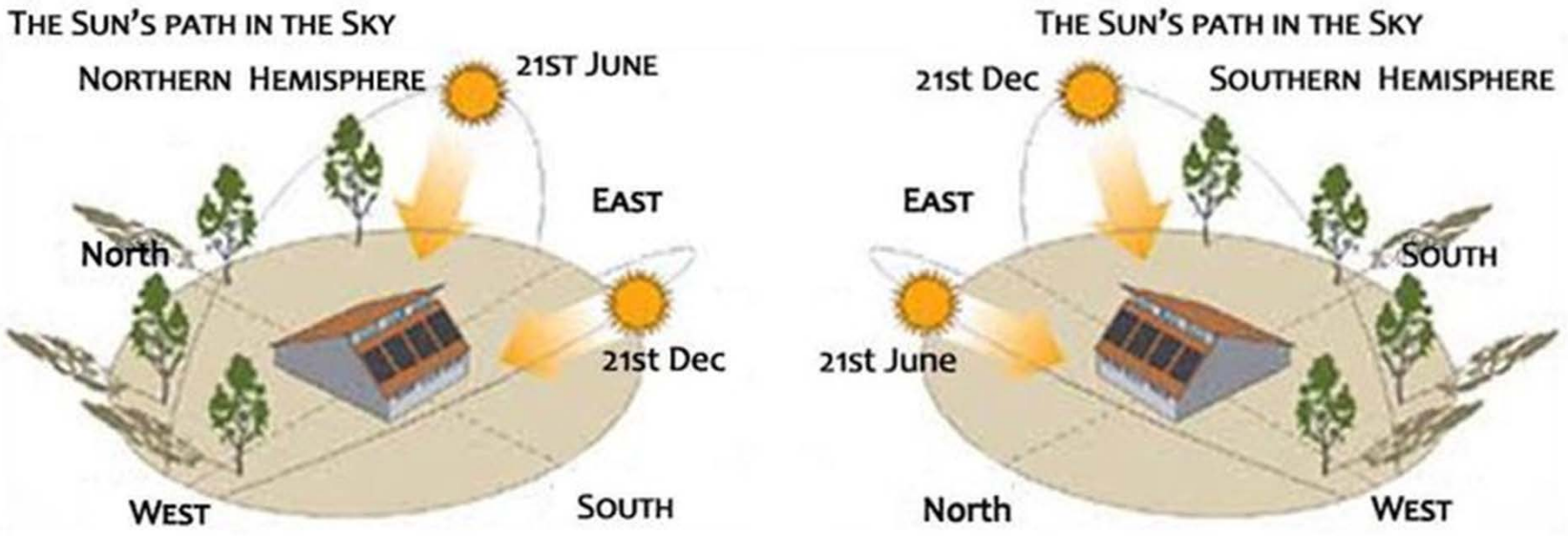


Floor area = 1000sf
Length of walls = 146'
12% increase in wall length



Floor area = 1000sf
Length of walls = 162'
25% increase in wall length

Building Shape



Building Orientation in the Northern and Southern Hemisphere

(Image source: Albert, Righter and Tittmann Architects)


Shading Strategies

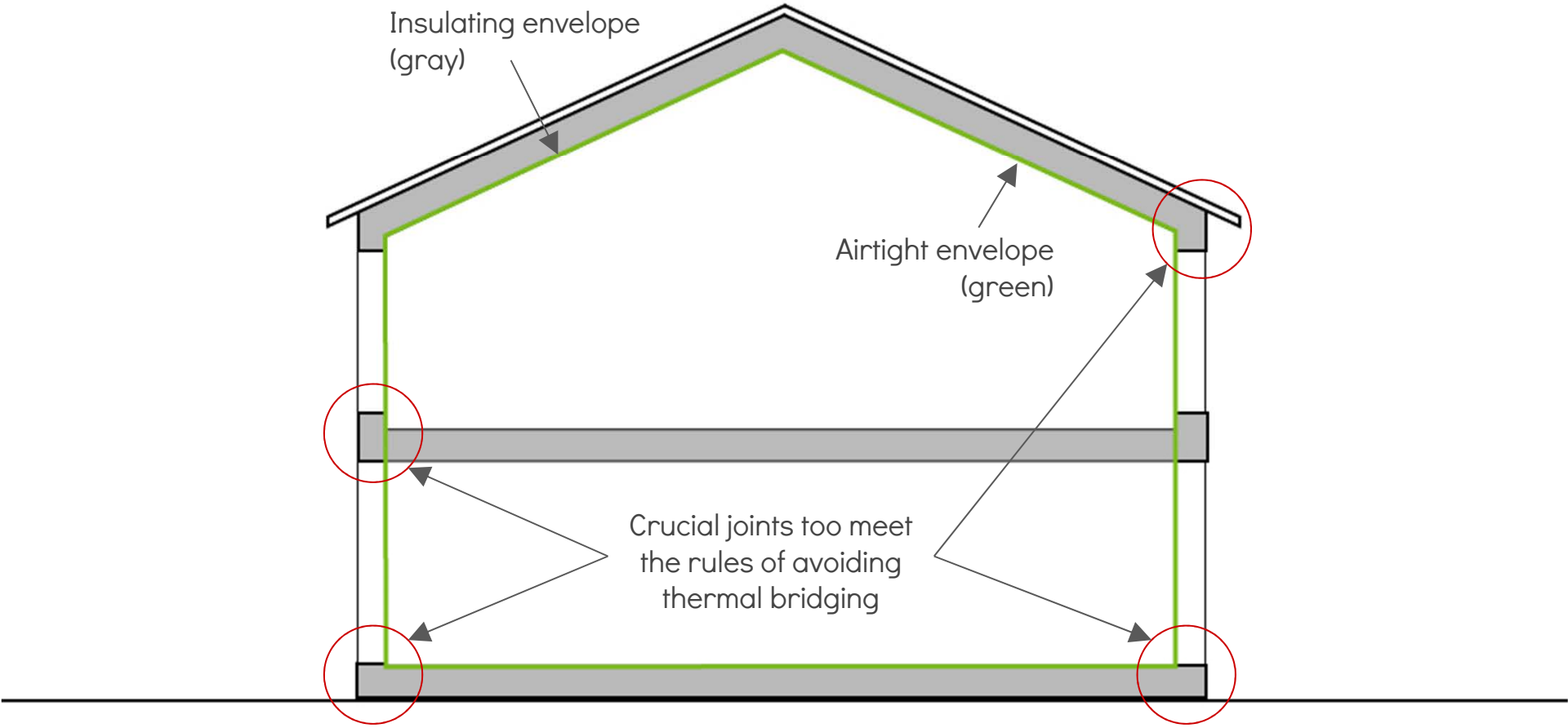
Overhangs

Bruck
Designer: Peter Ruge Architekten
Location: Changxing, Zheijang Province, China
Year: 2013

Shading Screens

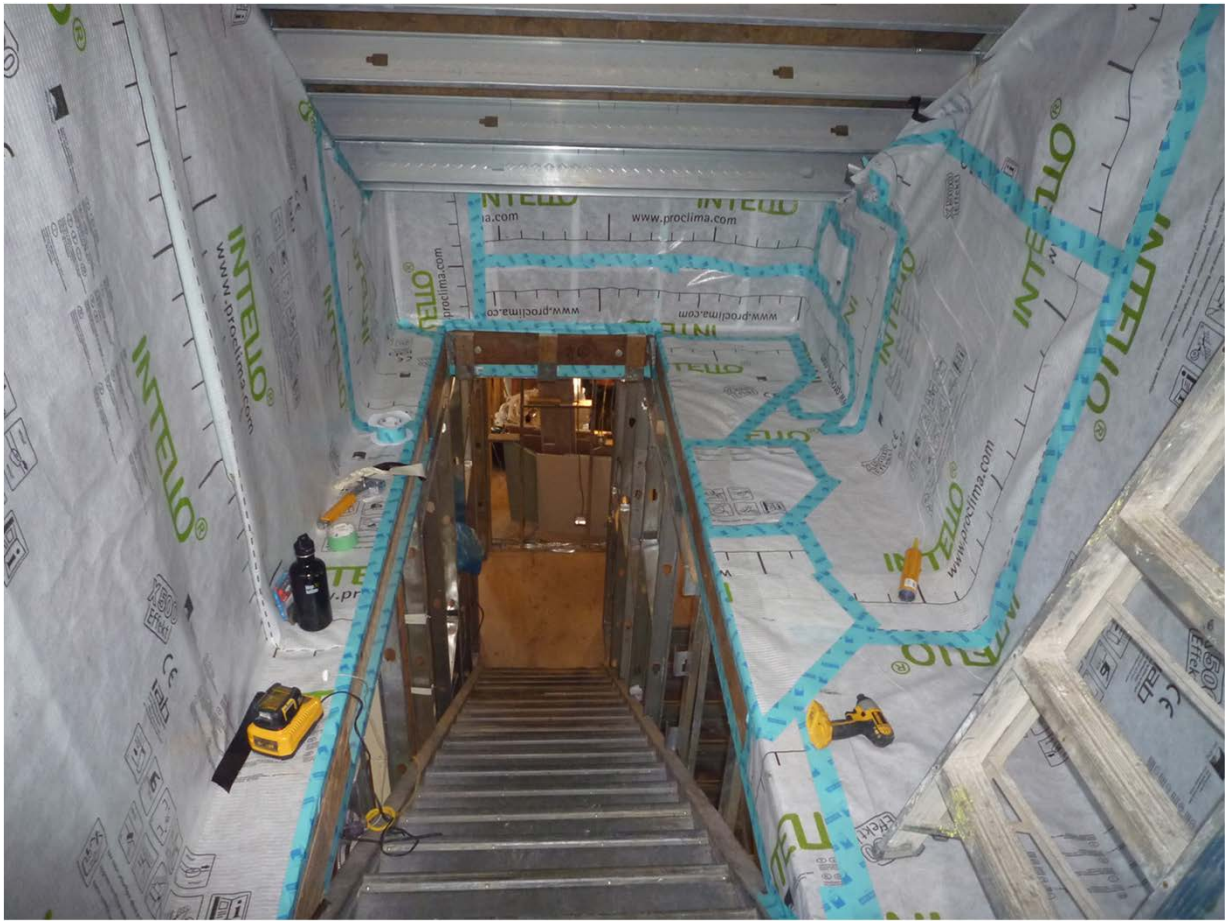
Loenareal
Designer:Din A4
Location: Innsbruck, Austria
Year: 2010


Envelope + Airtightness



Envelope + Airtightness

Design Phase



Envelope + Airtightness

Construction Phase

Permeable Vapour Layer

Envelope + Airtightness

Construction Phase

Sealing

Envelope + Airtightness

Construction Phase

Products + Technologies

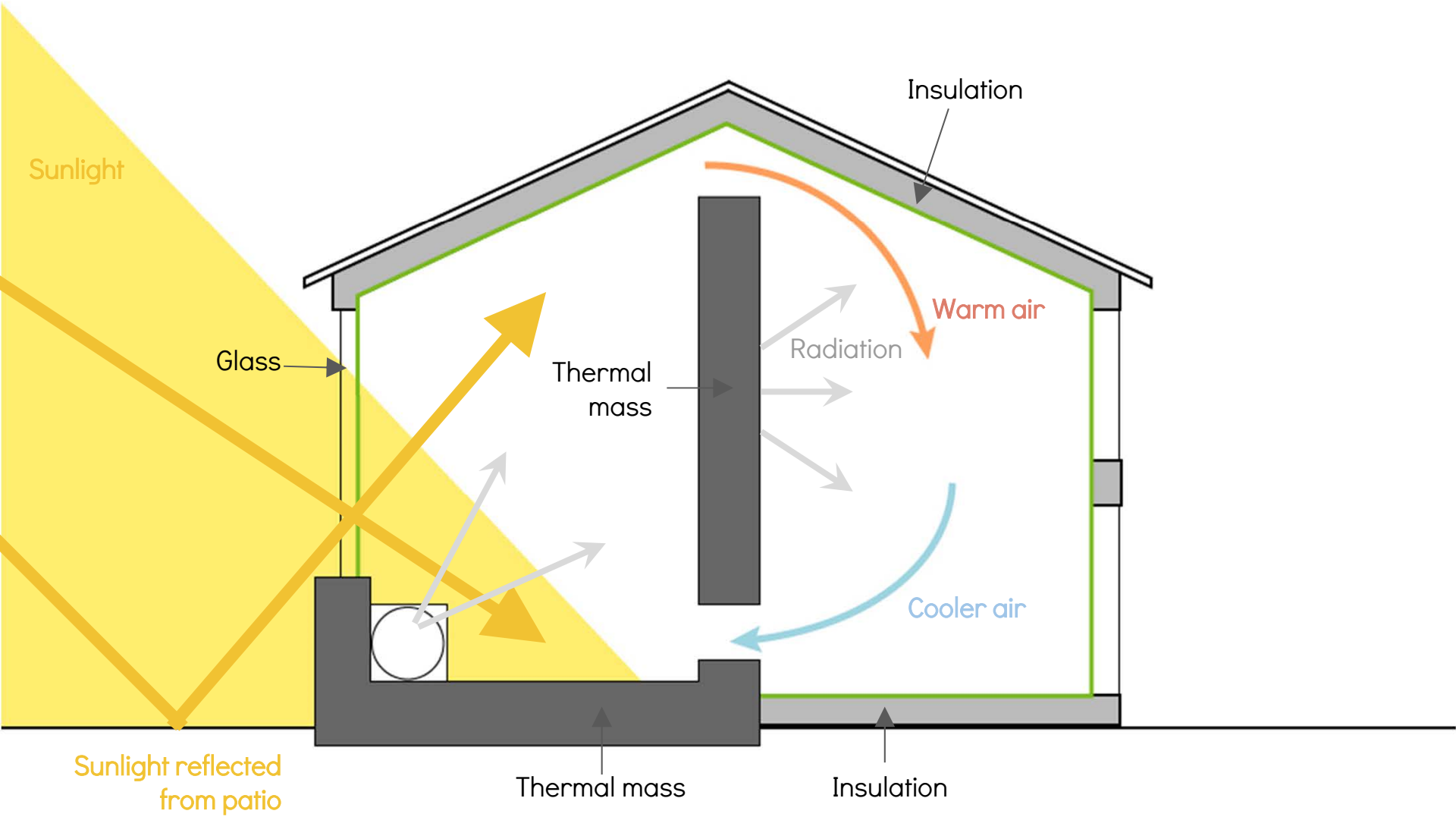
Window Reveal Tape

(Image source: passivehousesystems.co.uk)

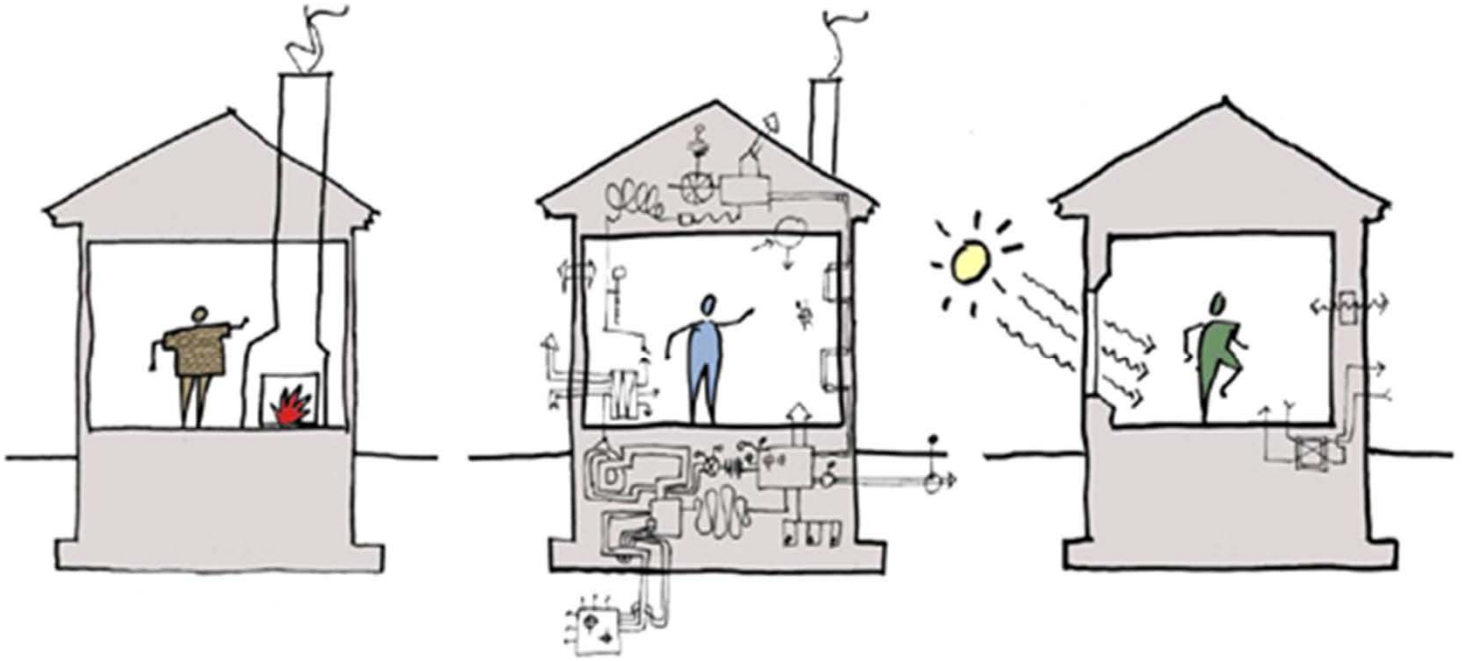
Envelope + Airtightness

Construction Phase

Blower Door Test



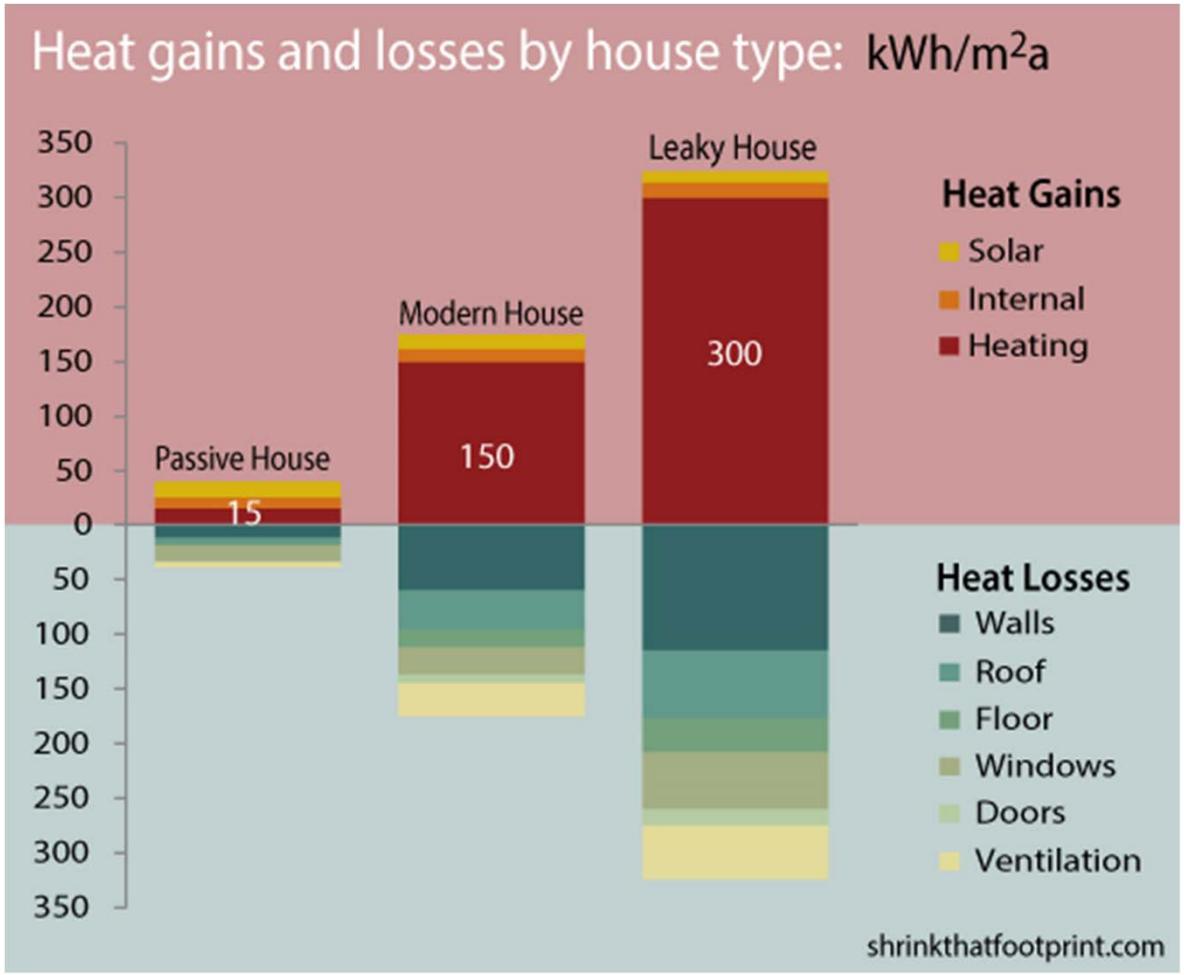
Passive Heating + Cooling



19th Century 20th Century 21st Century

Historically

(Image source: Albert, Righter and Tittmann Architects)

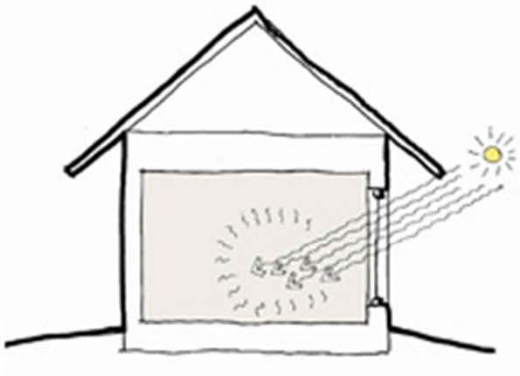


Passive Heating + Cooling

Heat Gains + Losses

Capturing Heat:
People

Capturing Heat:
Equipment

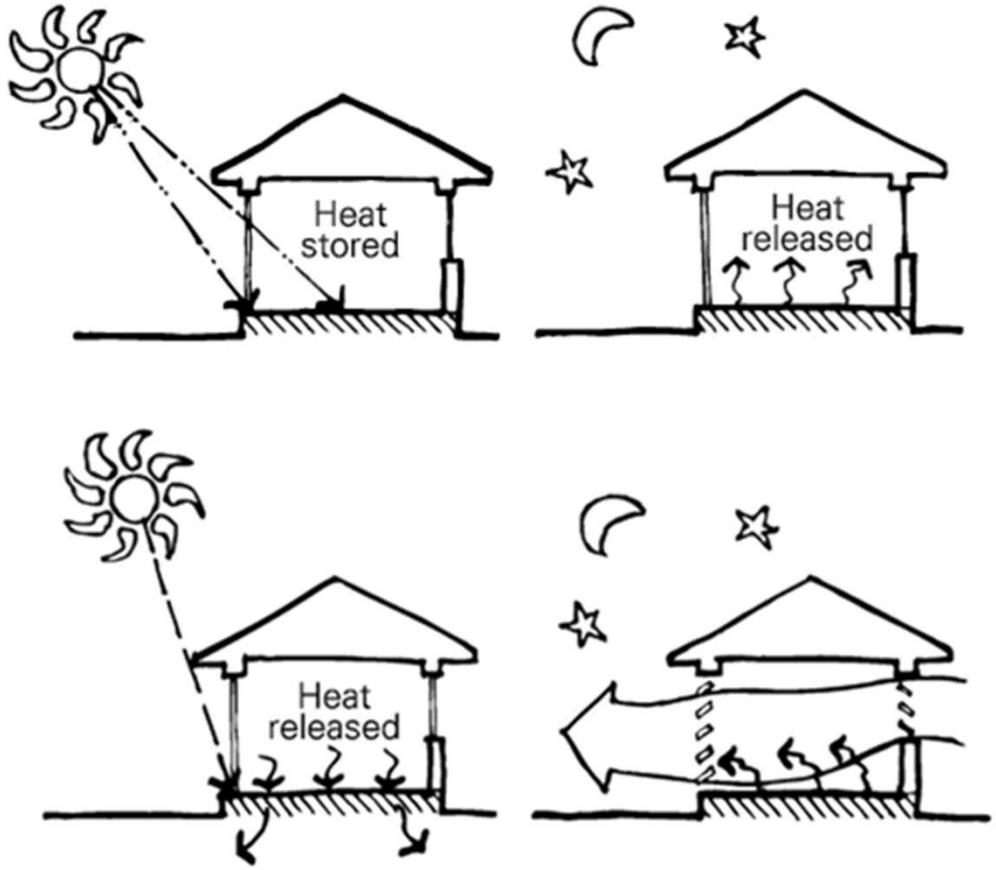


Capturing Heat:
Solar Energy

Passive Heating + Cooling

Passive House Internal Heat Gains

(image source: Albert, Righter and Tittmann Architects)



Passive Heating + Cooling

Thermal Mass and Night Convection

(image source: http://www.yourhome.gov.au/)

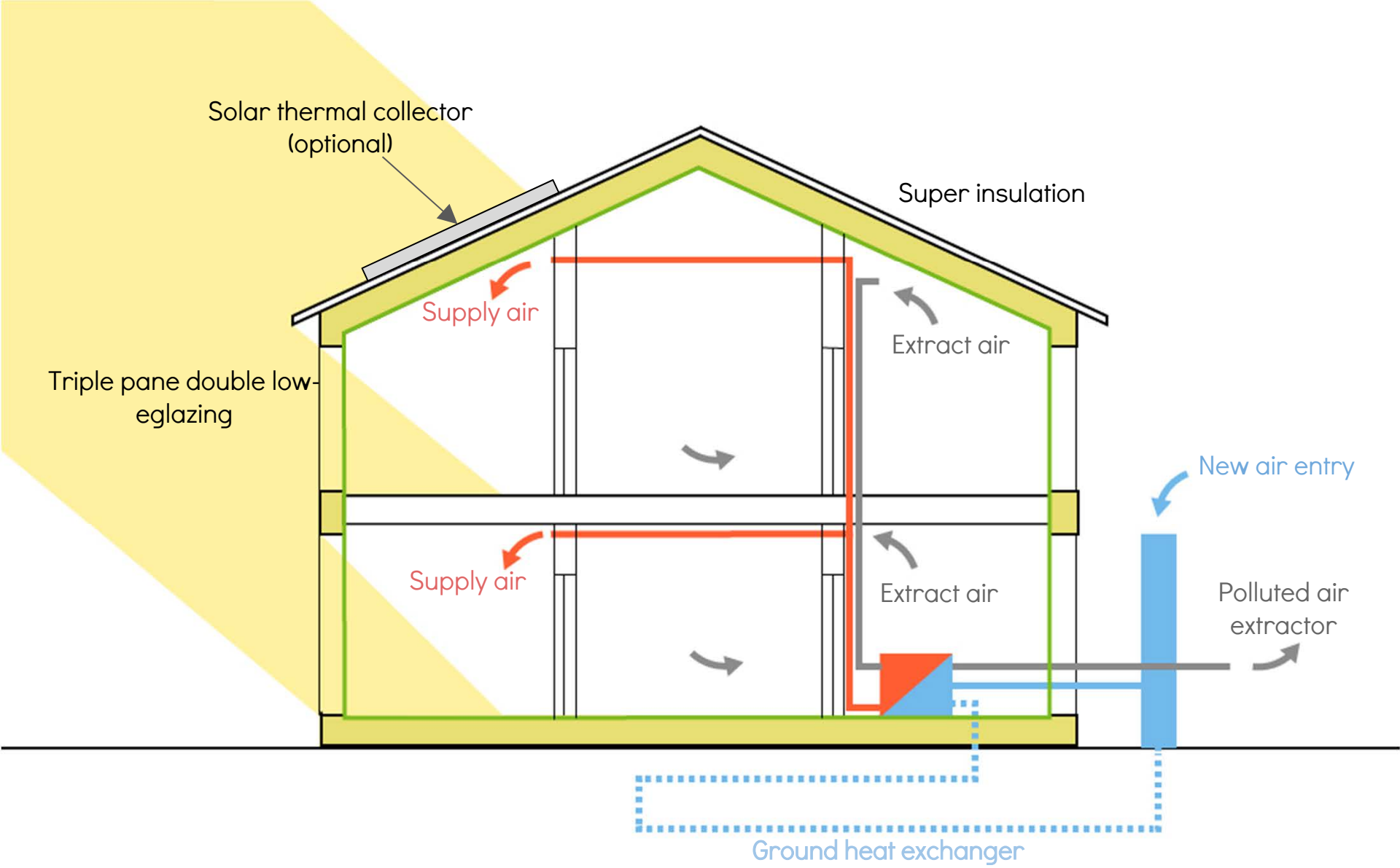
Minimize Heat Loss in Winter/Nighttime.

Shelter from Outdoor Heat in Summer/Daytime.

Passive Heating + Cooling

Buffer Zones

(image source: Passive House Institute)

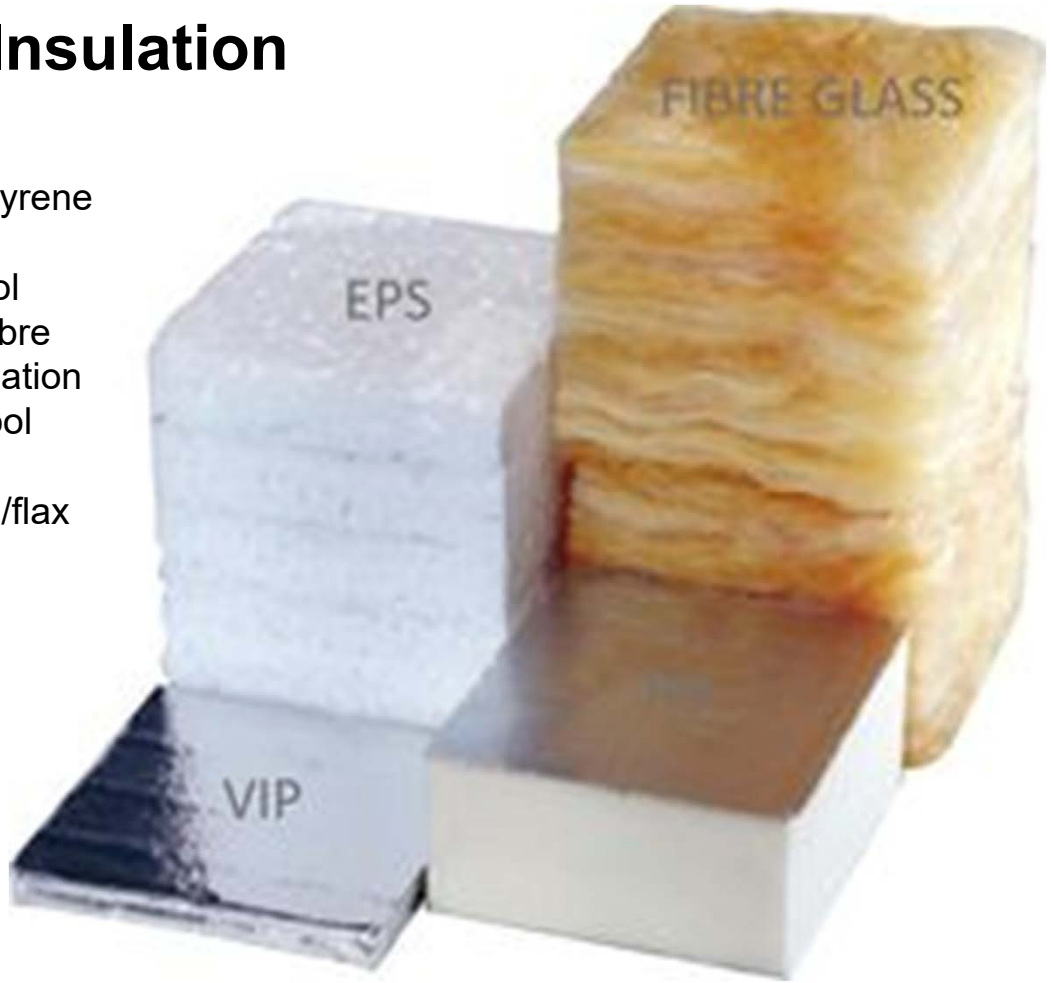


Passive Heating + Cooling

Heat Recovery Ventilation (HRV)

Types of Insulation

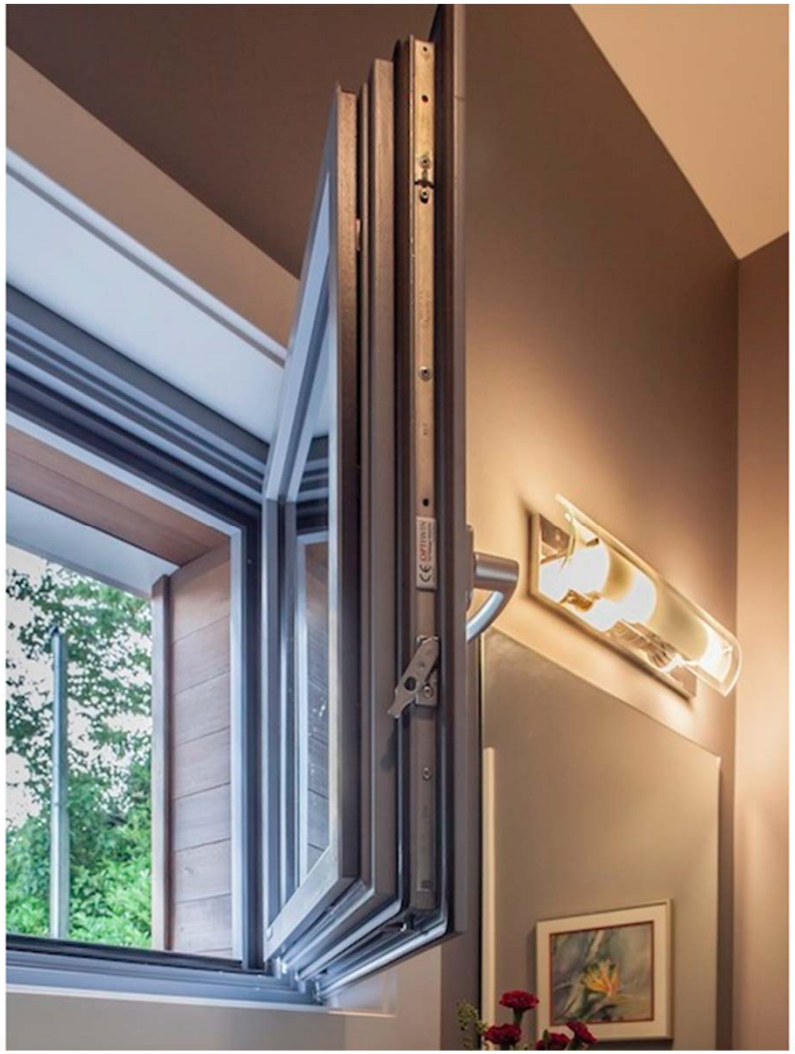
- Fibreglass
- Sprayfoam
- Rigid Polystyrene
- Aerogels
- Mineral Wool
- Cellulose Fibre
- Cotton Insulation
- Sheep's Wool
- Wood Fibre
- Straw/hemp/flax



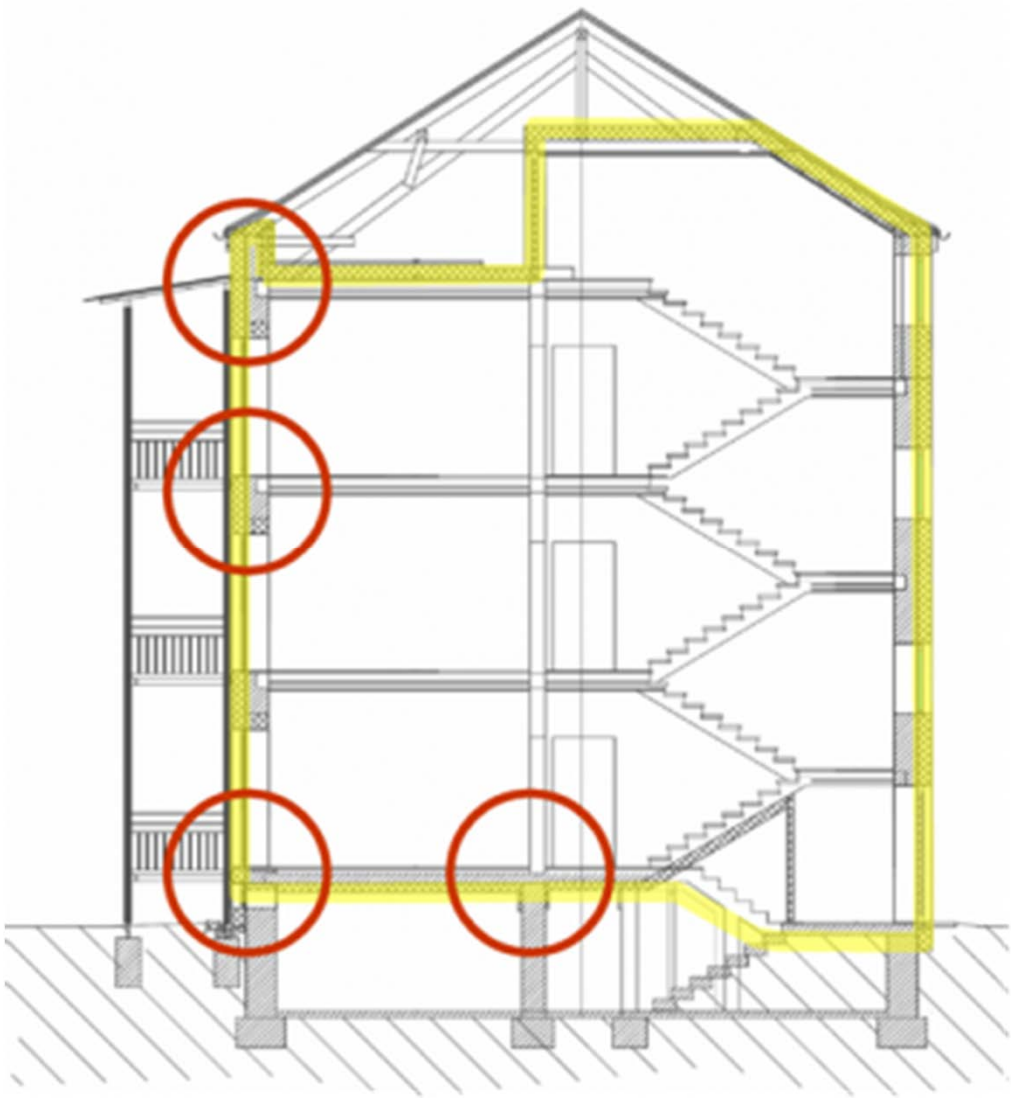
(image source: http://www.nanopore.eu)

Superior Insulation

South Surrey Passive House
Designer: Marken Design + Consulting
Location: Surrey, BC
Year: 2013



High Performing Windows

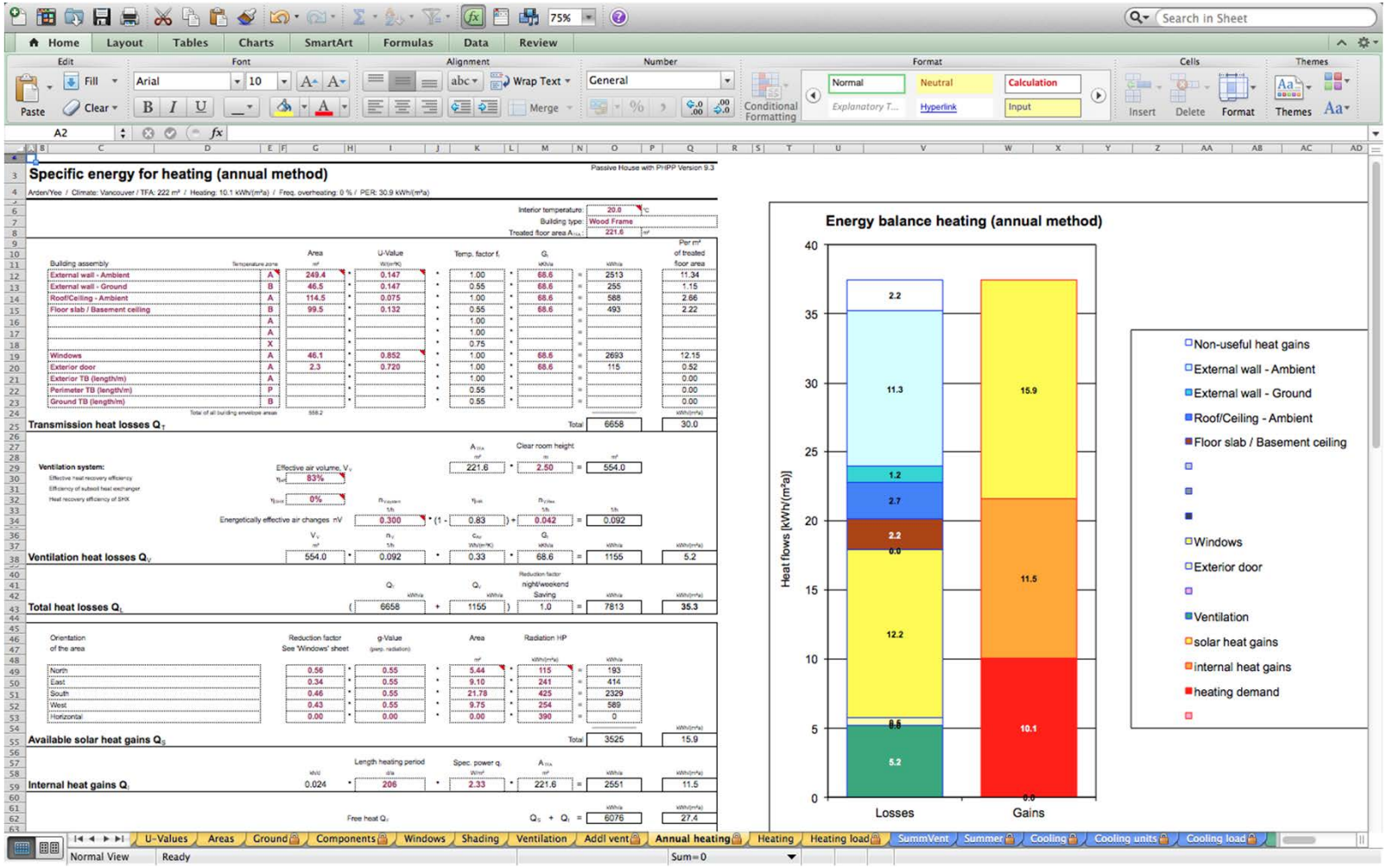


(image source: passive.de)

Thermal Bridge Free

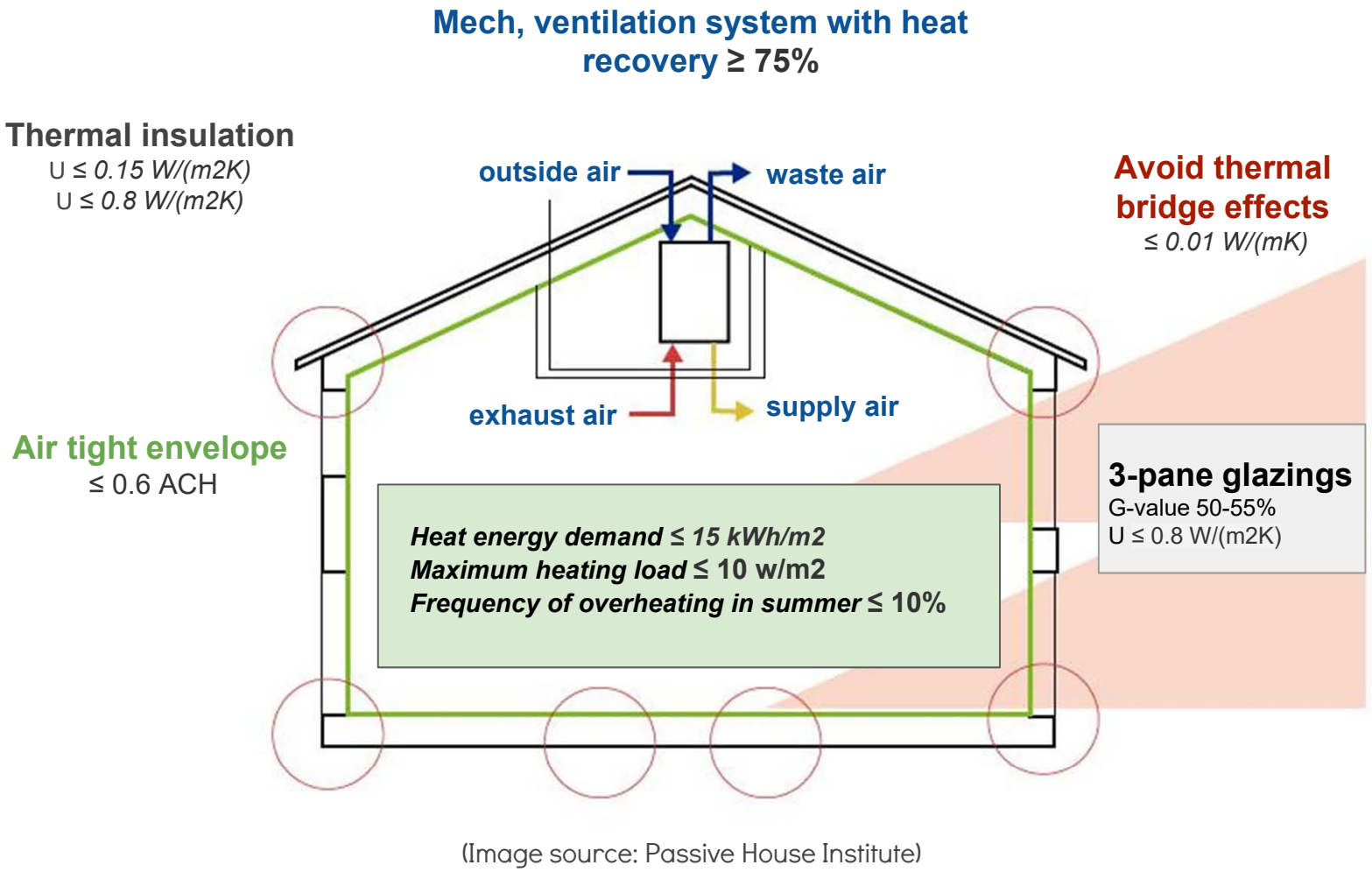
Energy balance and Passive House Design Tool

for quality approved Passive Houses and EnerPHit retrofits



PHPP - Passive House Planning Program

(Image source: database.passivehouse.com)



(Image source: Passive House Institute)

Passive House Requirements

City of Vancouver

Rezoning Requirements for MURBs

	Current Rezoning Policy - Typical Design	*Passive House*
TEDI	46kWh/m2	✓ ≤ 15 kWh/m2
Envelope	R-4.5 effective walls U-0.36 windows	✓ U ≤ 0.15 W/(m2K)
Direct Ventilation with HRV	52% efficient	✓ ≥75%

2020 - All buildings to be *carbon neutral* in operations.

2030 - New buildings required to use 100% renewable energy - *Zero Emissions*

CITY OF VANCOUVER

Municipal Compliance

Slide 57

1 Hi, Marybeth. I converted the image into a table, does it contain all the information you want?
Weiwei Fan, 2016-09-15

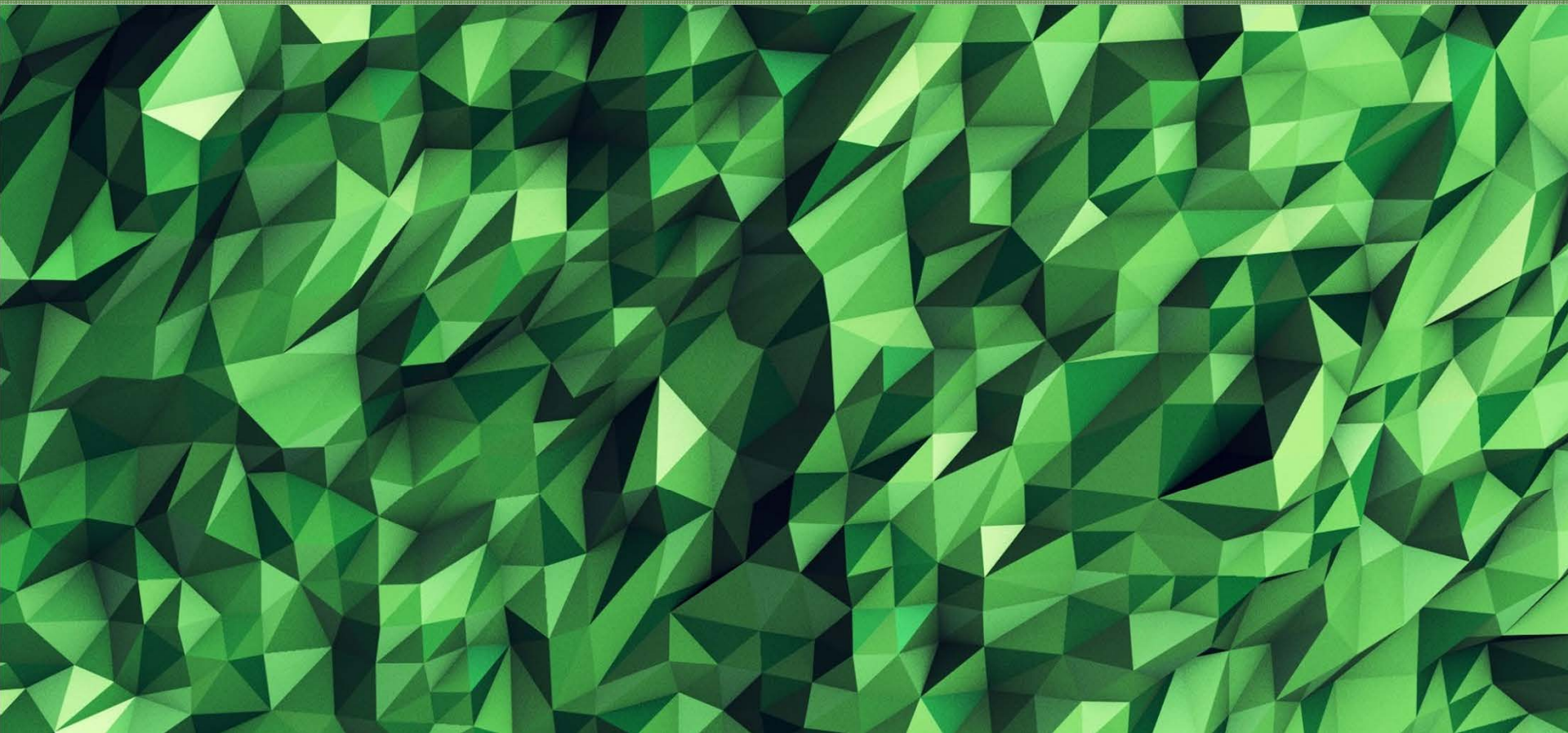
2 _Marked as resolved_
Chenyue Zhang, 2016-09-15

3 _Re-opened_
Chenyue Zhang, 2016-09-15

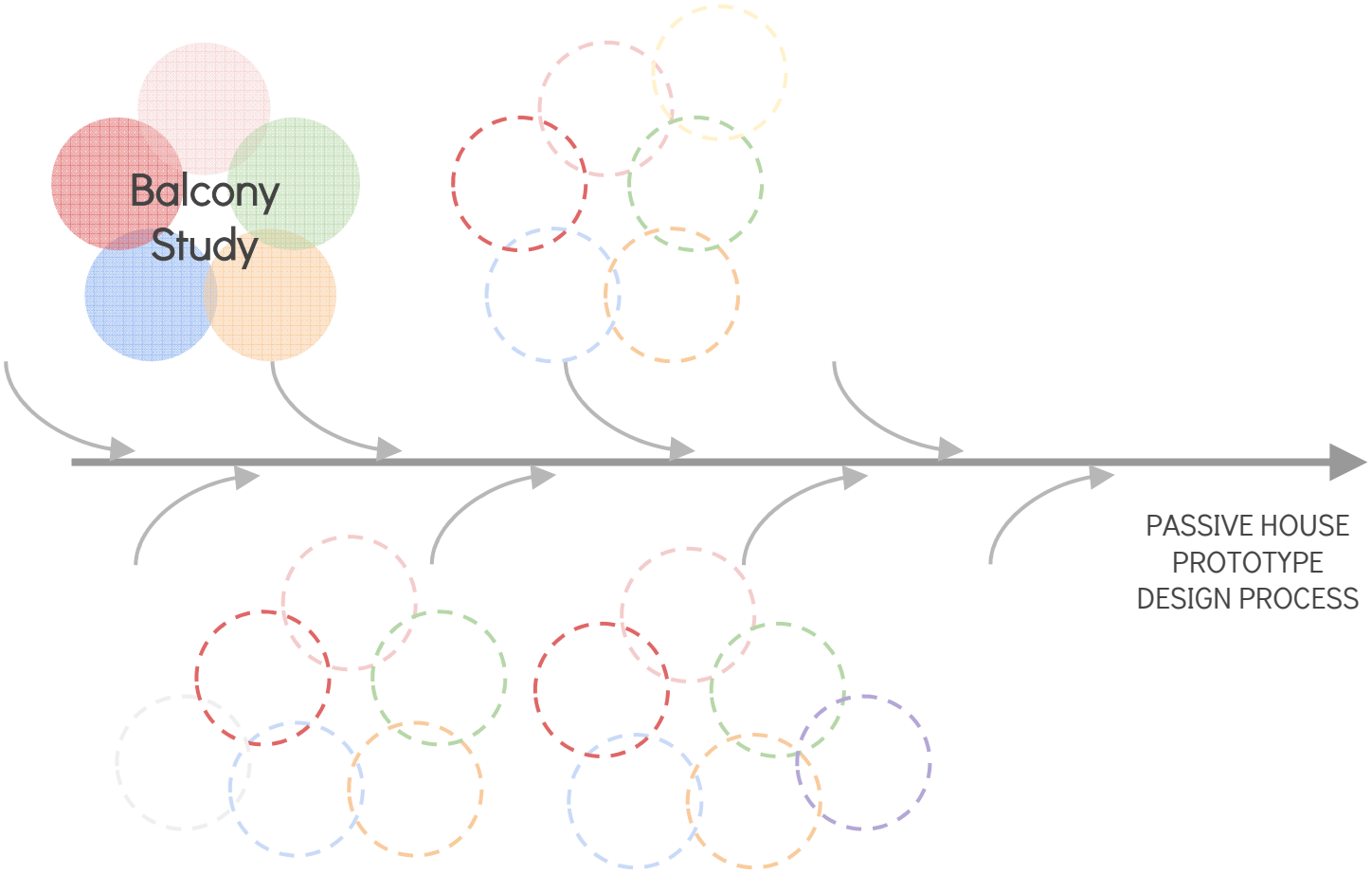
4 Also I could not find the window/wall ratio for Passive House
Chenyue Zhang, 2016-09-15

3 It's ok. I removed the window:wall ratio because PH doesn't really have one. it's depending on the climate, wall assemblies, etc.
Marybeth Welty, 2016-09-15

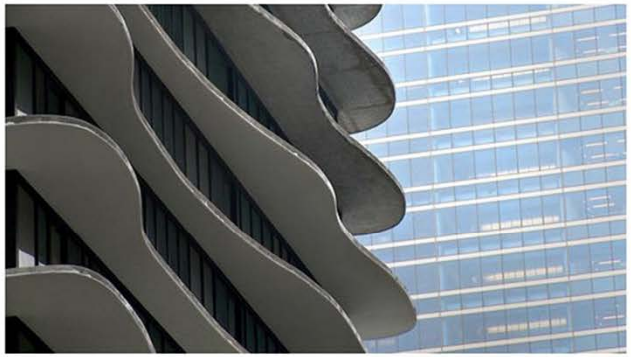
PASSIVE HOUSE MURB
COLLABORATIVE PROTOTYPE



Passive House MURB: Collaborative Prototype

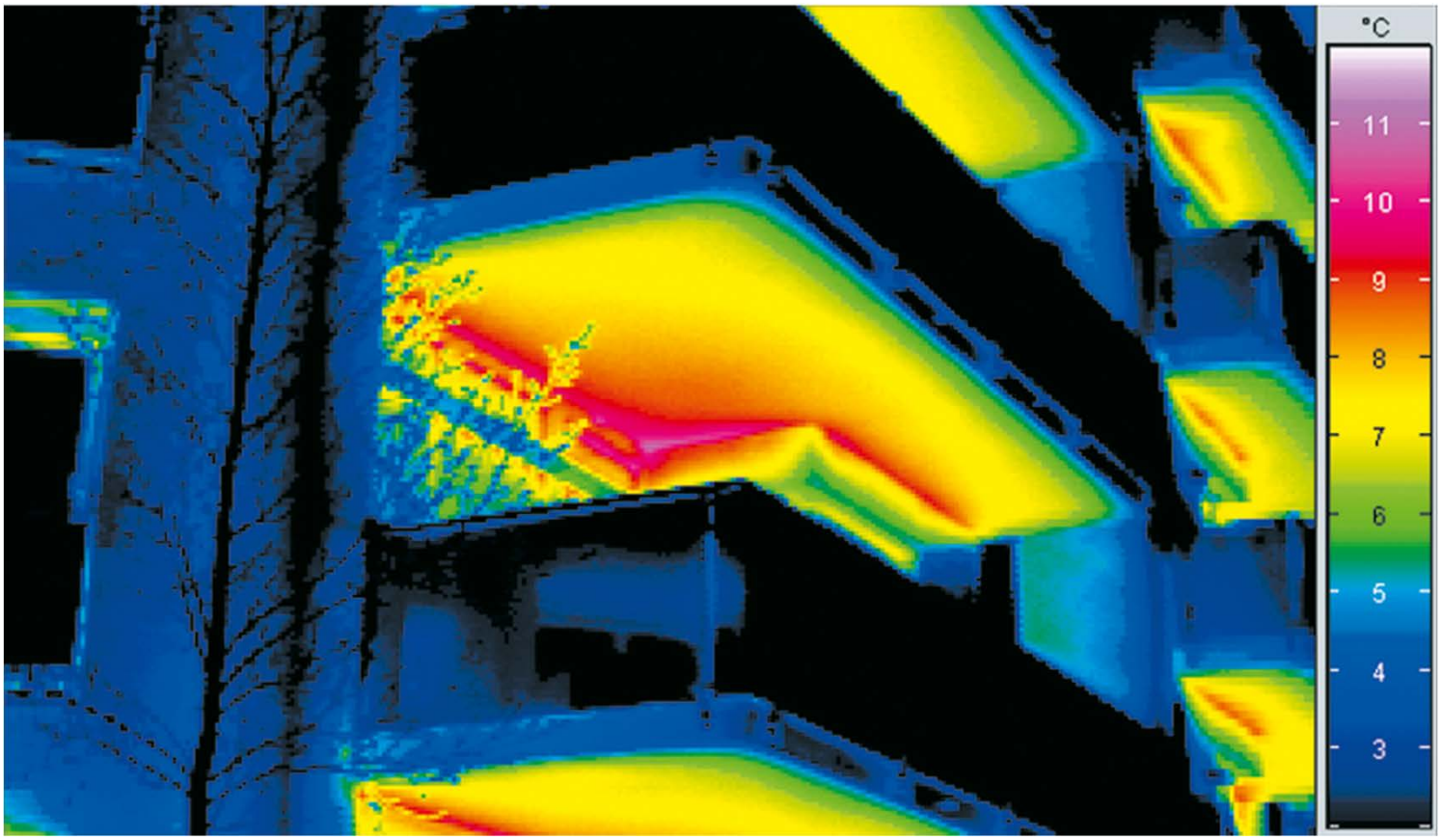


COLLABORATIVE PROCESS

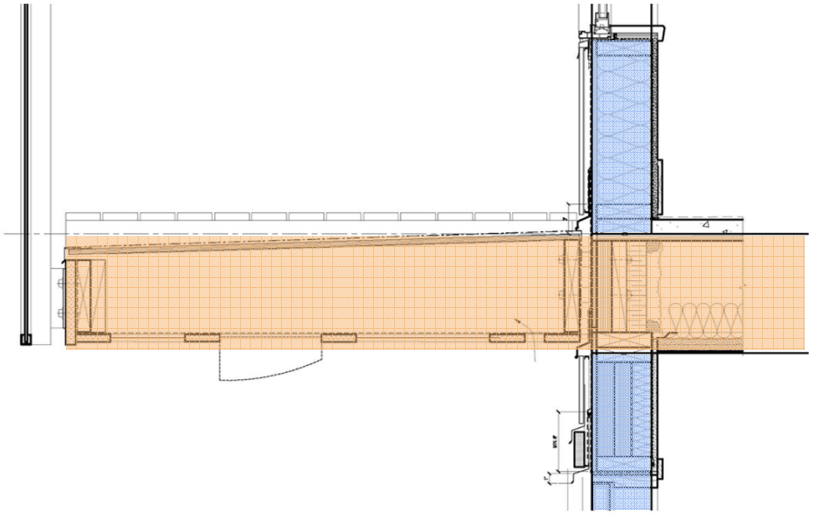


Articulated Slab Cantilevered Slab Edge

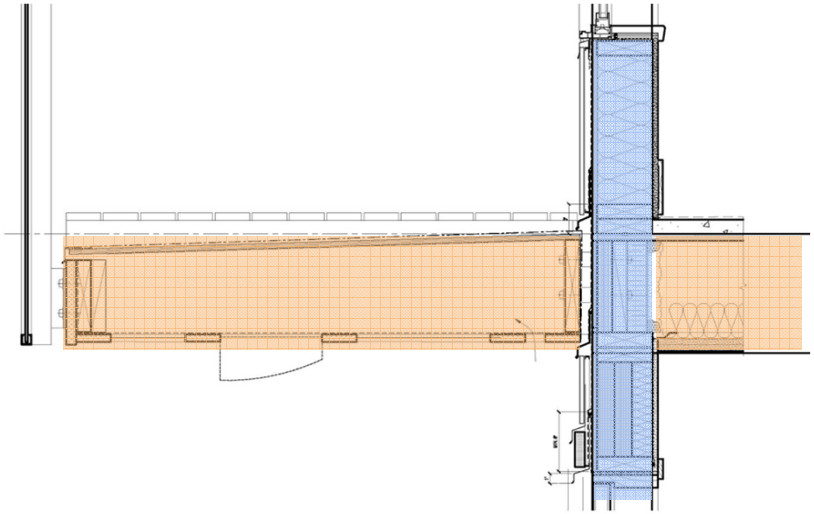
Heat Sink



Thermographic Imaging of Heat Loss Through Cantilevered Balcony

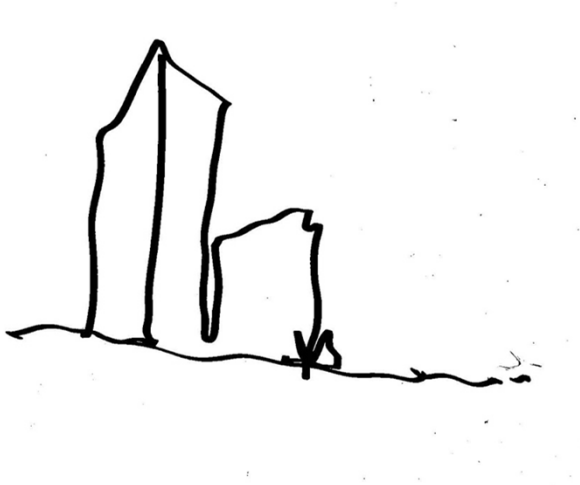


CONVENTIONAL CANTILEVERED

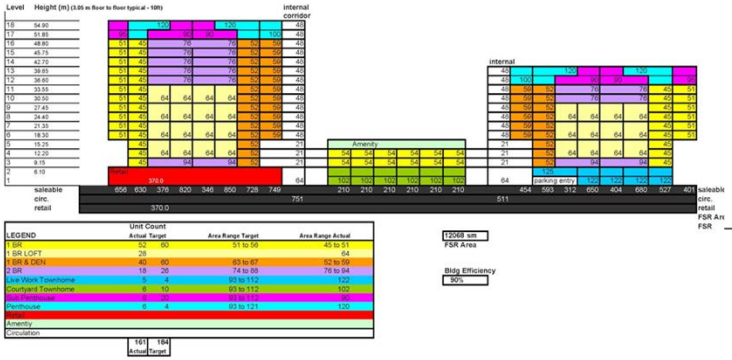


THERMALLY BROKEN CONNECTION

Building Projections



Process



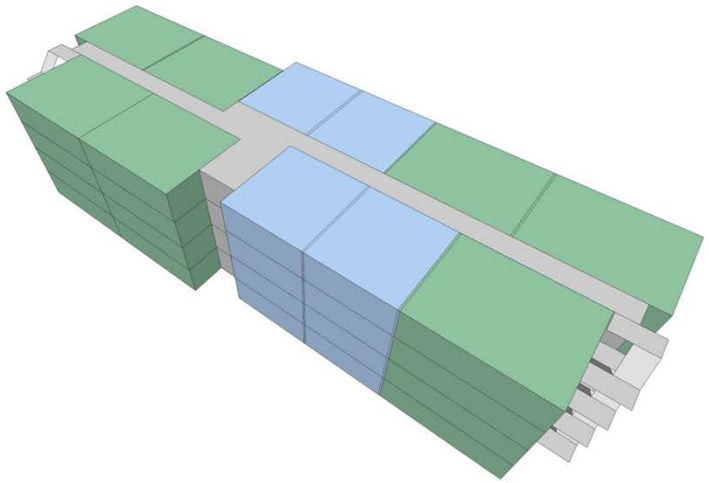
Excel

Sketchup

Revit

A Visual Process - Share Information

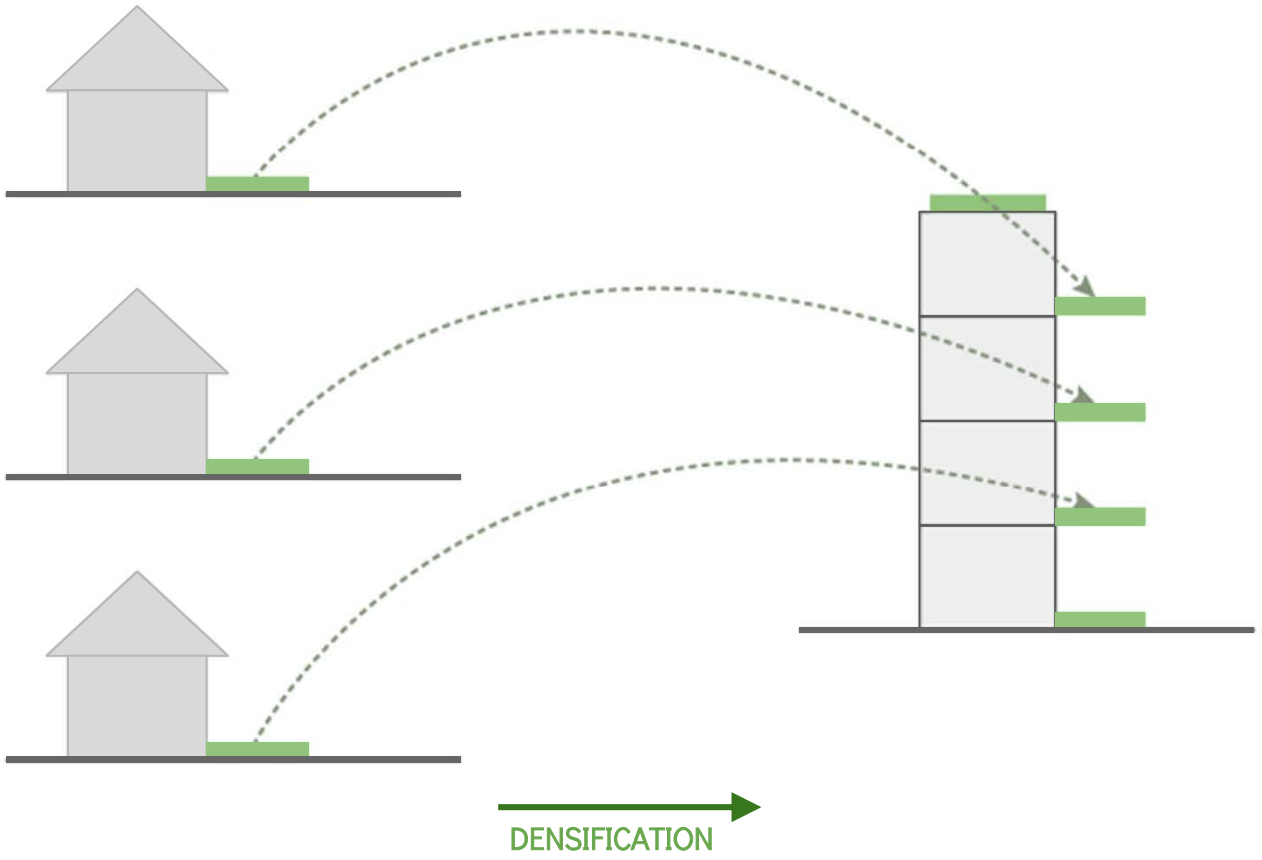
	2 Bed	2 Bed	2 Bed	2 Bed	2 Bed	2 Bed	2 Bed	Circulation	1 Bed	1 Bed	1 Bed	1 Bed	Residential Area		Circulation Area		
Level 6	875	875	875	875	875	875	875	1030					6125		1030		
Level 5	875	875	875	875	875	875	875	1360	642	642	642	642	8693		1360		
Level 4	875	875	875	875	875	875	875	1360	642	642	642	642	8693		1360		Site Area
Level 3	875	875	875	875	875	875	875	1360	642	642	642	642	8693		1360		27,846
Level 2	875	875	875	875	875	875	875	1360	642	642	642	642	8693		1360		
Level 1		300	875	875	875	875	875	1360	642	642	642	642	6943		1660	Total Building	Efficiency
P1	BIKE	LOBBY										Subtotal	47,840		8130	55,970	85%
													Target Residential	Residential Difference	Target Circulation	Circulation Difference	**FSR 1.95**
Notes: all units are imperial (F and SF)													46,155	1,685	8145	-15	54,300
														(over)		(over)	-1,670
Unit Sizes are approximate and may vary with refinement of layout																	
													Target Residential	Residential Difference	Target Circulation	Circulation Difference	**FSR 2.0**
Circulation Area is based on the exclusion of exterior stairs													47,339	501	8354	-224	55,692
Parking count is based on max 79 stalls on P1 (parking factor 1.3 equates to 60 units max / 58 units with 75 stalls)														(over)		(over)	278
Calculations Assumes portion of Level 1 is used for Bike Storage																	
Count									5	5	5	5	20	33%	**1 Bedroom**		
	5	5	6	6	6	6	6						40	67%	**2 Bedroom**		
															Average		
												Total Units	**60**	797	**Unit Size**		
												Parking Factor	1.30	1.25			
												Stalls Required	**78.0**	**75.0**			



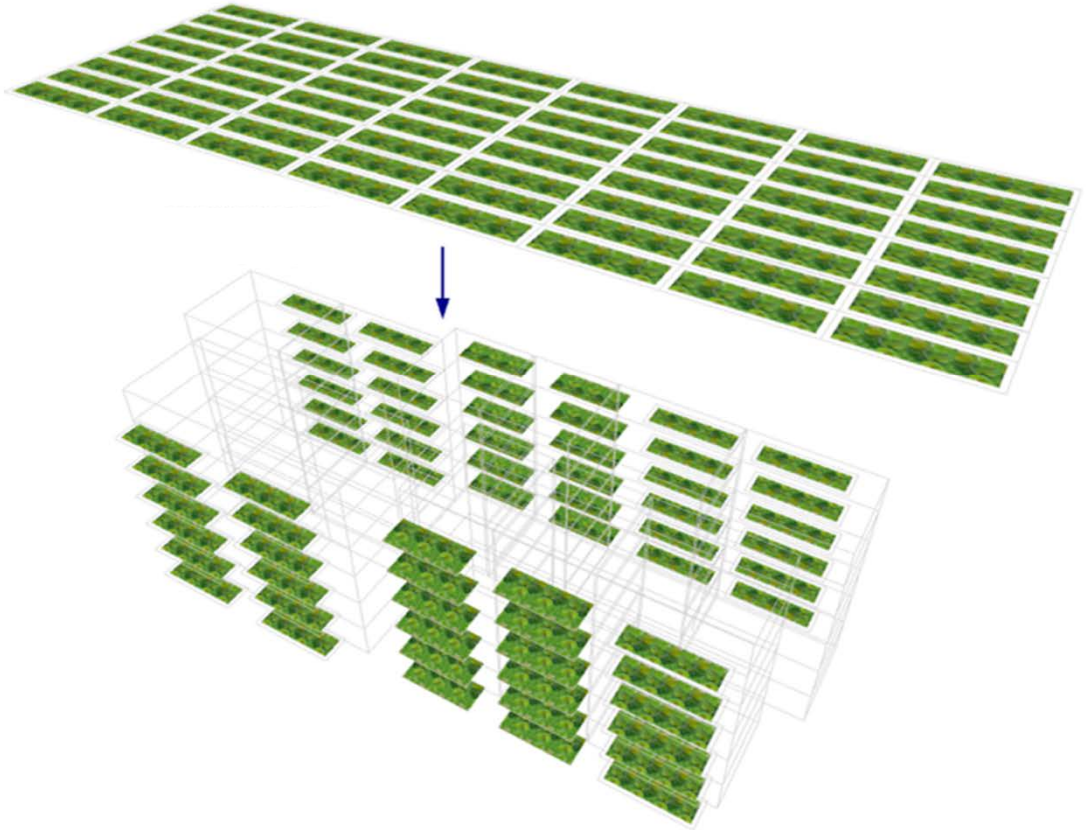
A Visual Process - Share Information

External Factors / Variables that Impact a Project

Client Program
Sustainability Goals
Community and Social Impact
Health and Well Being
Energy Performance
Zoning Regulations
Marketing and Economics

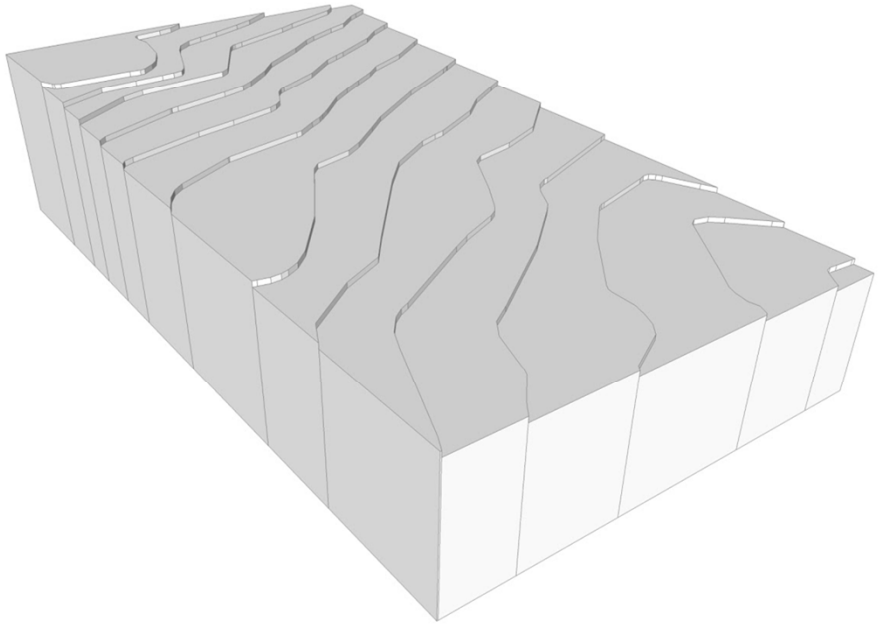


Balcony Gardens Concept

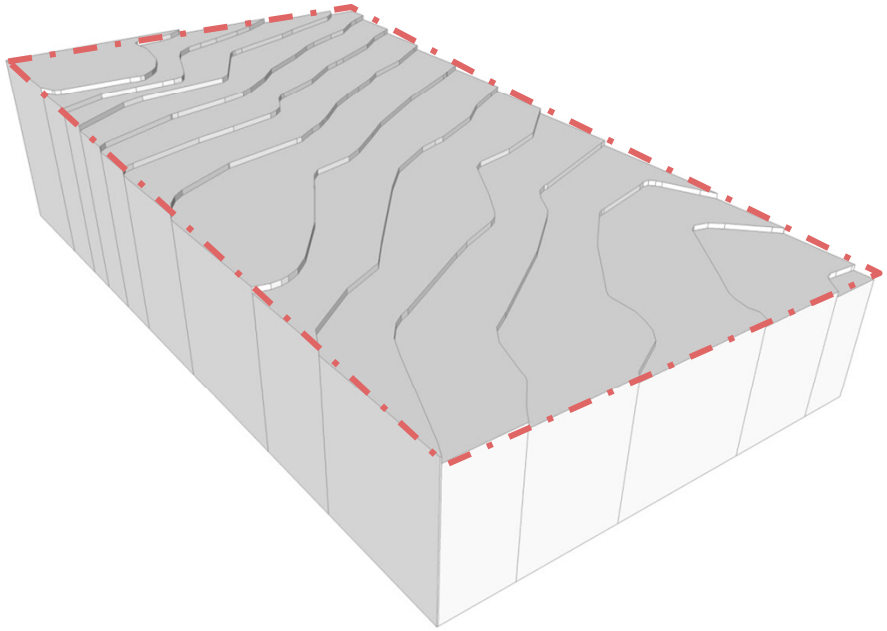


Communicating a Visual Process

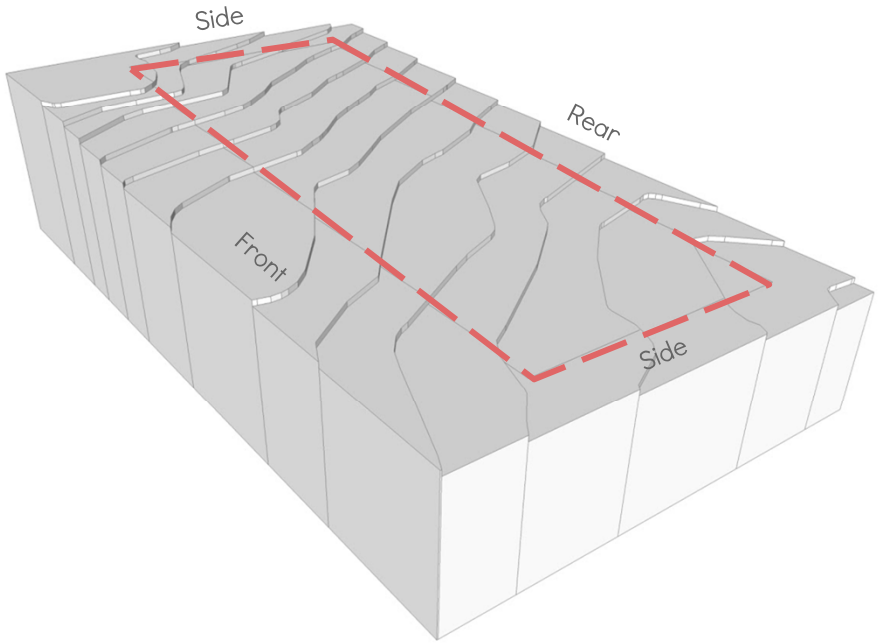
Zoning Envelope



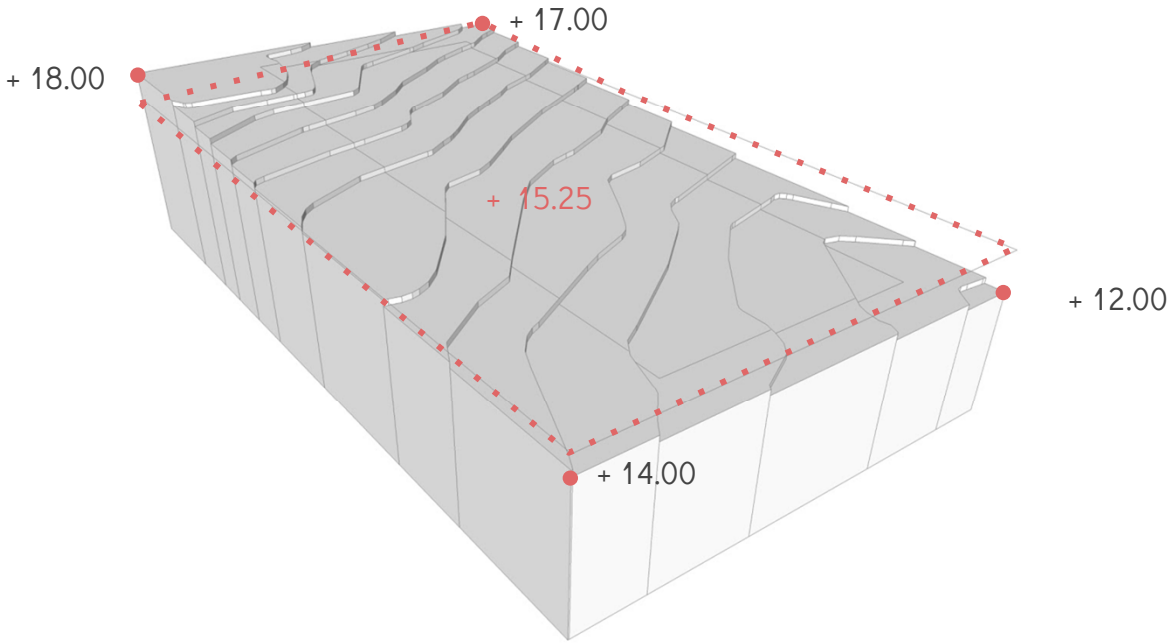
Site



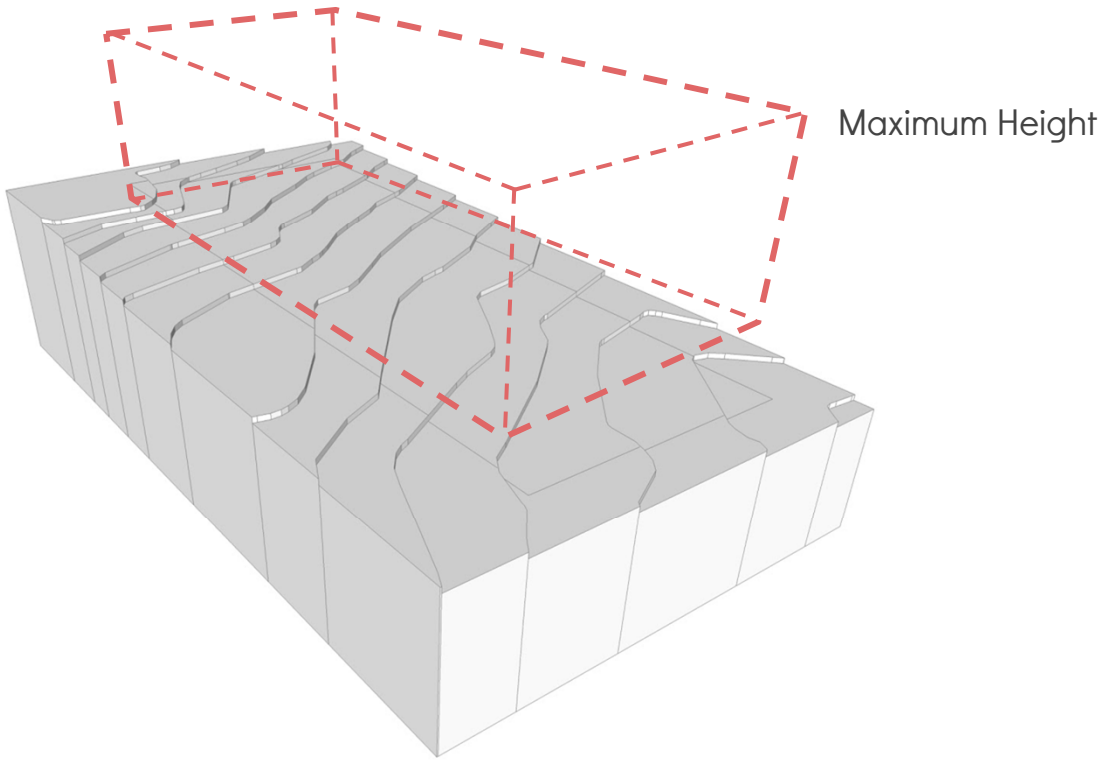
Property Line



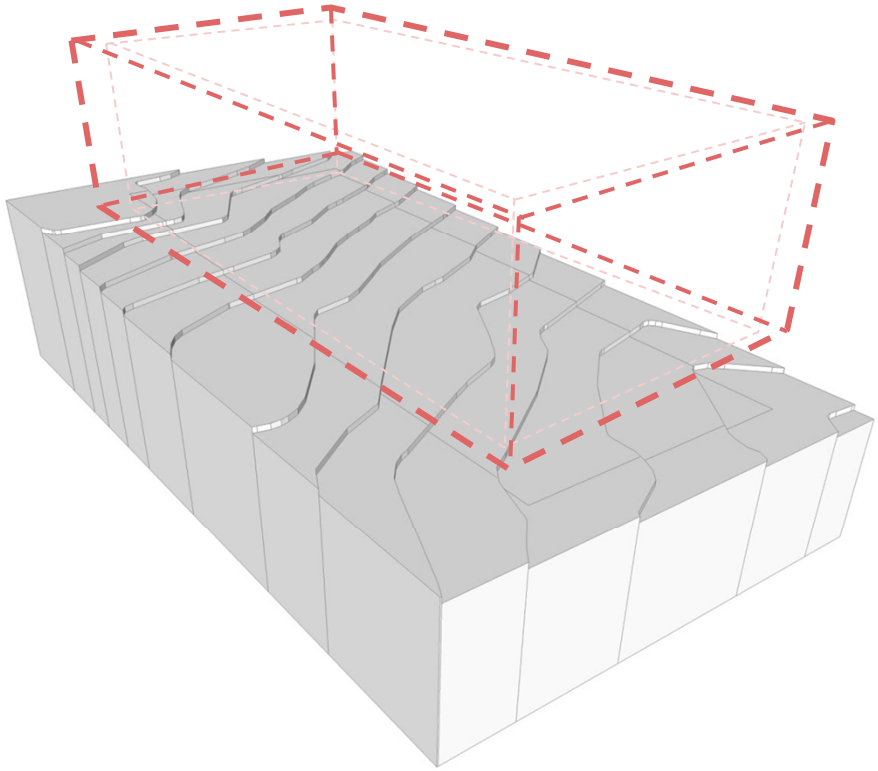
Setback



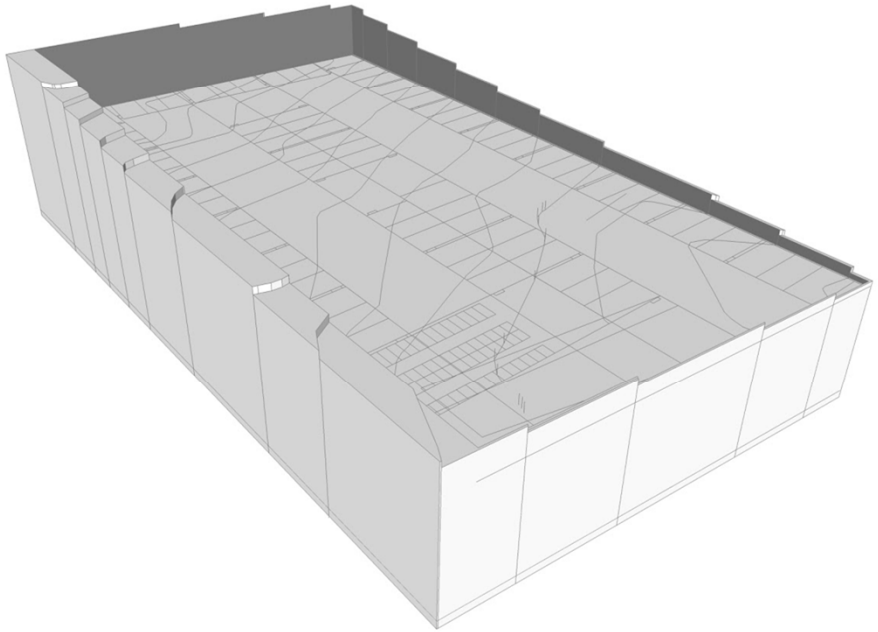
Average Grade



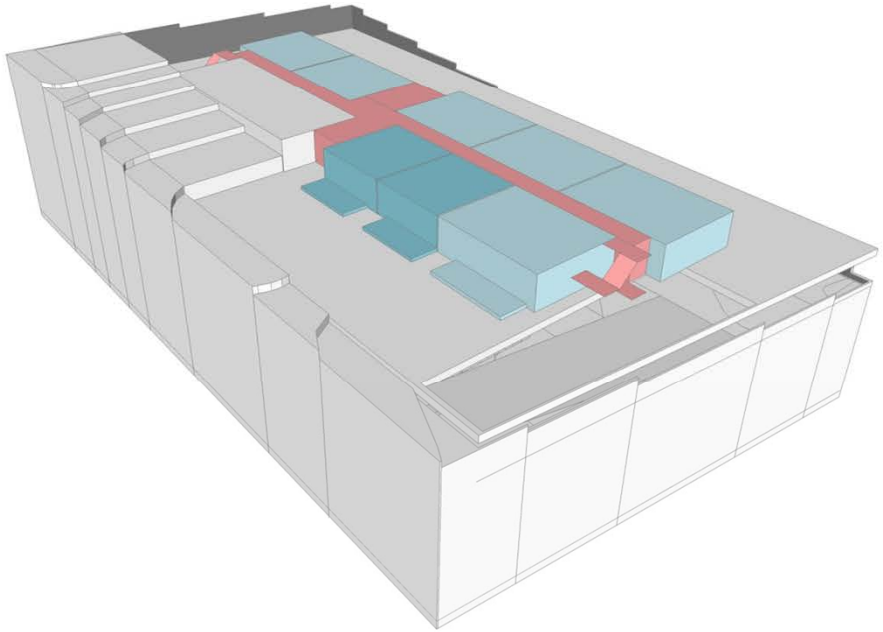
Height



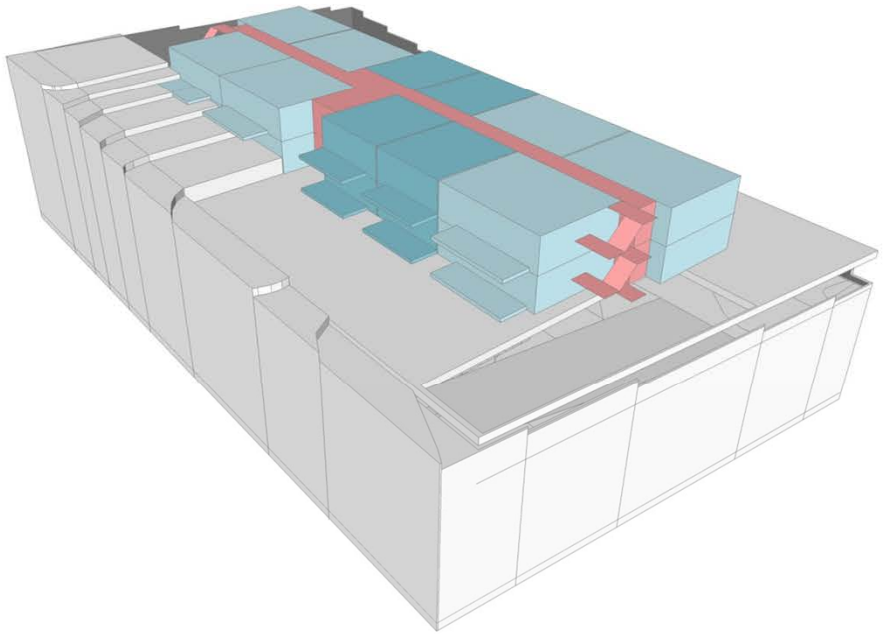
Balcony Setback



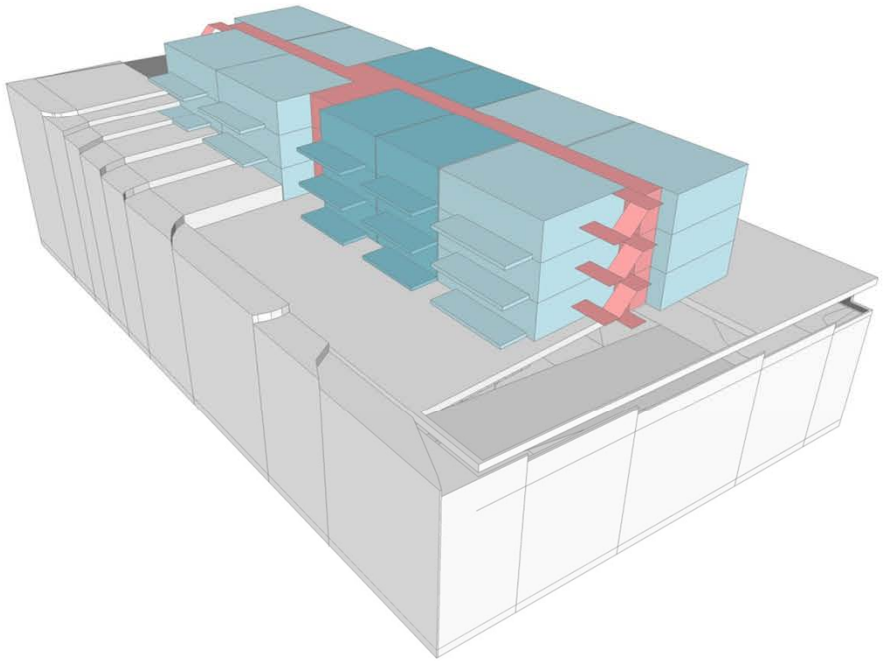
Parking



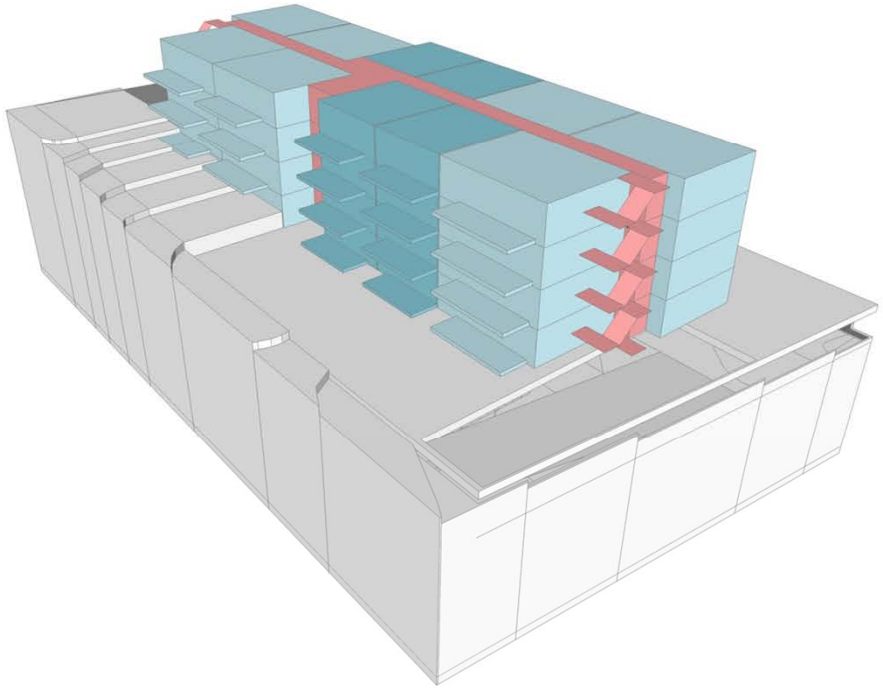
Level 1



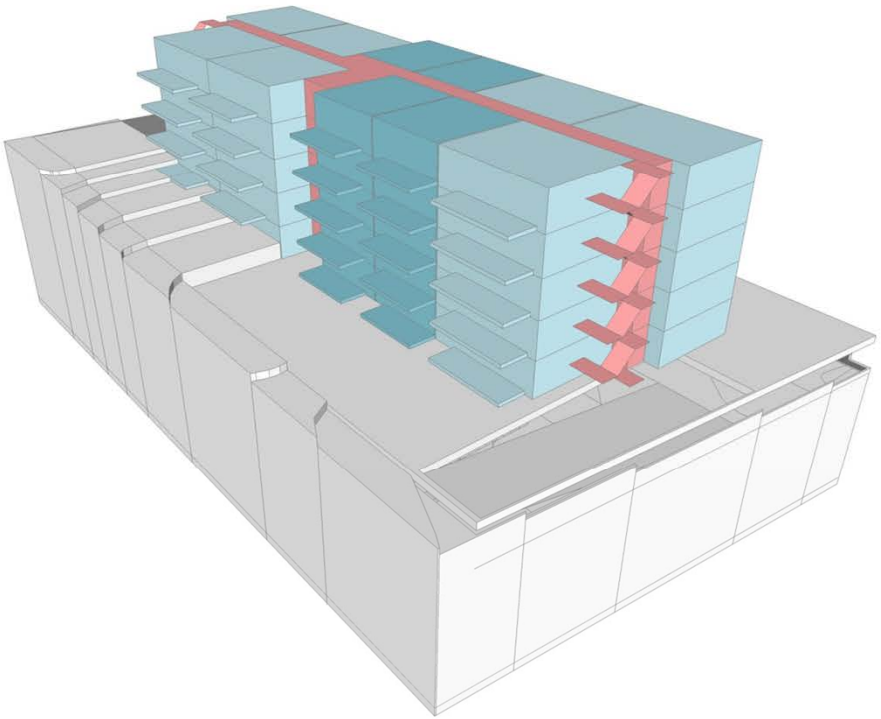
Level 2



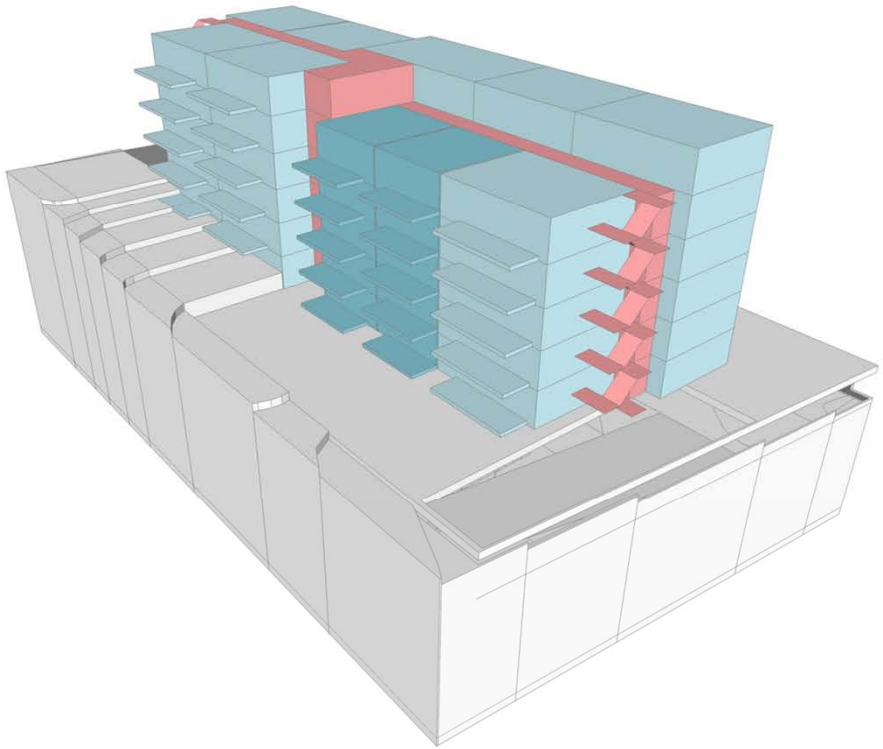
Level 3



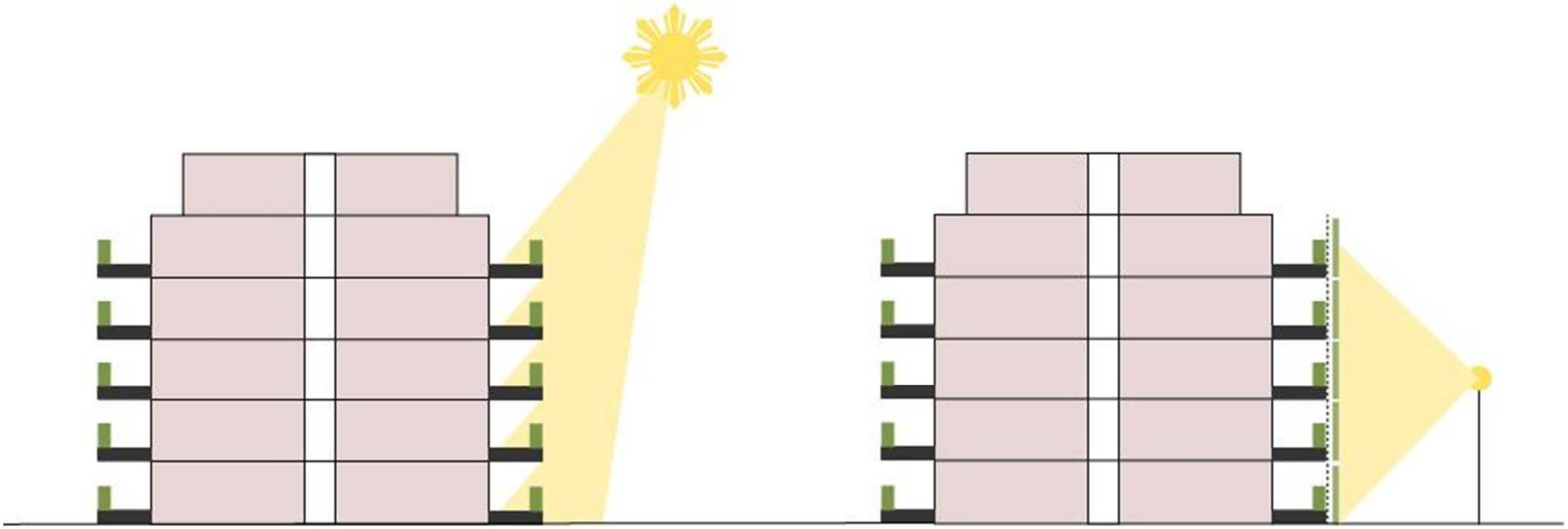
Level 4



Level 5



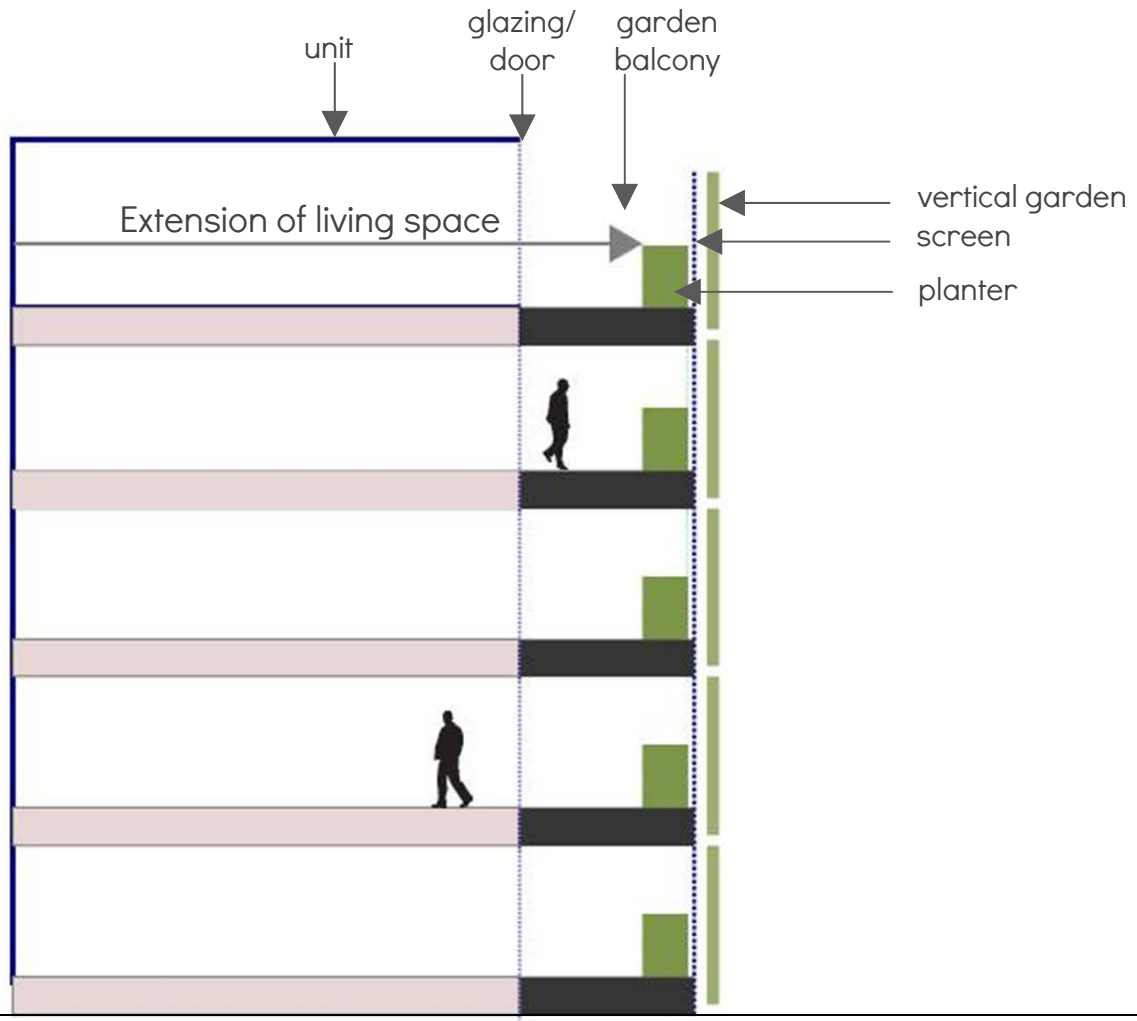
Level 6



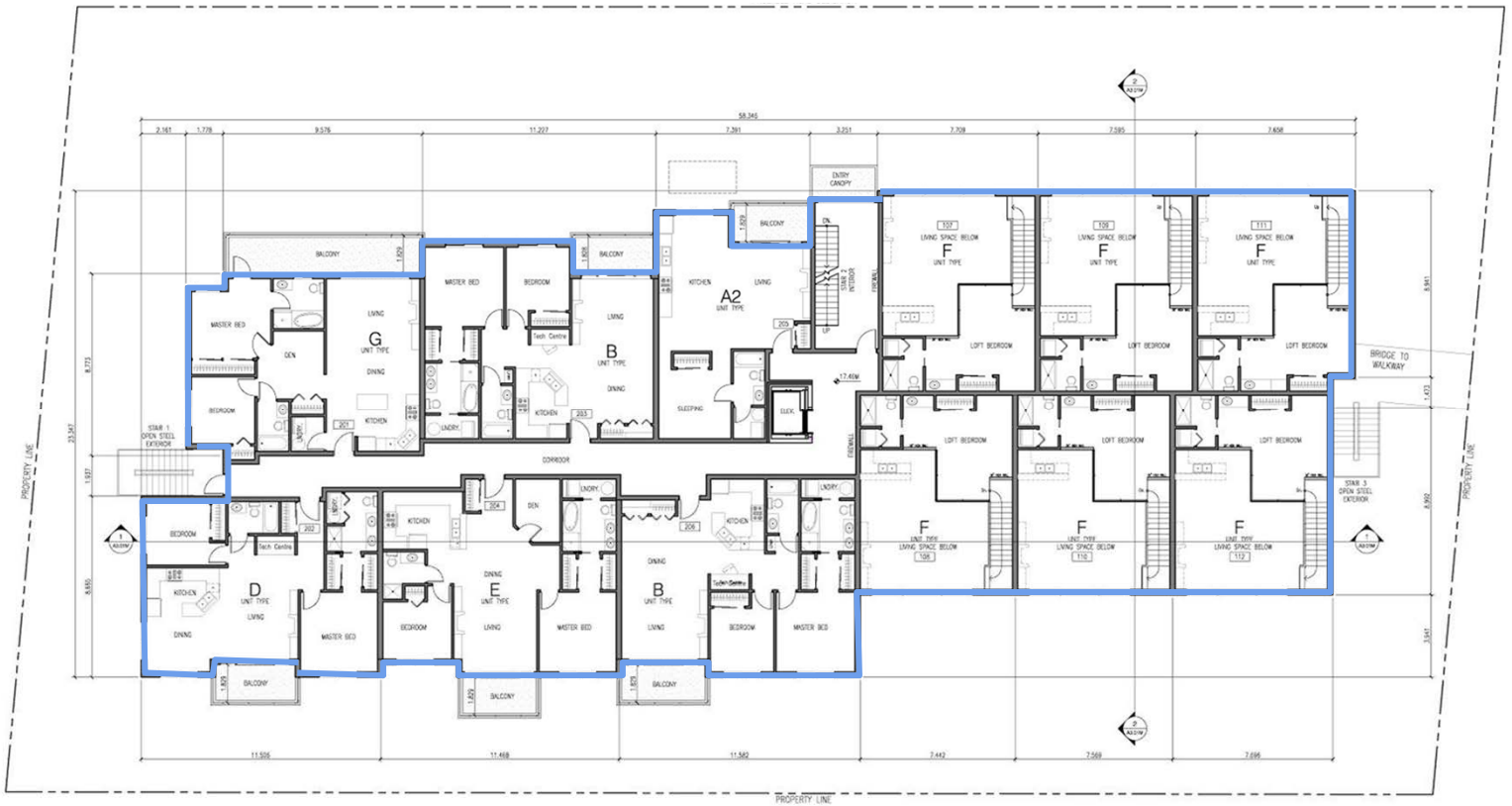
Sunshading

Light Control

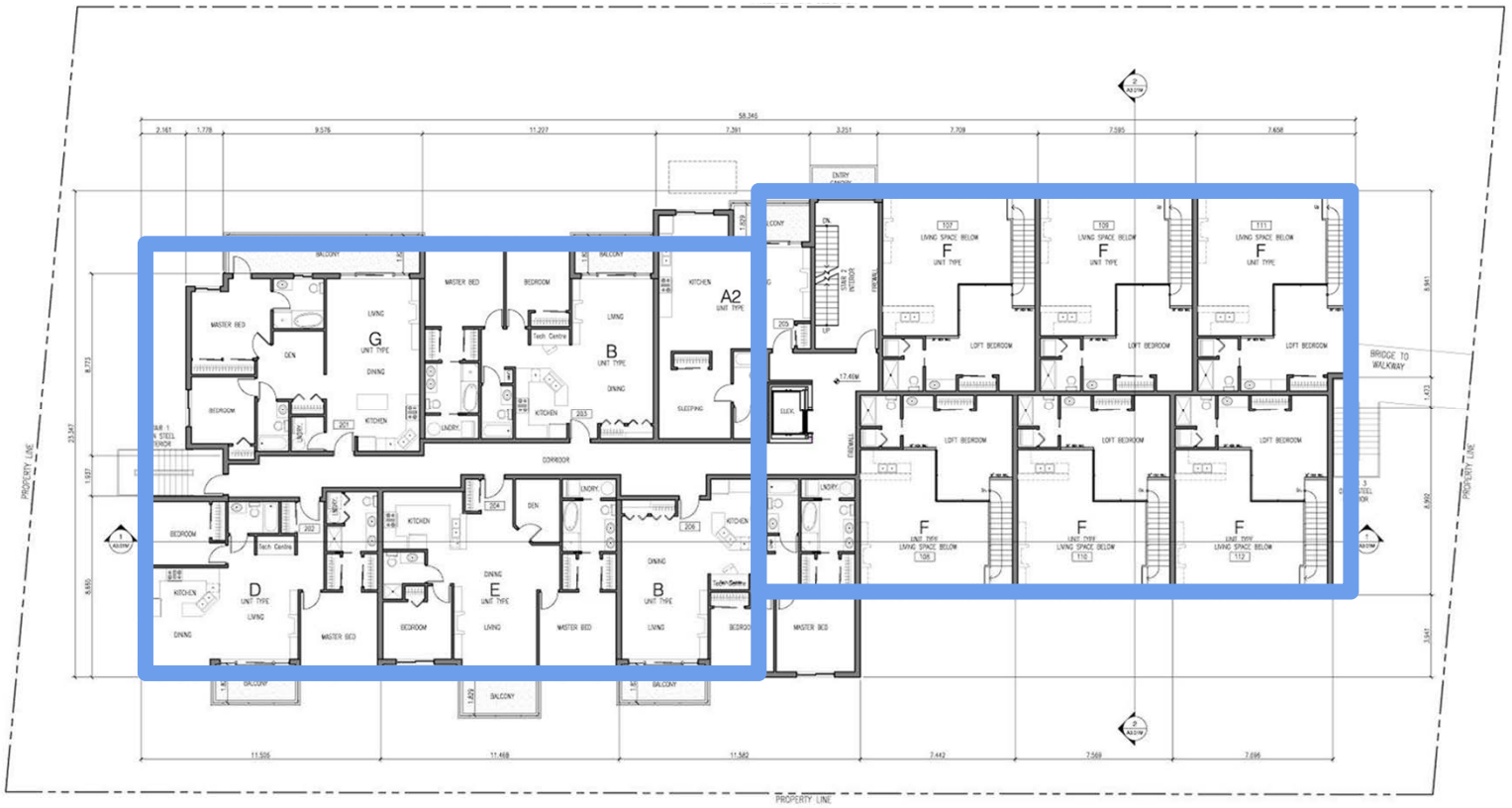
FUNCTIONS OF BALCONY



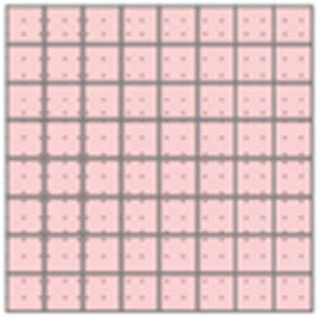
EXTENSION OF LIVING SPACE



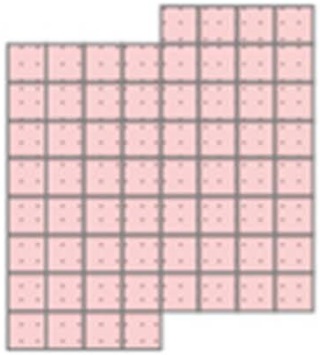
FLOOR PLAN WITH JOGS



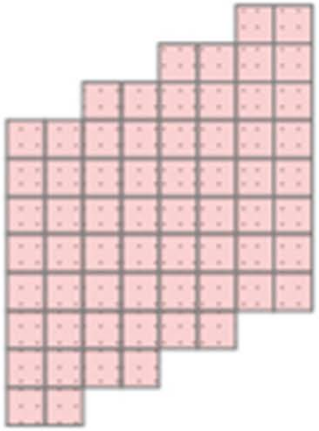
SIMPLIFY SHAPE



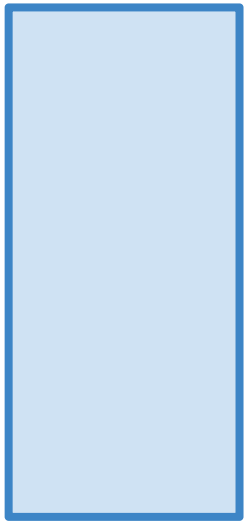
64 square units
Perimeter 32 units
100%



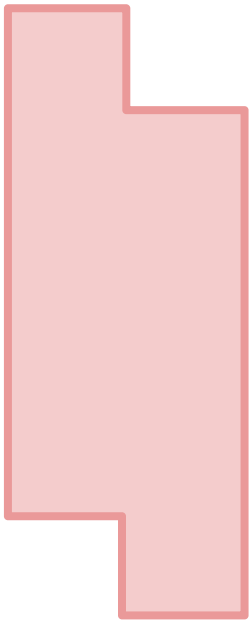
64 square units
Perimeter 34 units
106%



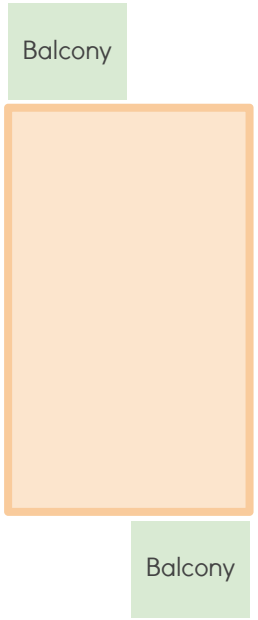
64 square units
Perimeter 38 units
119%



Floor area = 1000sf
Length of walls = 130’



Floor area = 1000sf
Length of walls = 146’
12% increase in wall length

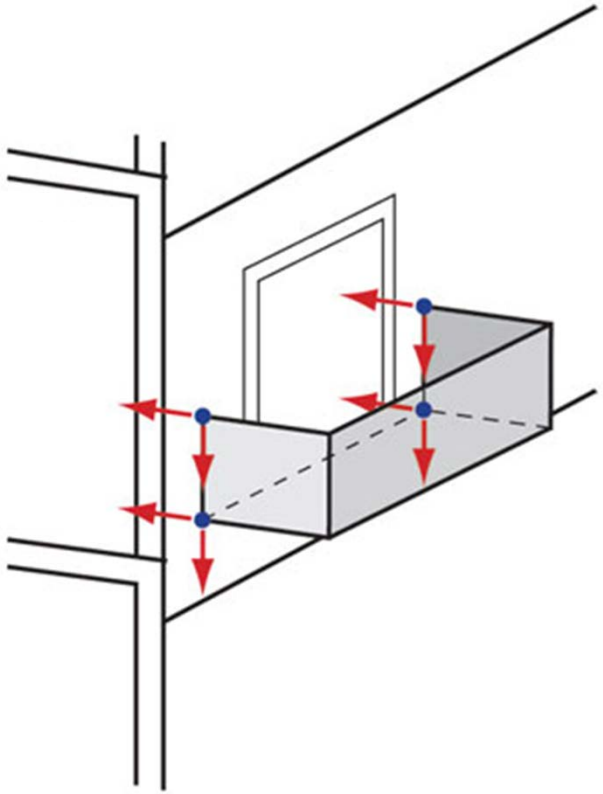


Floor area = 1000sf
Length of walls = 130’
0% increase in wall length

Cantilevered Balcony

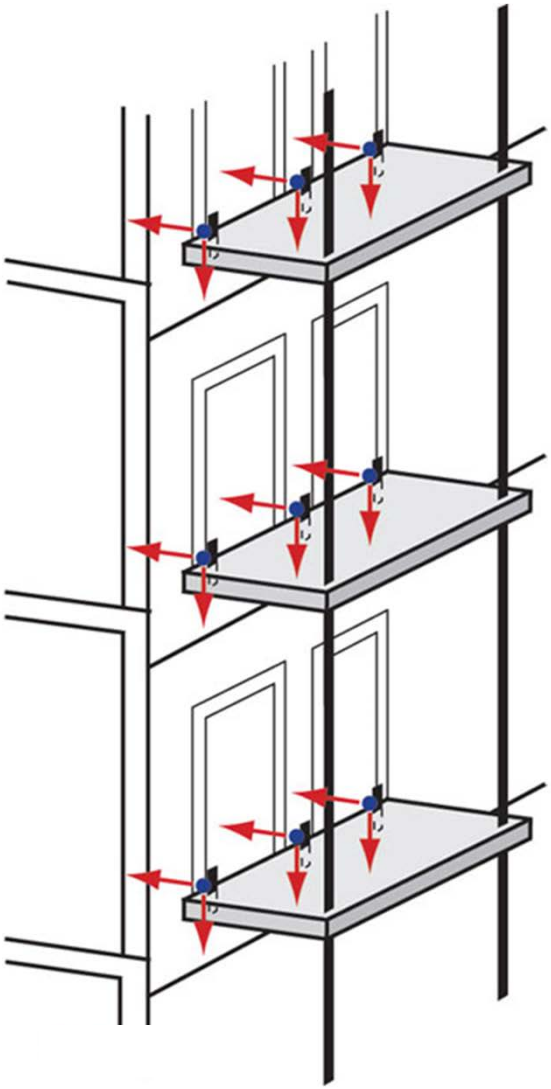
Thermally Broken Balcony

Thermal Comfort



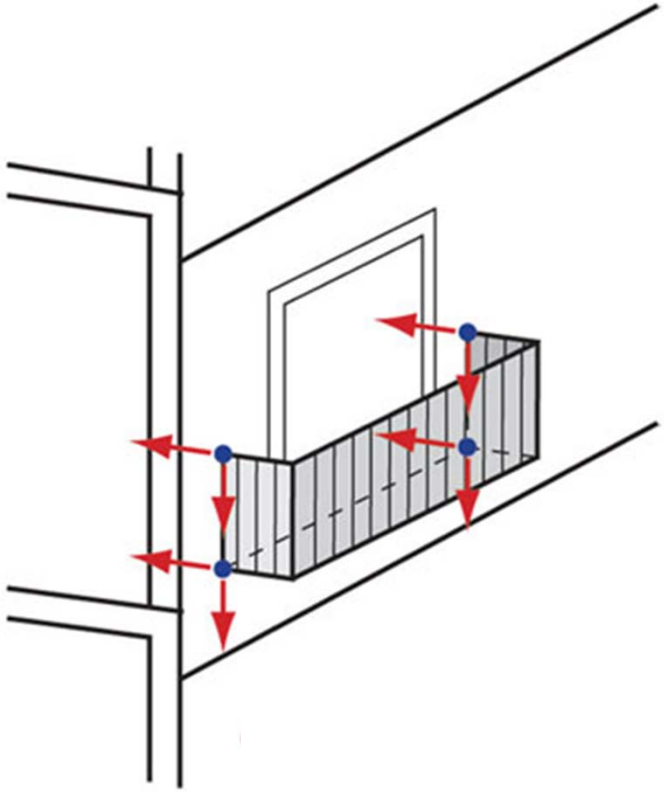
Four Point Connection

(image source: buildingscience.com)



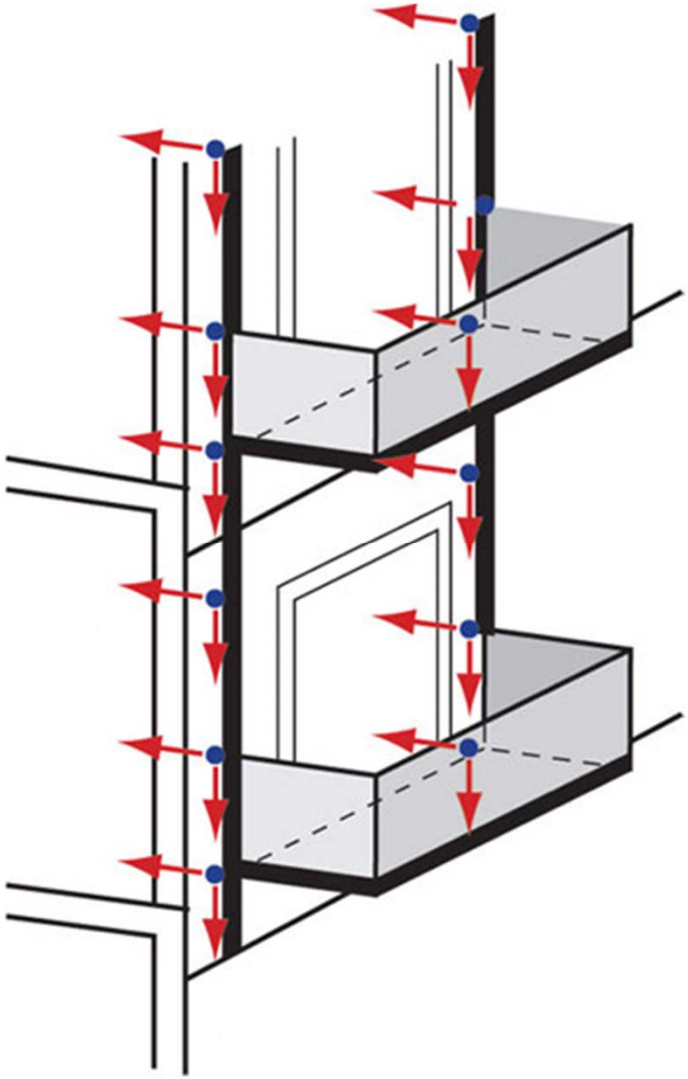
"Clip-on" Balcony

(image source: buildingscience.com)



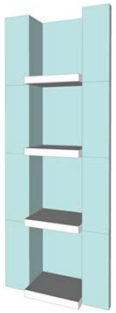
“French” Balcony

(image source: buildingscience.com)



"Rail" Balcony

(image source: buildingscience.com)

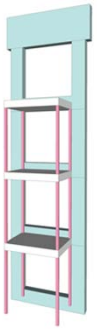


inset

cantilever

corner

2 columns



4 columns

brace

Balcony Types

Balcony Detail Construction Sequence

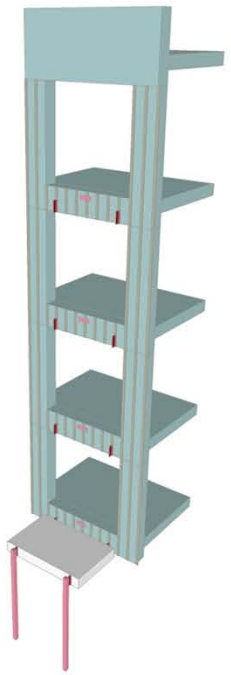
Frame

Balcony Detail Construction Sequence

Strapping

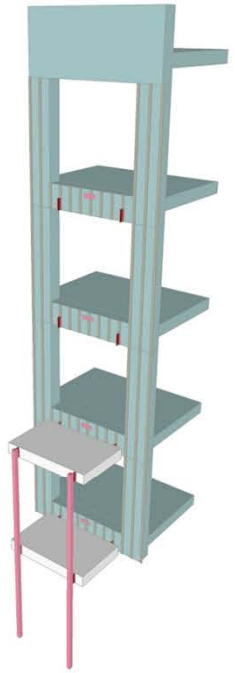
Balcony Detail Construction Steps

Metal Work



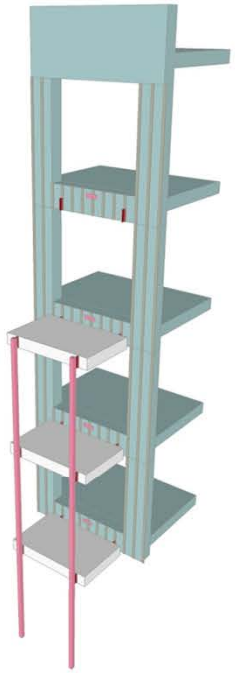
Balcony Detail Construction Sequence

Structure - 1



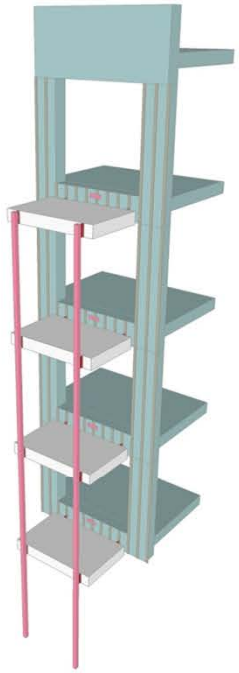
Balcony Detail Construction S Sequence

Structure - 2



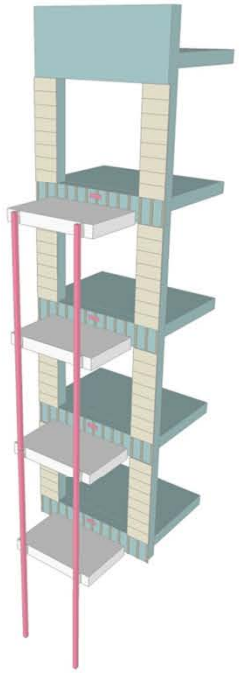
Balcony Detail Construction Steps

Structure - 4



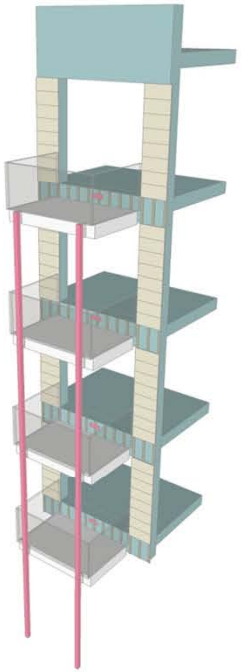
Balcony Detail Construction Sequence

Structure - 4



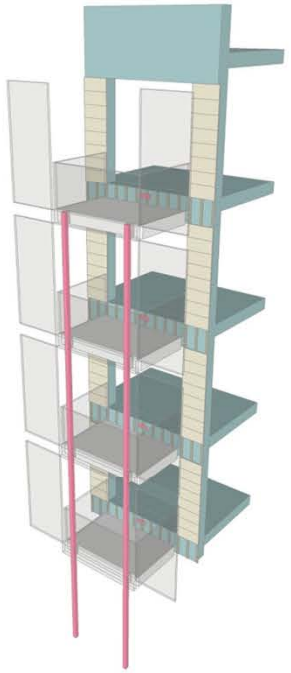
Balcony Detail Construction Sequence

Cladding



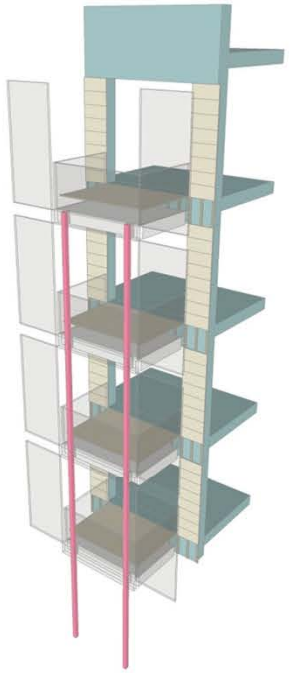
Balcony Detail Construction Sequence

Guards



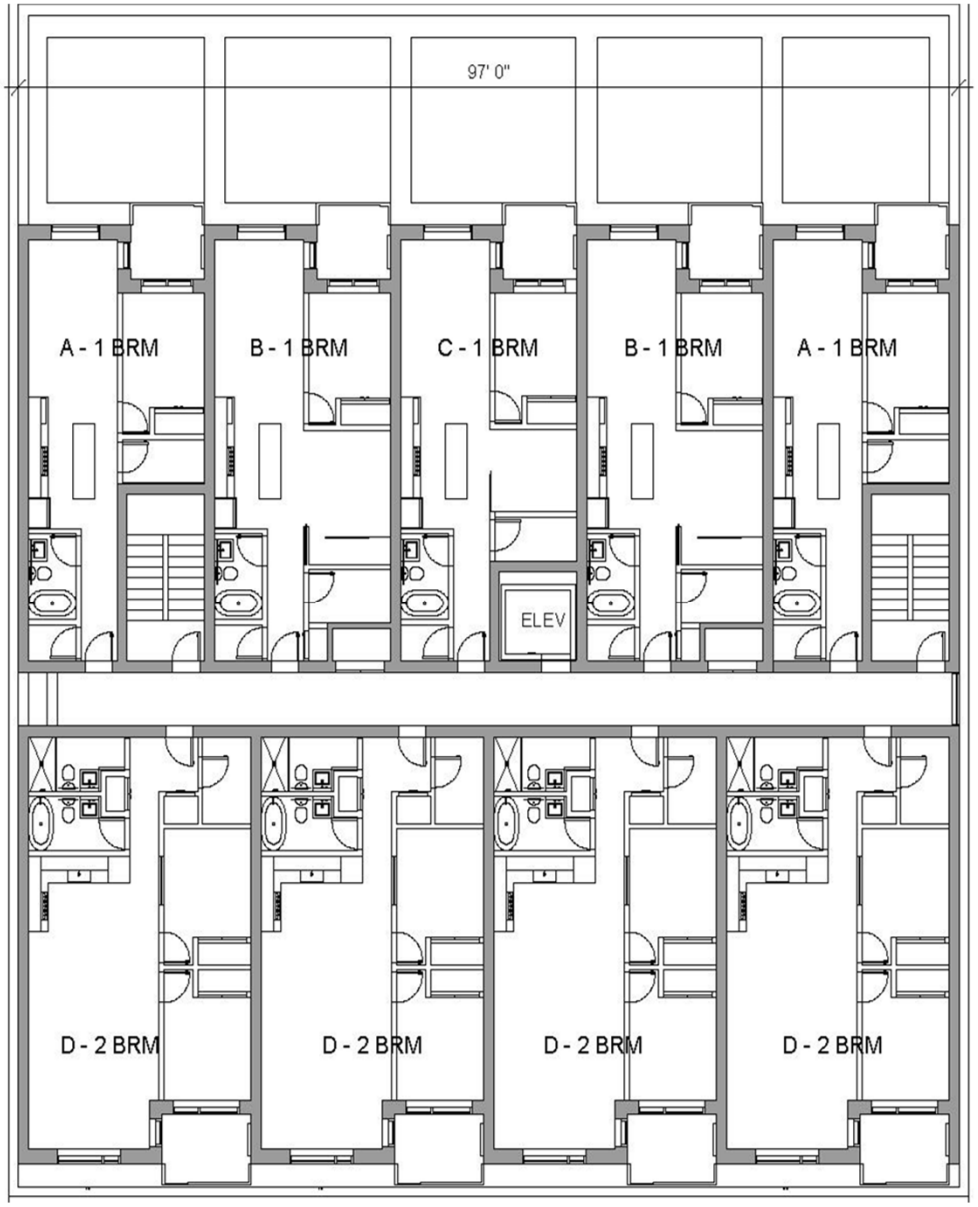
Balcony Detail Construction Sequence

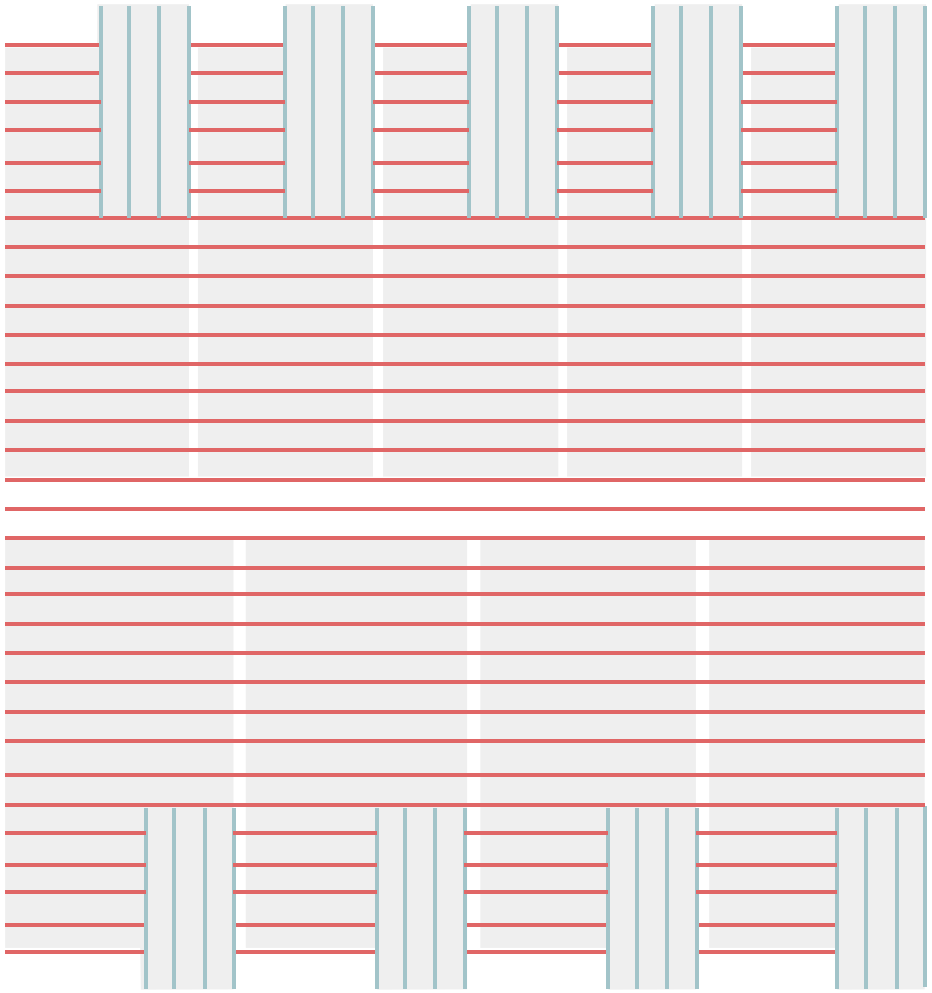
Screens



Balcony Detail Construction Sequence

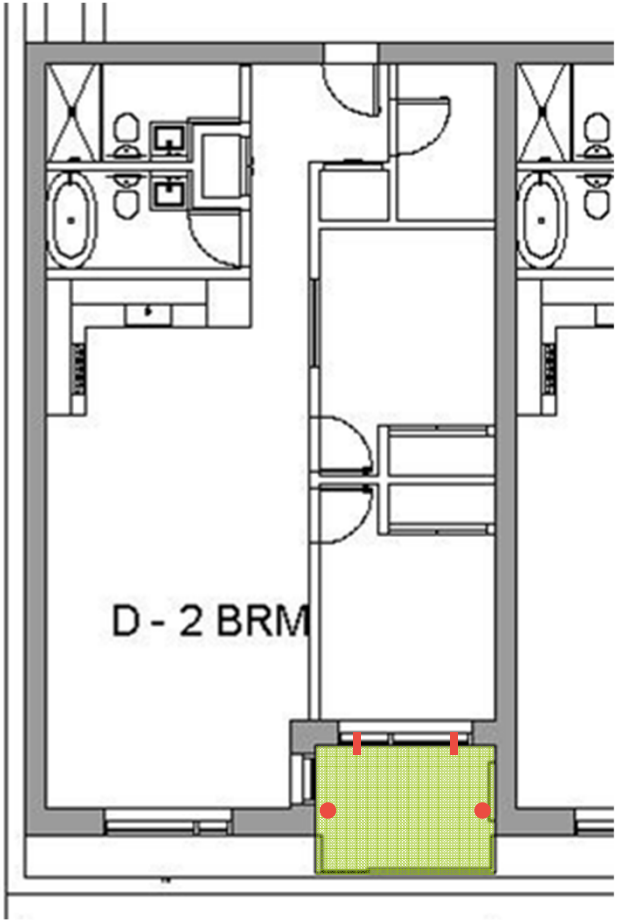
PHMURB PROTOTYPE BALCONY

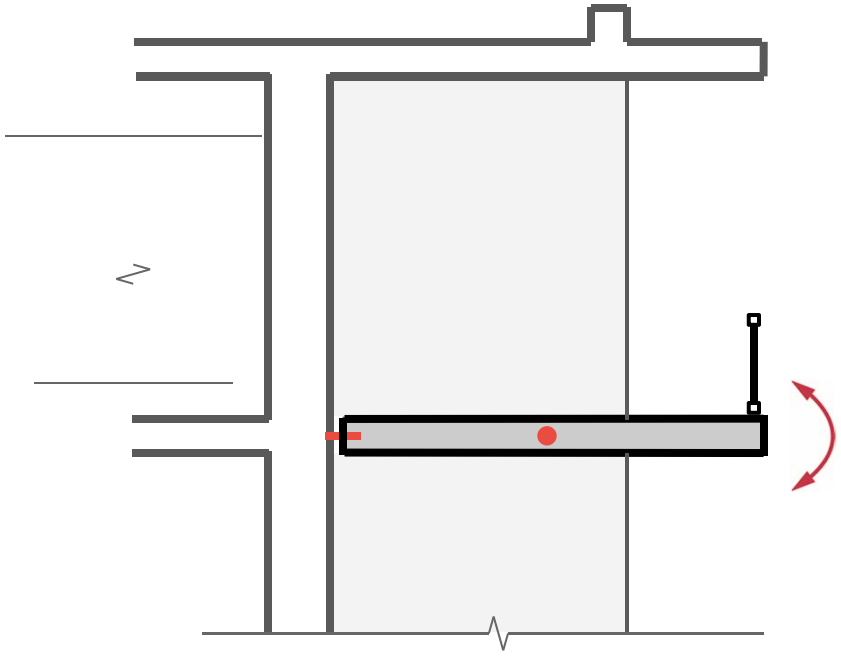

97' 0"
A - 1 BRM
B - 1 BRM
C - 1 BRM
B - 1 BRM
A - 1 BRM
ELEV
D - 2 BRM
D - 2 BRM
D - 2 BRM
D - 2 BRM



Overlay Structural Grid - Conventional

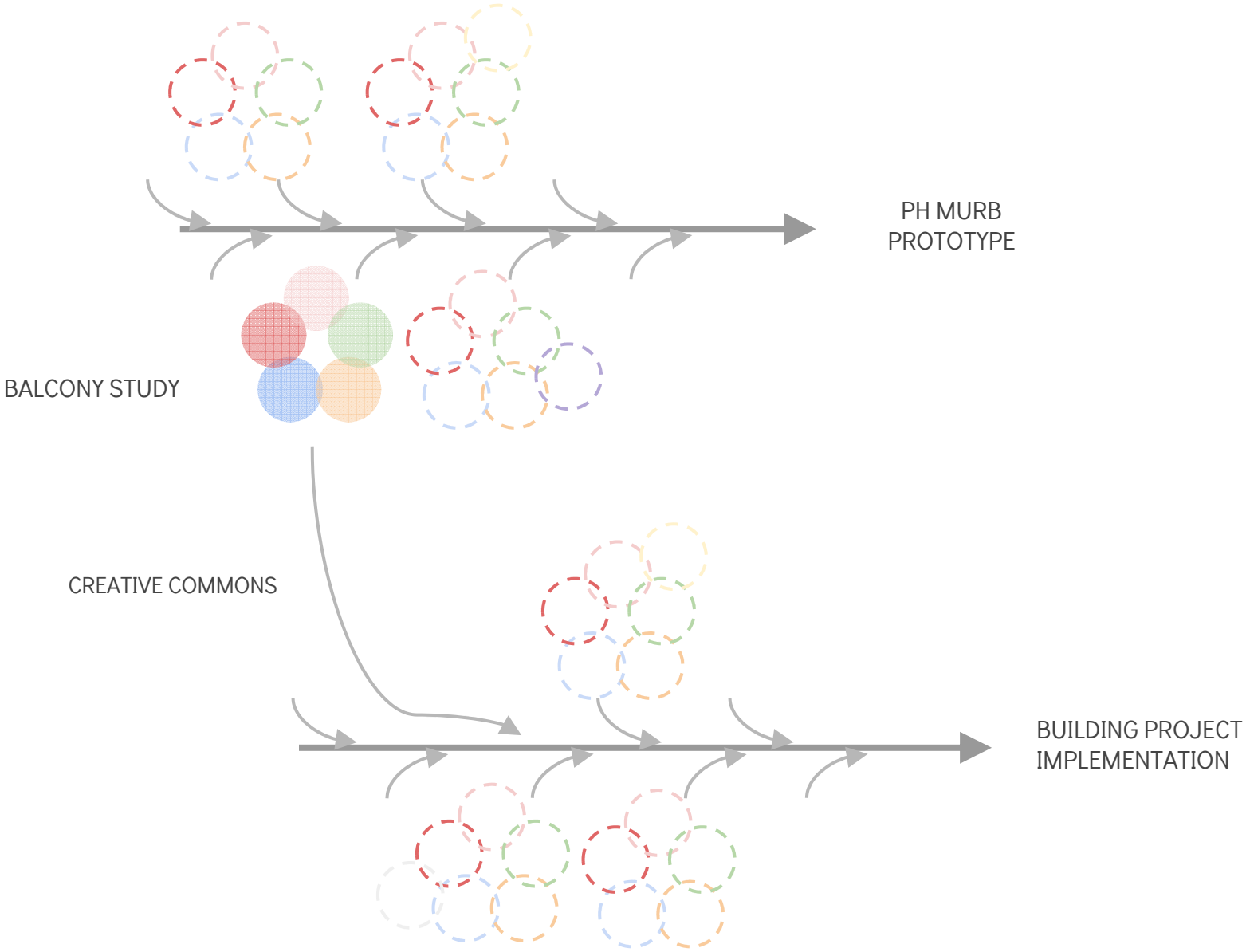

97' 0"
A - 1 BRM
B - 1 BRM
C - 1 BRM
B - 1 BRM
A - 1 BRM
ELEV
D - 2 BRM
D - 2 BRM
D - 2 BRM
D - 2 BRM



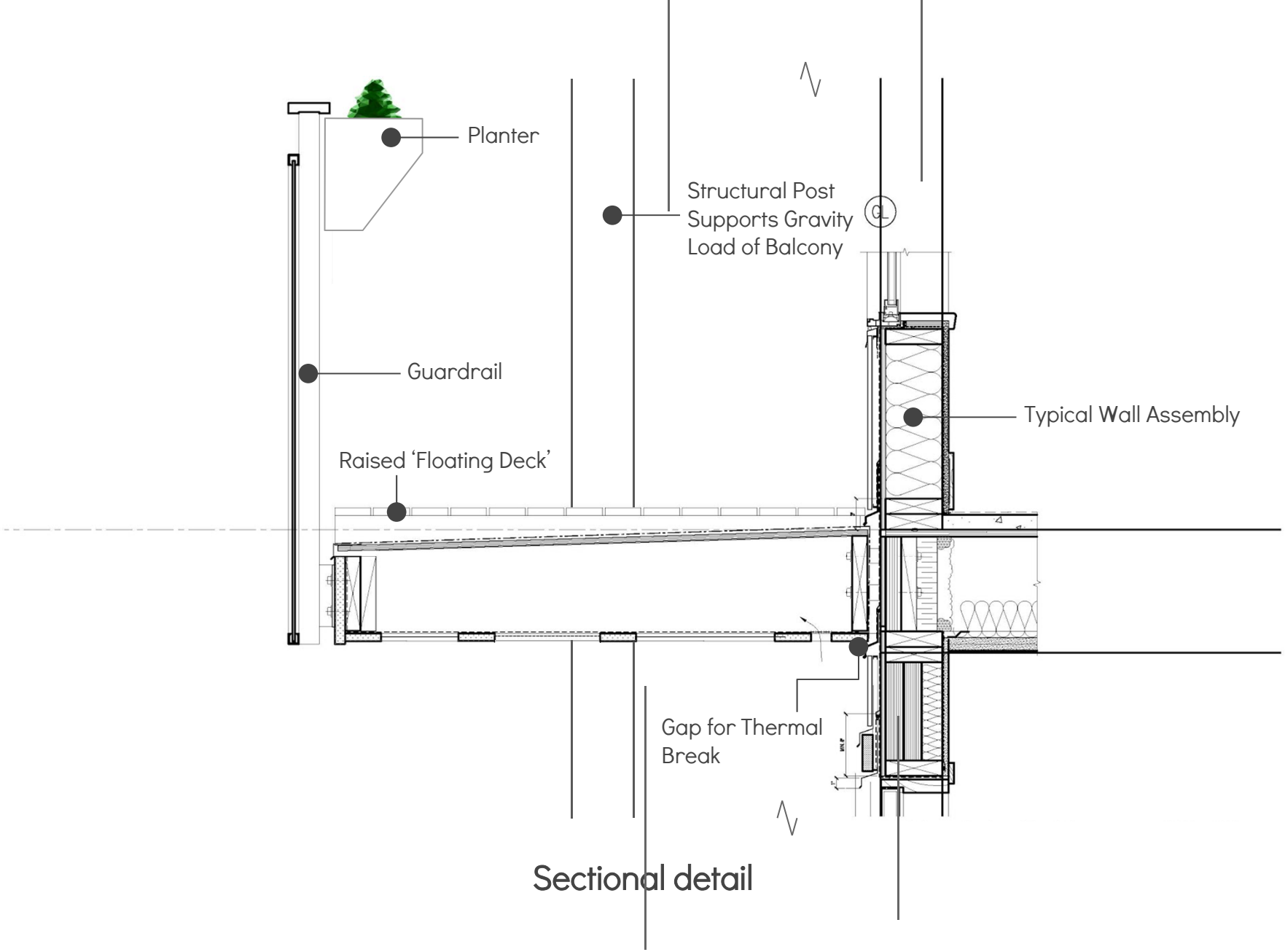


BALCONY THERMAL BREAK STUDY

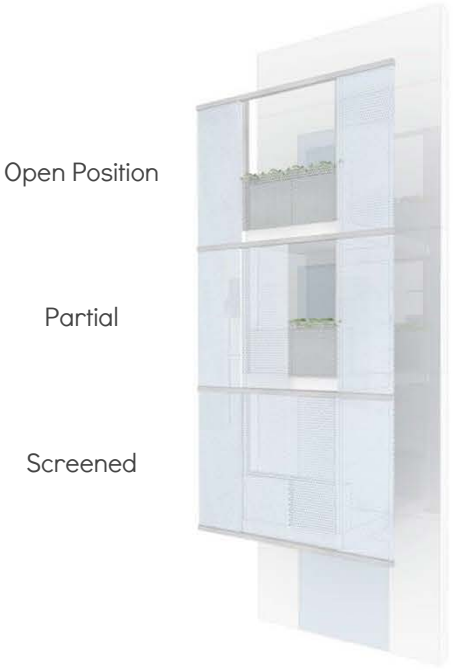
4-POINT CONNECTION, NOT CONTINUOUS CANTILEVER



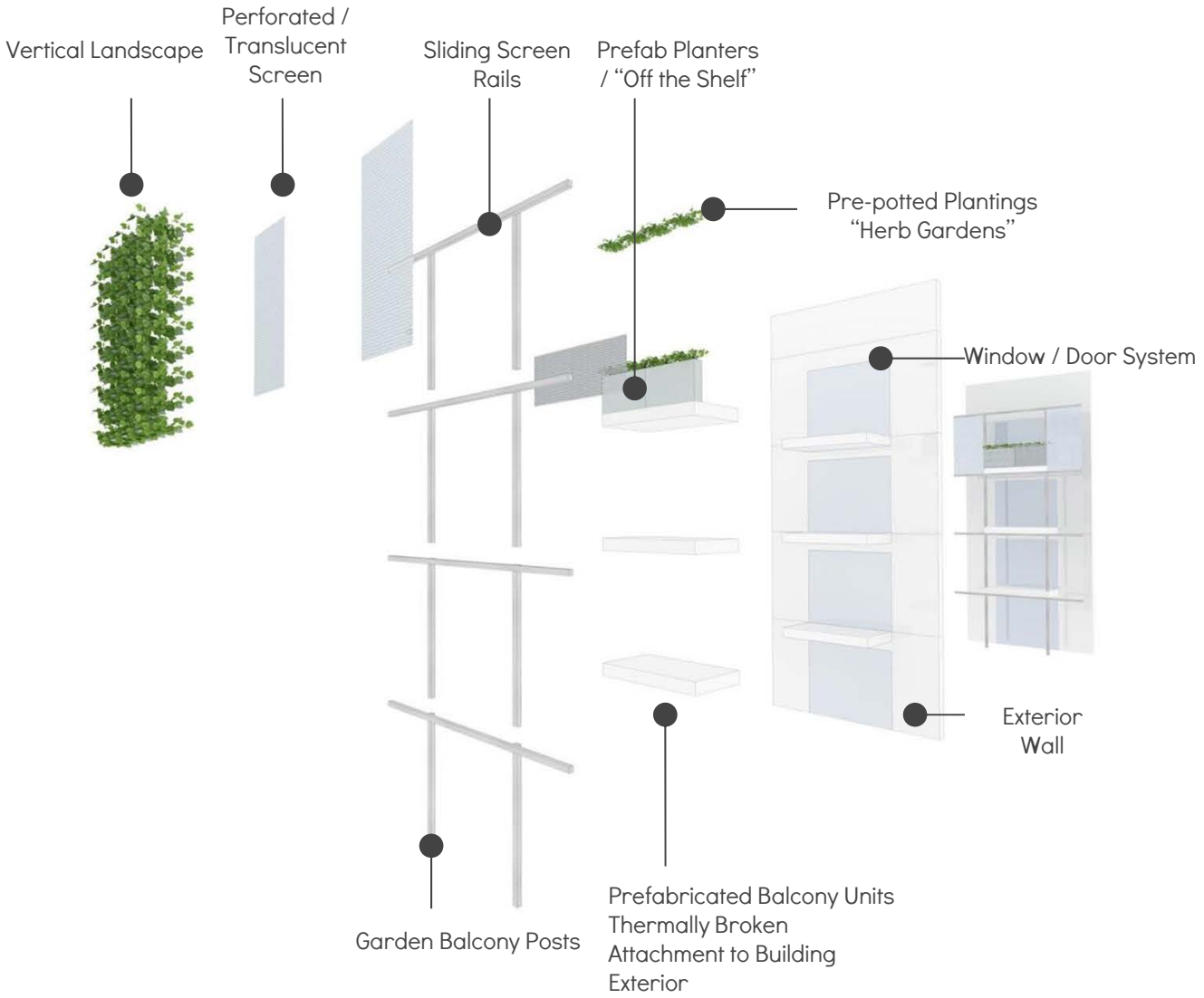
Creative Commons for Sustainable Building



Sectional detail



Variation/Layering



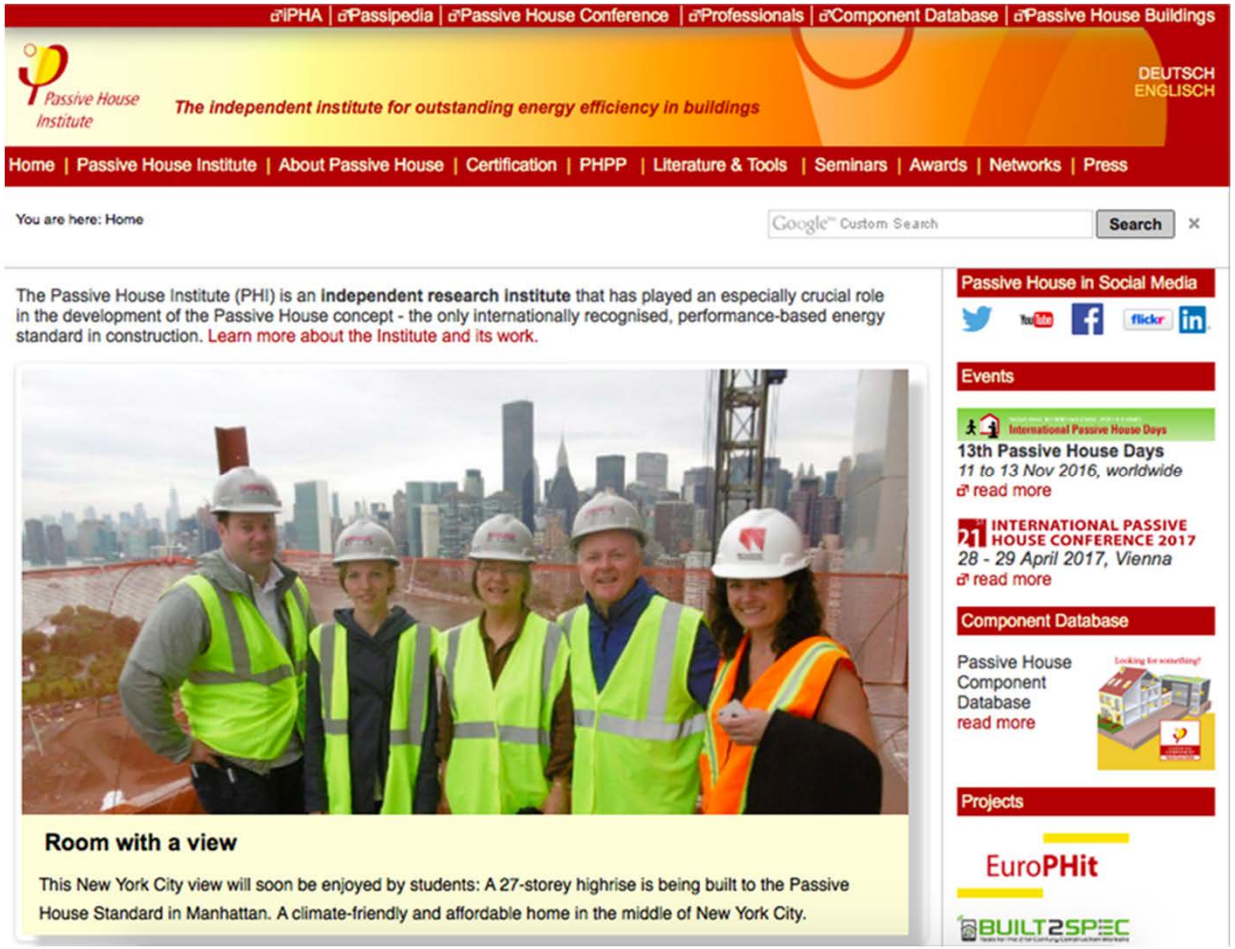
Kit of Parts


887


How can you contribute to the creative commons for sustainable building?

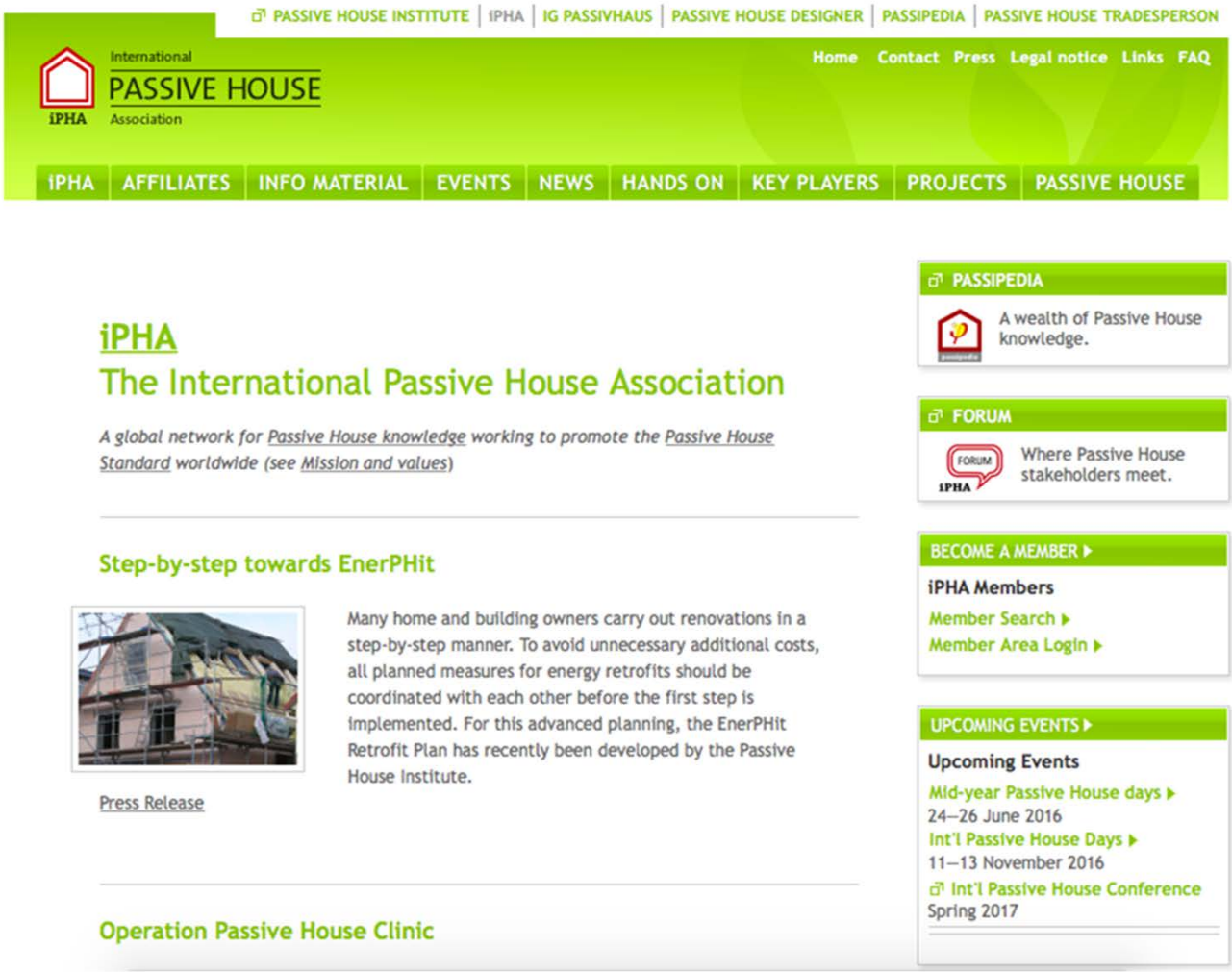
Resources

Koka architecture + design
Marken Design + Consult
Passive house institute
International Passive House Association



Passive House Institute

passivehouse.com

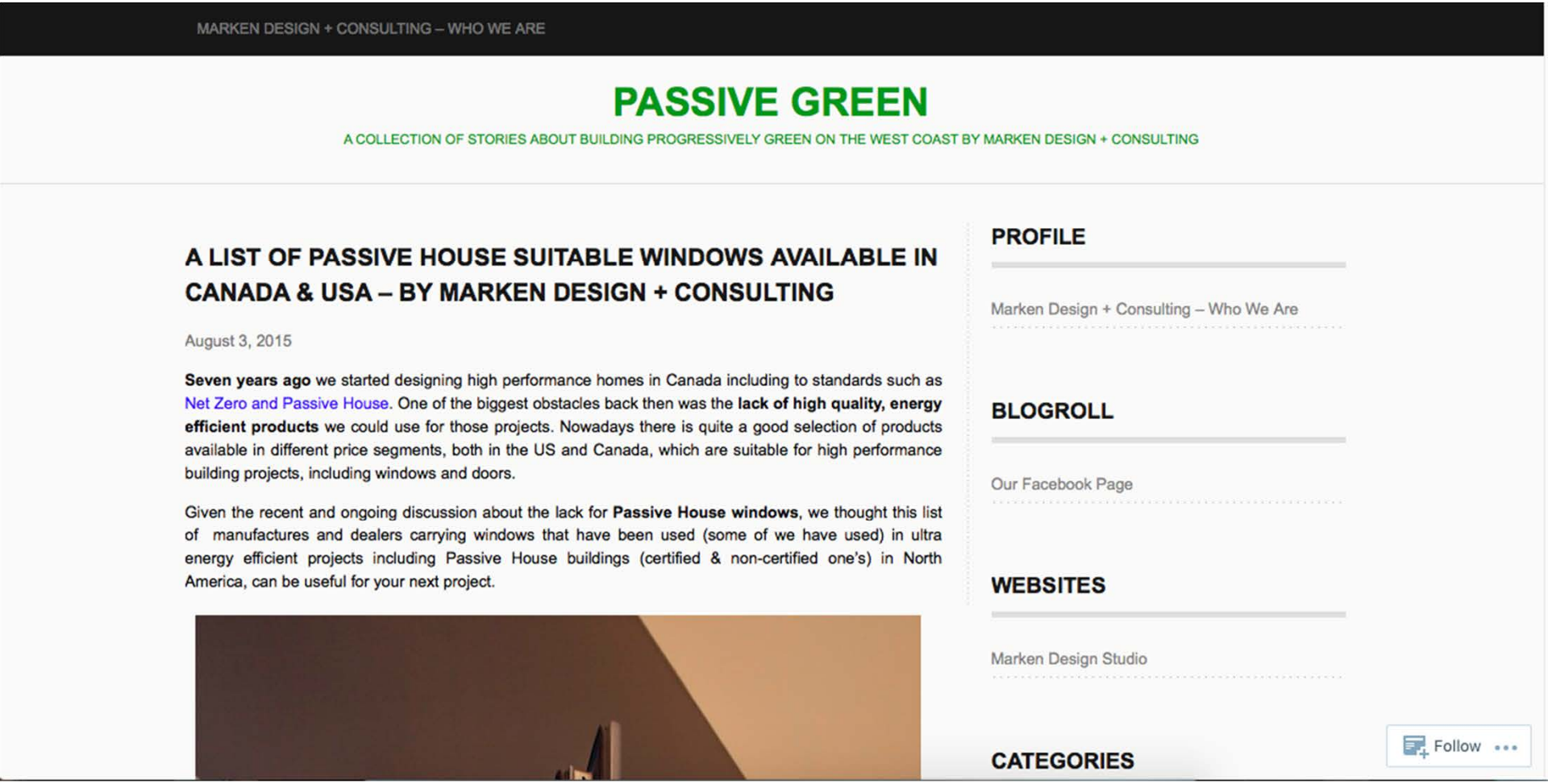


International Passive House Association

passivehouse-international.org

CoV Passive Design Toolkit

http://vancouver.ca/files/cov/passive-home-design.pdf



Passive House Design Features

(Image Source: PassiveGreen.Wordpress.com)

Thank you.

Presentation and PHMURB Prototype contributors:

Architectural	Passive House Consultant	Structural	Mechanical	Electrical	Envelope	Interior Design	Code	Quantity Surveyor
koka architecture + design inc.	marken Design + Consult	Fast + Epp	ReNü BUILDING SCIENCE	LITTLE MOUNTAIN ENGINEERING CO.	LDR ENGINEERING GROUP	Maza Interior Design	LMDG Building Code Consultants Ltd	LEC GROUP

Passive House Explained in 90 Seconds Video