Prepared To Design For ZNE?

AIA
Los Angeles

Prepared to Design for ZNE?





- **John Zinner, LEED Fellow** – Principal & Founder, Zinner Consultants
- **Lisa Matthissen, FAIA** – National Sustainability Design Director, HGA and Chair, AIA|CC Committee On The Environment (COTE)
- **Dan Brunn, AIA** – Founding Principal, Dan Brunn Architecture
- **Moe Fakih, LEED AP (O+M, RATER, QAD), CCP, GBP, BPI, AT TECH, WELL AP** – Vice President, VCA Green

with moderator **Ric. Abramson, FAIA** – Founder & Firm Principal, WORKPLAYS studio*architecture

Overview

7:30-8:00AM Sign-in for 2 CES Learning Units and coffee in the Louis Poulsen showroom

Introduction

Ric. Abramson, FAIA – Founder & Firm Principal, WORKPLAYS studio*architecture

ZNE Requirements and Regulations: An overview, how did we get here and where are we now?

John Zinner, LEED Fellow – Principal & Founder, Zinner Consultants

ZNE Resources: What tools are there to study and predict energy use for low-rise residential projects?

Lisa Matthissen, FAIA – National Sustainability Design Director, HGA & Chair, AIA|California Committee On The Environment (COTE)

ZNE Designing for the Environment: How do we get there?

Dan Brunn, AIA – Founding Principal, Dan Brunn Architecture

ZNE Tools & Implementation: How do we integrate it into the project?

Moe Fakih, LEED AP (O+M, RATER, QAD), CCP, GBP, BPI, AT TECH, WELL AP – Vice President, VCA Green

General Panel Discussion

with moderator Ric. Abramson, FAIA – Founder & Firm Principal, WORKPLAYS studio*architecture

Q&A

Ric. Abramson, FAIA
Founder & Firm Principal, WORKPLAYS studio*architecture

100% of all low-rise residential properties will be ZERO NET ENERGY beginning in 2020….*not*

What is a zero-net energy (ZNE) building?

Photo Credit: UC Davis, West Village

A ZNE building is highly energy efficient and **produces as much energy onsite** through clean, renewable resources **as it consumes** over the course of a year.

Why ZNE?

- Optimized building performance
- Lower net energy costs and higher resale value
- Highest architectural, mechanical, and environmental leadership
- Comfortable and productive environment for working, learning and living
- Makes communities stronger, resilient and energy independent

John Zinner, LEED Fellow
Principal & Founder, Zinner Consultants

Prepared to Design for ZNE?

John S. Zinner

Zinner Consultants

October 11, 2018

Lingo

- ZNE, ZE = Zero Net Energy, measured on annual basis
- ZER = Zero Energy Ready
- All Electric = To meet climate goals, buildings must be all electric powered by 100% renewable

- Site Energy = Energy consumed on site
- Source Energy = Site + energy to produce & distribute electricity
- Time Dependent Valuation = Minimizing peak energy use prioritized

Lingo 2

- Prescriptive Compliance Path = Implement required list
- Performance Compliance Path = Building performance using energy model
- LCA = Life Cycle Assessment
- Passive Solar = Comfort & efficiency through building design
- Active Solar = Solar water heating & power
  - PV = Photovoltaic solar electricity
  - DHW = Solar domestic hot water
  - Some solar panels address both

Lingo 3

- CPUC = California Public Utilities Commission
- CEC = California Energy Commission

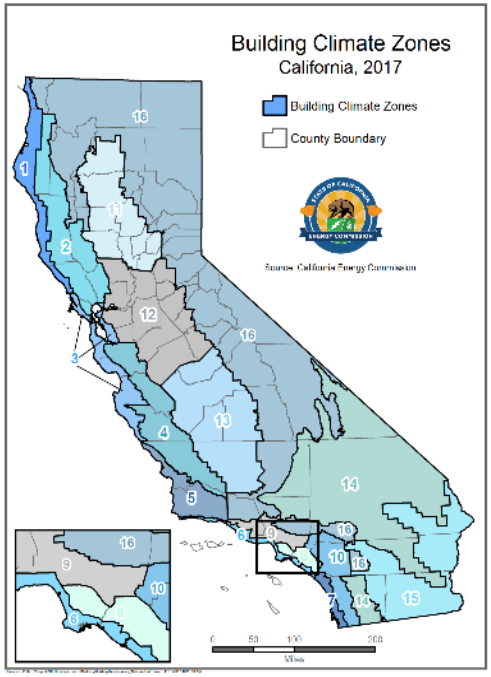
- HERS = Home Energy Rating System
- Cx = Commissioning
- CxA = Commissioning Agent

California ZNE Policy

- Adopted 2008
  - ZNE in 2020: All low-rise residential (3 stories & under)
  - ZNE in 2030: All commercial & mid/high-rise residential
- Must be cost effective by law

Title 24 2019, Part 6 SFH Req.

- ZNE <u>not</u> cost effective
- PV
  - Amount based on building/unit size & number of bedrooms
- Solar DHW preheat
  - 20% net solar fraction Climate Zones 1-9
  - 35% NSF Climate Zones 10-16
- Additional HERS testing



T24 2019, Part 6 SFH Costs & Benefits

- T24 2019 vs. T24 2016 single-family home with PV
  - Energy use - 53%
  - Construction cost + $9,500
  - Operating cost - $19,000 over 30 years
  - 30-year mortgage + $40/month
  - Utility costs - $80/month

- Exception
  - Santa Monica, Berkeley require SFH ZNE as of T24 2016 (“reach” code)

Design Options

- Meet State code
  - T24 2019, Part 6, Building Energy Efficiency Standards
  - Takes effect January 1, 2020
  - Updated every 3 years
- Design ZNE or zero carbon buildings now
- Minimize water use
  - 20% of CA energy use for water
  - Not part of T24 or ZNE calculation

The Climate Challenge

- New UN Climate Report: 11 years to save the planet
- Global Weirding *Not* Warming: Intensification of weather (kudos to Amory Lovins, RMI)
- Resilience: Future proofing buildings for climate change

Lisa Matthissen, FAIA

National Sustainability Design Director, HGA &
Chair, AIA|CC Committee On The Environment (COTE)

AIA
California Council

American
Institute of Architects,
California Council

ZERO NET ENERGY PRIMER

The Cottle House
San Jose, CA
One Sky Homes
2012

American Institute of Architects,
California Council

ZERO NET ENERGY PRIMER

ACKNOWLEDGEMENTS

The concept for this document came from members of the American Institute of Architects, California Council (AIACC), who are embracing the architect's role in meeting California's ZNE goals. The AIACC Board of Directors lends its enthusiastic support of the work done by Ann V. Edminster and Pacific Gas and Electric Company (PG&E). The effort was funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.

The author would like to acknowledge the generous contributions of time and expertise by Rick Chitwood, Gary Klein, Gina Rodda, Ted Tiffany, and Larry Weingarten; the equally valuable contributions and oversight by PG&E's project manager, Bill Burke; and the exceptional talents and dedication of designer Debra Turner and architect-illustrator Steven Lee, which have made this *Primer* immensely more valuable. Many thanks also to the architects and photographers who contributed photos.

TABLE OF CONENTS

In 2016, the Net Zero Energy Coalition documented 3,137 zero-energy homes in California – 38% of all units in the US and Canada combined.

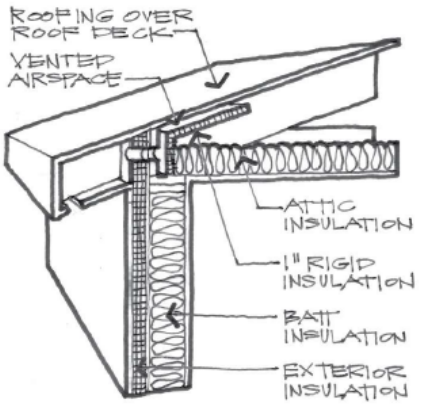
WALL & ROOF ASSEMBLIES

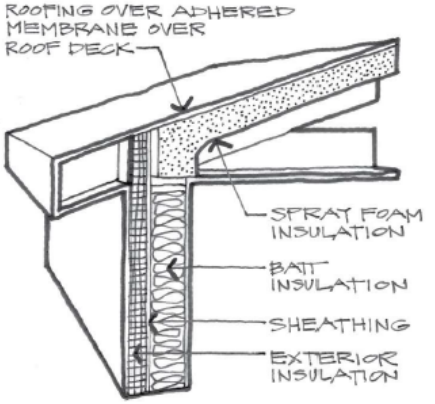
A high-quality enclosure is the bedrock of efficient construction, thus well-designed, well-detailed, and well-constructed wall and roof assemblies are critical to achieving ZNE. Key elements in high-performance assembly design include the framing, cavity insulation, exterior insulation, barriers, and air leakage control. Each of these elements is discussed below, and extensive relevant resources are listed on page 16.

FRAMING

Framing acts as a "thermal bridge" between interior and exterior surfaces; incorporating "advanced framing" or "optimum value engineering" features will reduce thermal bridging, thereby improving thermal performance while also saving the builder money on lumber. Although only a few specific advanced framing measures (e.g., 24" o.c. framing instead of 16") can be modeled in Title 24 software, all of them will reduce your project's framing factor, improving operating energy performance. Several advanced framing references are listed in the RESOURCES section on page 16.

Raised-heel trusses are another particularly valuable efficiency measure; while they require a bit more lumber, they allow the full depth of insulation to be installed all the way to the edge of the roof.





Title 24-2019 offers two roof/attic prescriptive options, vented (top) and unvented (bottom).

Plaza Point
Arcata, CA
K. Boodjeh Architects
2012
Brandi Easter photo

A high-quality enclosure is the bedrock of efficient construction .

RESOURCES

(Note: some of these are free, others available for purchase)

HIGH-PERFORMANCE ASSEMBLIES (GENERAL)

- *Guide for Designing Energy-Efficient Building Enclosures for Wood-Frame Multi-Unit Residential Buildings in Marine to Cold Climate Zones in North America,* FP Innovations and RDH Building Engineering Ltd., Graham Finch, et al.
- *Illustrated Guide - R22+ Effective Walls in Residential Construction in B.C.,* BC Housing
- *Field Test of Hygrothermal Performance of Highly Insulated Wall Assemblies,* M. Fox, et al.
- *Hygrothermal Analysis of California Attics,* Building Science Corporation, Joseph Lstiburek and Christopher Schumacher
- Building Science Corporation case studies – in the search window, select "Designs That Work" as the document type, and the appropriate US climate zone[7] (or "Any")
- *Building Science Corporation assembly guidance documents,* e.g., "ETW: Walls - 2x6 Advanced Frame Wall Construction High R-Value" – in the search window, select "Enclosures That Work" as the document type and select "Any" as the climate zone
- Residential High Performance Walls, California Energy Codes & Standards
- Building America Solution Center, U.S. Department of Energy – Energy Efficiency & Renewable Energy – *Ceilings Guide* and many other relevant guides
- *Construction Guide, Next Generation High Performance Walls, Climate Zones 3-5 Part 1: 2x6 Walls.* Home Innovation Research Labs, V. Kochkin and J. Wiehagen
- Several listed at Workforce Instructions for Standards and Efficiency (WISE), e.g., *Illustrated Guide: R22+ Effective Walls in Wood-Frame Construction in British Columbia,* Homeowner Protection Office, BC Housing

FRAMING

- *Advanced Framing Construction Guide,* APA – The Engineered Wood Association

INSULATION

- The BuildingGreen Guide to Insulation – each insulation type analyzed, including thermal performance (R-value), response to aging, performance in extreme temperatures, off-gassing, global warming potential, health impacts, and other key factors
- *Builder's Guide to Continuous Insulation,* Dow, Building Science Corporation
- *Measure Guideline: Incorporating Thick Layers of Exterior Rigid Insulation on Walls,* US Department of Energy, Building Science Corporation
- *Residential Insulated Sheathing – Design Guide,* Roxul, Building Science Consulting, John Straube

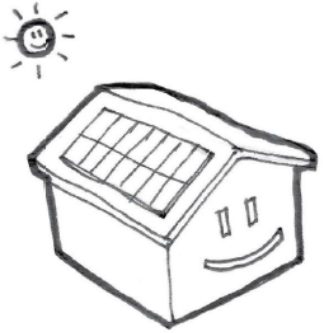
AIR SEALING

- "Fact Sheet: Envelope Air Sealing 2013 California Energy Efficiency Building Standards," California Energy Commission
- Coldham & Hartman Architects continuous air barrier drawing
- Hammer and Hand Best Practices Manual
- *Forty Years of Air Barriers,* Building Science Corporation
- *Passive House Design,* Gonzalo Roberto
- *Details for Passive Houses,* Österreichisches Institut für Baubiologie und -ökologie

INSULATION SPECIFICATIONS AND SCOPES OF WORK

- State of California Quality Insulation Installation specifications
- HERS fact sheet
- *Ace Installation Residential,* Energy Code Ace
- Energy Code Ace Quality Insulation Installation resources – a sample plan set including air sealing details, a QII note block to be added to architectural plans, and a contractor's QII checklist
- *Revisions to Quality Management Products: Four Scopes of Work for High Performance Homes* – NREL, National Association of Home Builders Research Center – covers excavation, foundations, framing, and HVAC

Valley Glen Apartments
Dixon, CA
Pacific West Communities
2014
Glen McDowell photo



KEYS TO SUCCESS

START WITH THE END IN MIND

Set ZNE as a project goal from the very beginning, to calibrate your mindset (and your client's). Then you'll figure out how to do it and stay on budget!

Learn from the pioneers – research how other architects have tackled the ZNE challenge.

Pick a rock star team, and involve all of them from early in the design process – include a really great mechanical system designer, a really great energy modeler, and a really great general contractor! The ideal qualifications are:

- **Commitment** to the ZNE goal
- **Creativity** to go beyond business-as-usual
- **Experience** with high-performance/ZNE projects
- **Engagement** ("plays well with others")

Focus on the enclosure – it's the key to success with ZNE. Dedicate time to developing a comprehensive set of air sealing and air-vapor-water barrier continuity details that you can use over and over again.

Control what happens in the field as much as you can – develop a rigorous set of quality management specifications to include in your CDs (every time); include field diagnostics (blower door testing, duct blaster testing, infrared imaging, etc.) and commissioning.

Make a checklist of the new things you will need to accommodate now (and should plan for in the future), and their space needs: shading, PVs, more PVs for electric vehicles, mechanical equipment in conditioned space, etc.

HAVE FUN!

RESOURCES

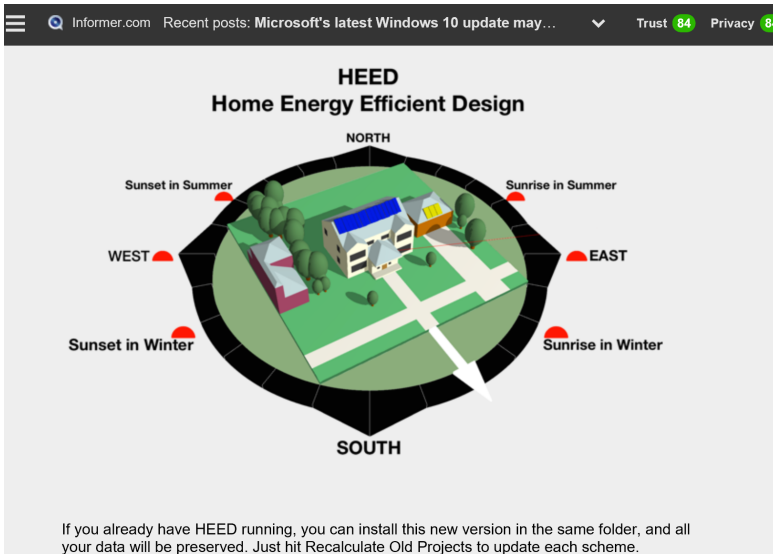
"Making Choices Instead of Paying Premiums," Northeast Sun, Bruce Coldham – excellent article on the relationship between goals and budget

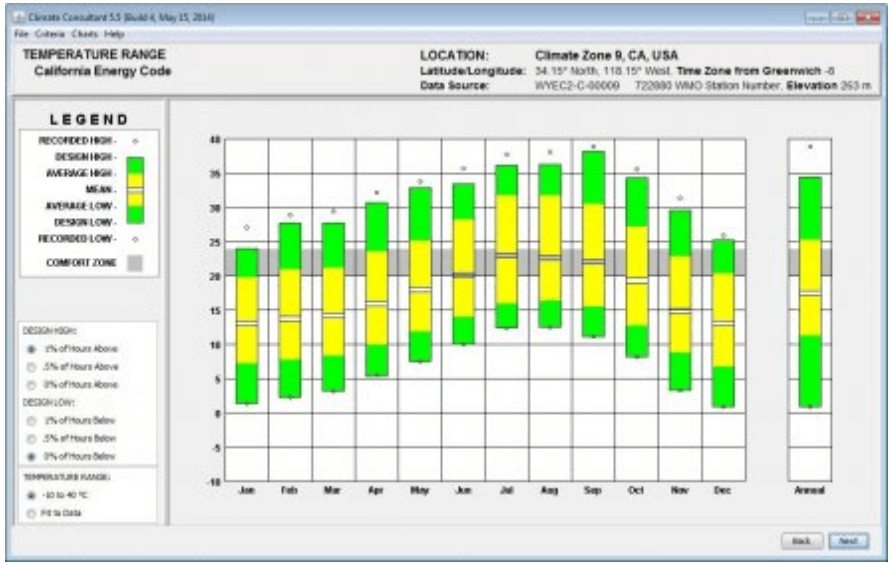
Net Zero Energy Coalition/NESEA case study database

Tour of Zero, US Department of Energy project profiles

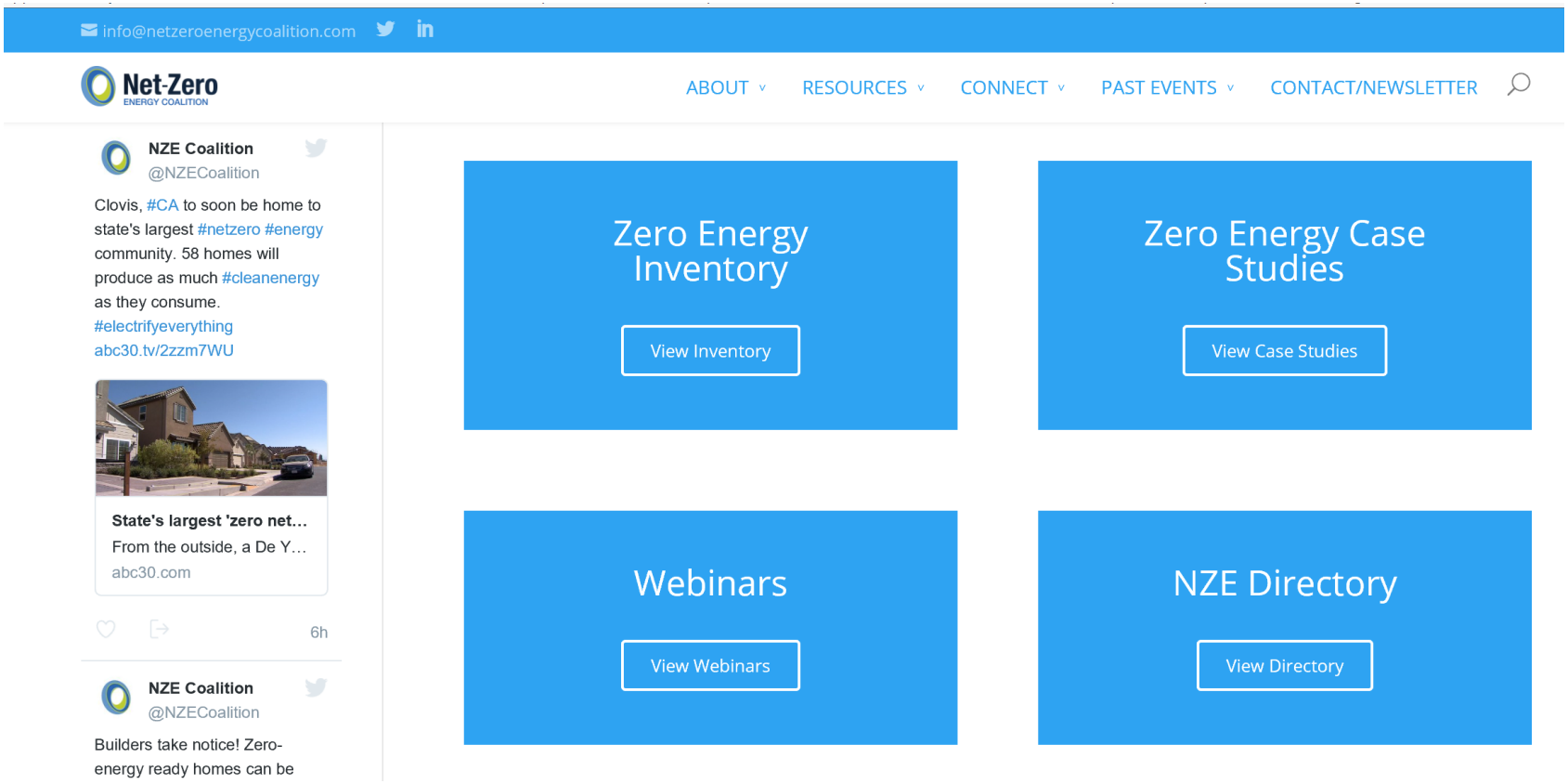
California Association of Building Energy Consultants (CABEC) listing of Certified Energy Analysts

Climate Consultant 6.0





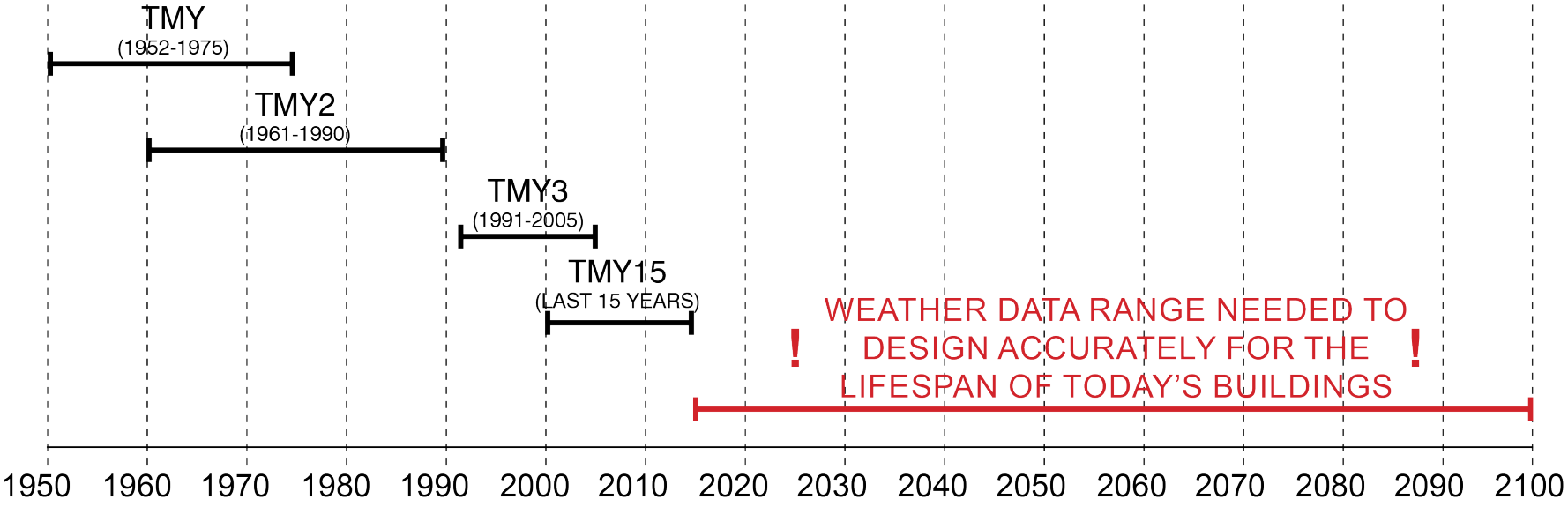
Net Zero Energy Coalition



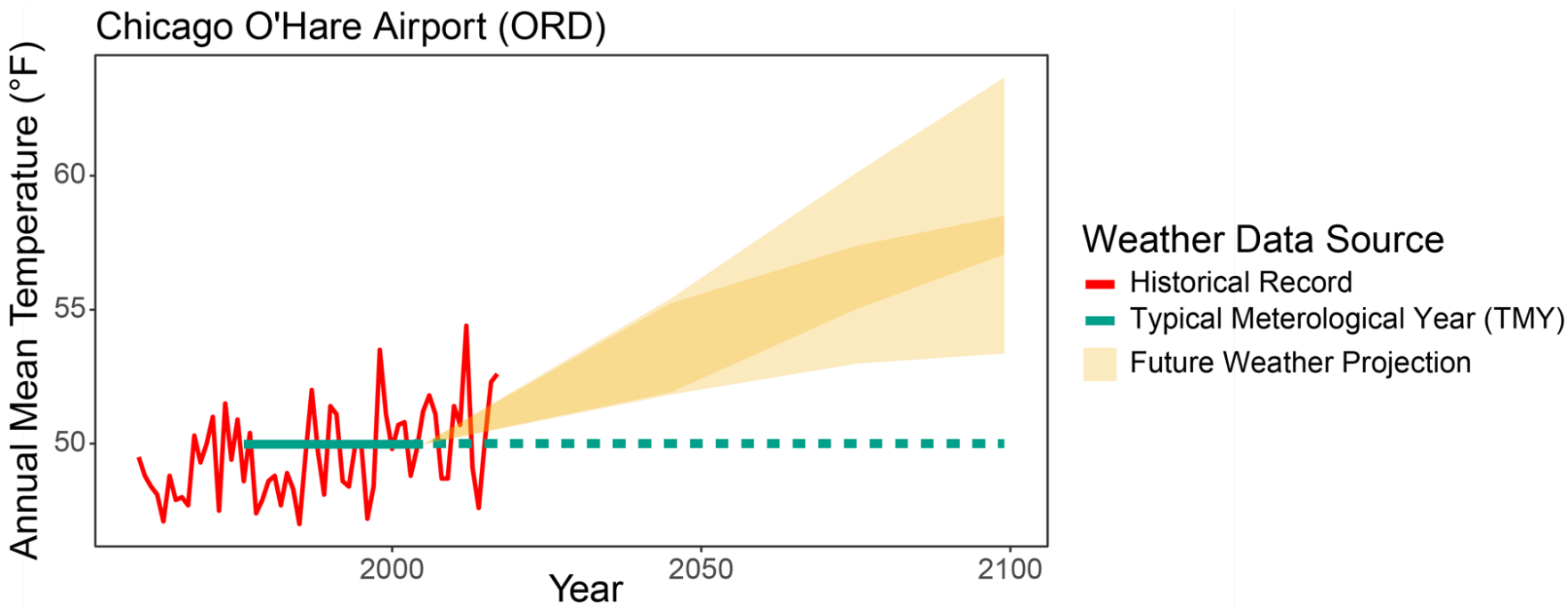
Every day in the USA
150,000 Architects
&
275,000 Civil Engineers
are relying on weather data that is decades outdated.

Source of Employment: National Council of Architectural Registration Boards *and* DesignIntelligence (http://www.di.net/almanac/stats/number-of-licensed-architects/)
US Department of Labor Bureau of Labor Statistics (https://www.bls.gov/oes/current/oes172051.htm)

Standard Practice: Historical Weather



Standard Practice: Historical Weather

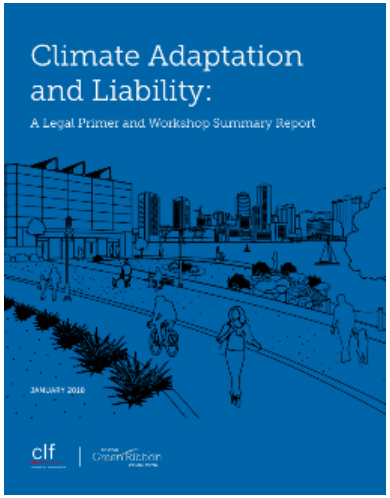


Action has been voluntary. That is changing.

"Failure to act in the face of climate risk could result in legal liability.

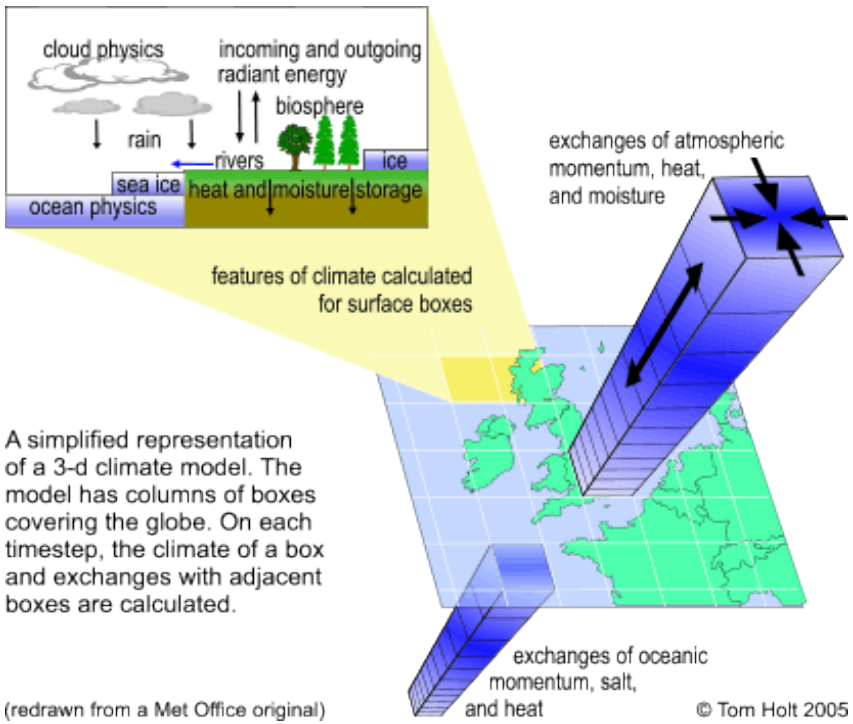
…prevailing practices… [and] explicit standards.... are not the only factors that determine legal responsibility for… failing to act reasonably in the face of ascertainable climate risk.

…obligations can be heightened when considerations of public health or safety are at issue.



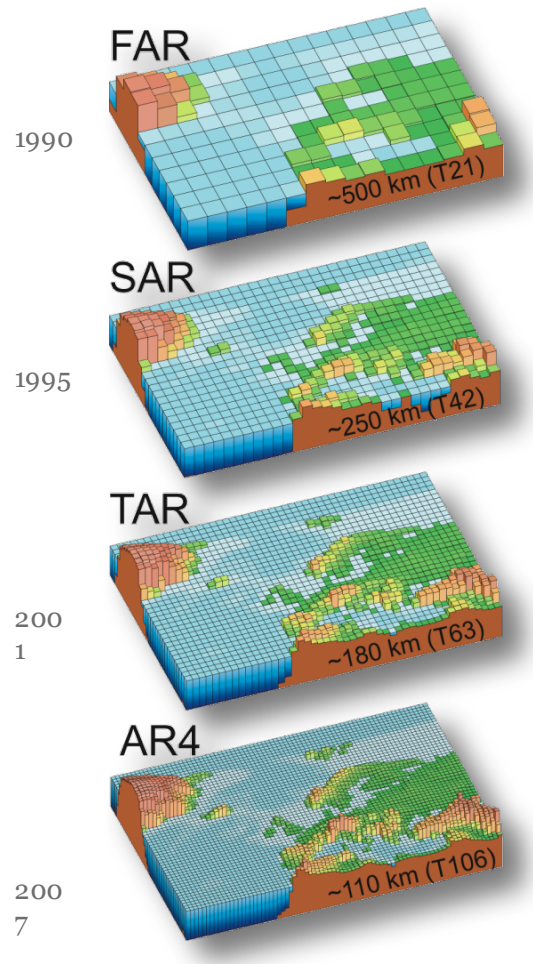
clf | Conservation Law Foundation

General Circulation Model



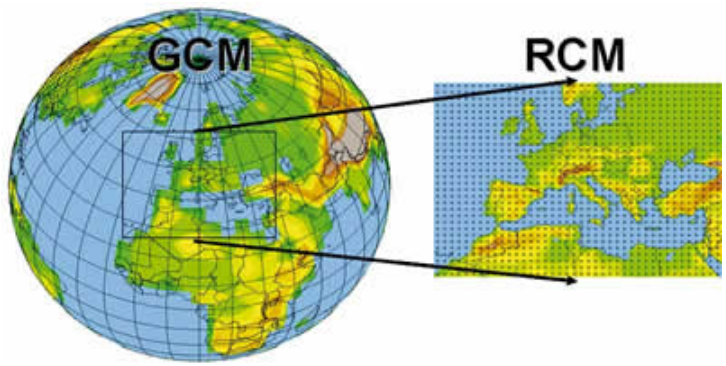
A simplified representation of a 3-d climate model. The model has columns of boxes covering the globe. On each timestep, the climate of a box and exchanges with adjacent boxes are calculated.

(redrawn from a Met Office original)



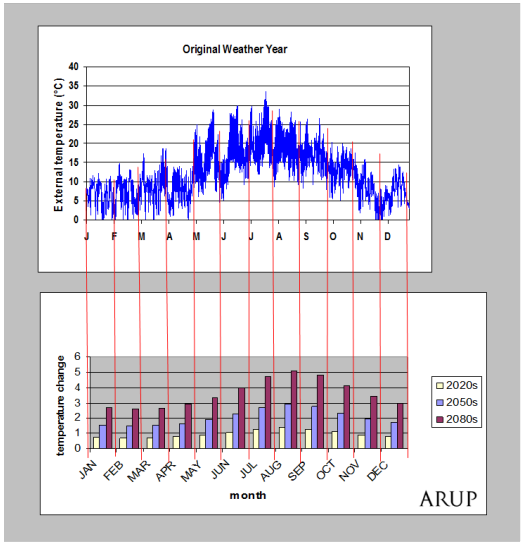
Downscaling GCM to a Regional Climate Model

"MORPH" HISTORICAL DATA FOR FUTURE CONDITIONS

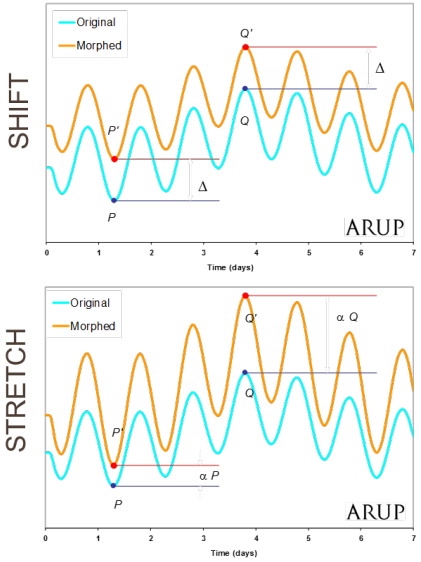


Statistical Downscaling

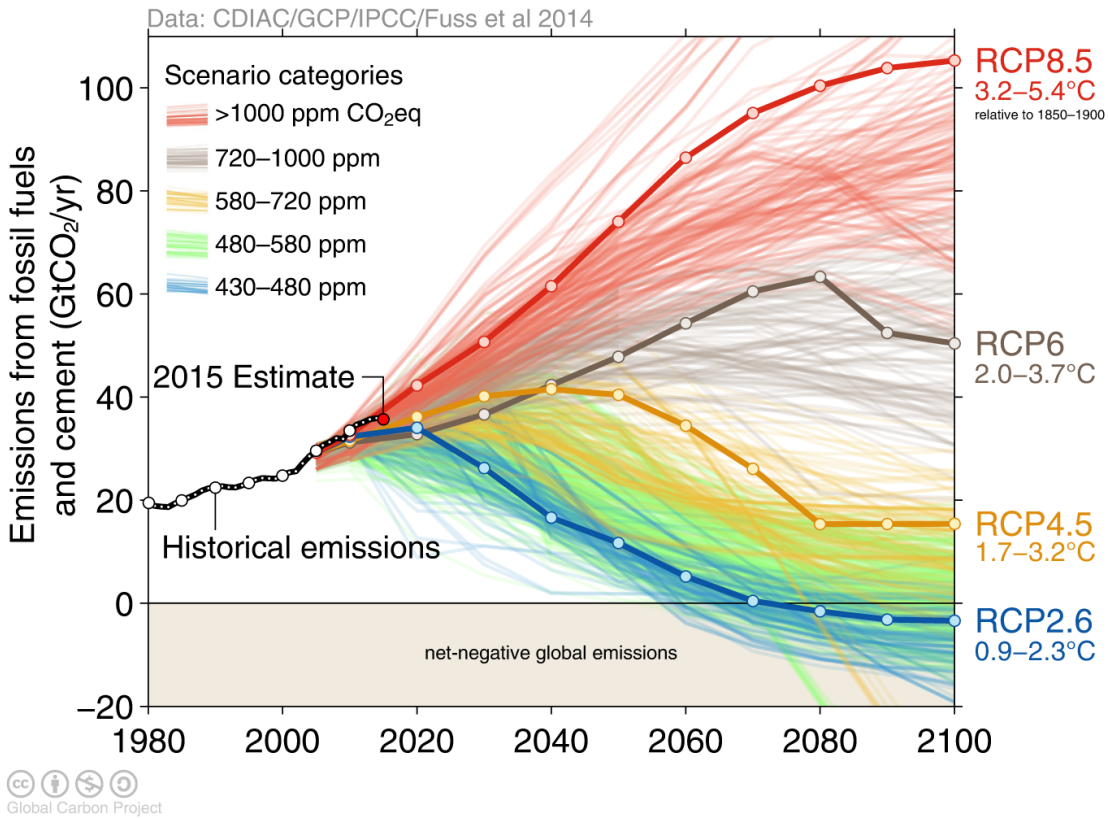
Shift Factors



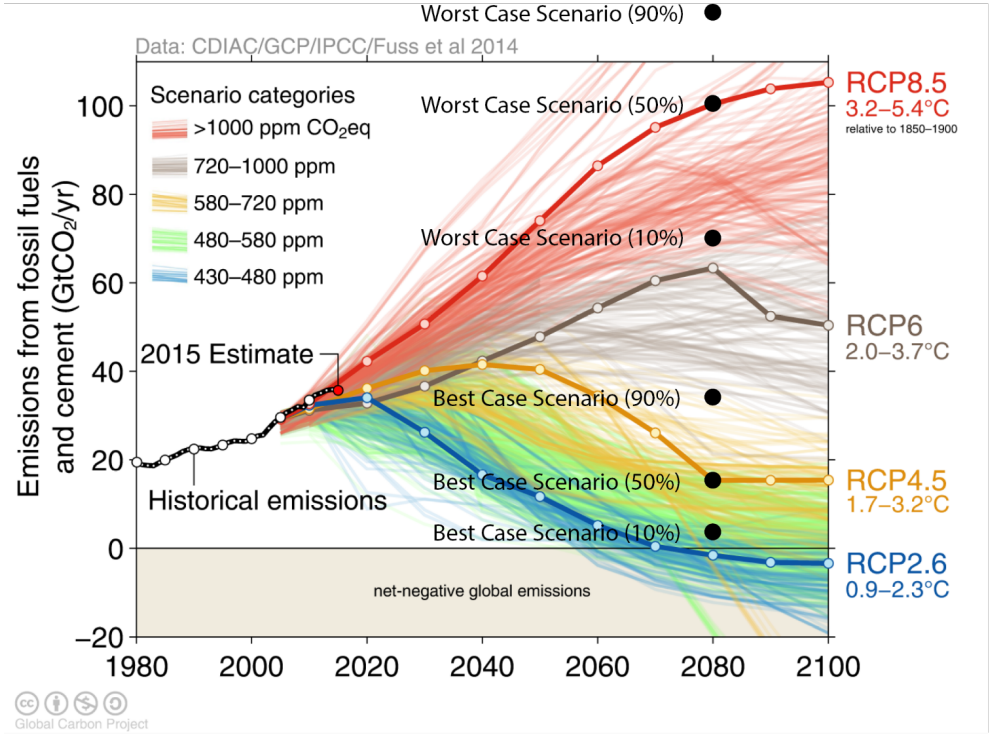
Morphing Strategies



Climate Projection Uncertainty



Weathershift Outputs



Future Weather Data Options:

TMY Format (Typical Year)
AMY Format (Actual Year)
XMY Format (Extremes)

Any location (using WeatherAnalytics)

Emissions Scenarios:
RCP 4.5
RCP 8.5

Future Time Period:
2020s (2011-2030)
2030s (2021-2040)
2040s (2031-2050)
2050s (2041-2060)
2060s (2051-2070)
2070s (2061-2080)
2080s (2071-2090)
2090s (2081-2100)

Percentile:
10th Percentile
50th Percentile
90th Percentile

WeatherShift™ Tool	Application	Status	User
WEATHER FILES (.tmy/.epw)	1) Cooling & Heating System Design 2) T24 Cost Effectiveness 3) ZNE Target Potential 4) Statewide Energy Demand and GHG from Buildings	IN USE	Architects Building Engineers City Planners
RAINFALL INTENSITY, DURATION, FREQUENCY (IDF)	1) Flooding risk from rainfall 2) Drainage design (pipe and pump) for buildings, highways, and city streets	IN USE	Civil Engineers Roadway Engineers Stormwater Managers

WEATHERSHIFT™ v2.0

Country: United_States_of_America

Location: Minneapolis

Emission scenario: RCP 8.5

Warming percentile: 95% (most warming)

View Future Weather

or upload EPW file near Shift location

Buildings and infrastructure built today will experience significantly different weather patterns over the course of the 21st century due to the impact of climate change.

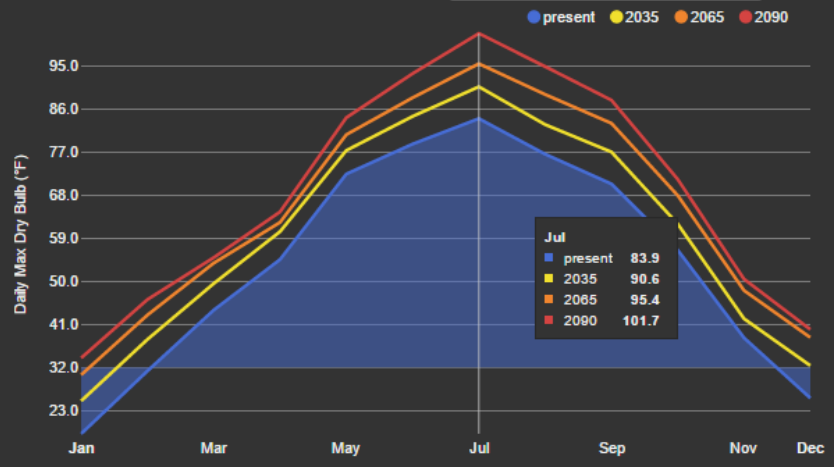
The WeatherShift™ tool uses data from global climate change modeling to produce EPW weather files adjusted for changing climate conditions. (EPW files contain hourly values of key weather variables for a typical year and are intended to be used for simulating building energy requirements.) The projected data can be viewed for three future time periods based on the emission scenario selected to the left.

* This site is preloaded with some EPW files provided to the public domain by the US Department of Energy. For all other shift locations -- *indicated by an* * -- an EPW file must be uploaded as the basis for shifting.

Projected changes in typical weather conditions can be reviewed month-by-month for a number of weather variables.

Average Monthly Data

Daily Max Dry Bulb



Dan Brunn, AIA
Founding Principal, Dan Brunn Architecture

Designing for the Environment

- How do we get there?
- What are specific design strategies to ease achieving net zero? (Designing for energy conservation versus energy production for consumption)
- How to best analyze and understanding context and how to optimize passive design responses to conserve energy?
- Are there successful replicable residential precedents in Los Angeles area?
- Are there specific design responses for microclimates within L.A. Basin area? (and predicted changes of these microclimates)

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Designing for the Environment

- How do we get there?

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Designing for the Environment

- How do we get there?

1. **Target** setting
2. **Contract** to achieve the target
3. **Design** to the Target
4. **Build** to the Design
5. **Operate** to the Design
6. **Occupy** to the Design

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Designing for the Environment

HVAC

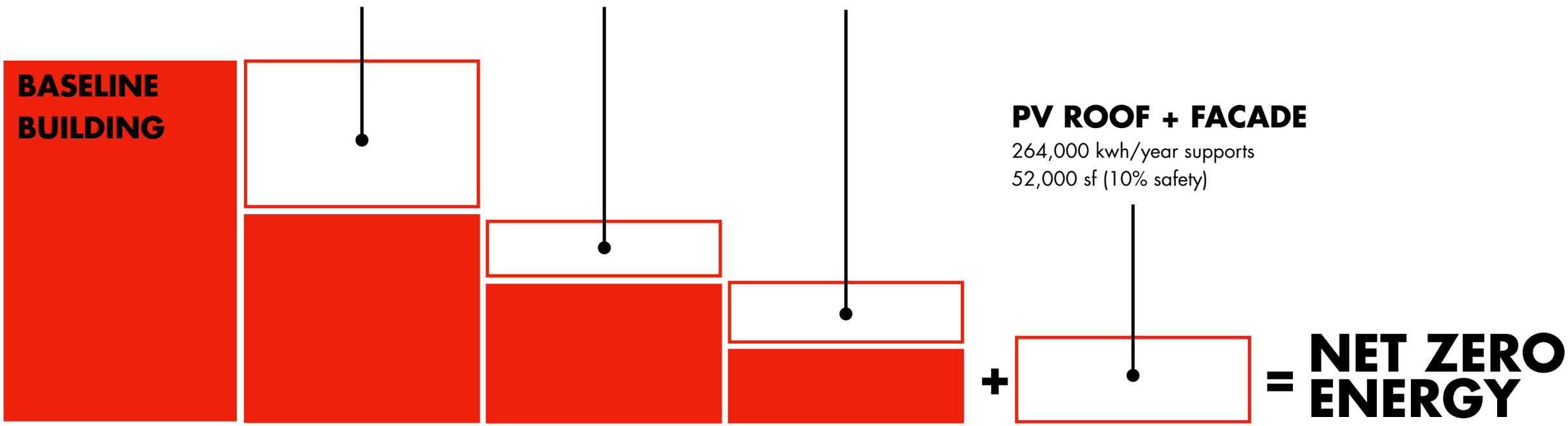
+ high performance glass
+ high performance walls and envelope
+ 65% effective heat recovery
+ ground source heat pumps
+ on demand controlled ventilation
+ radiant slab heating / cooling

LIGHTING

+ maximize daylighting
+ daylight dimming
- lighting power

TENANT

+ stair design to discourage elevator use
+ cooling set point w/ radiant
+ daytime office cleaning
+ 80% laptop / 20% desktop
- phantom loads
- heating set point w/ radiant



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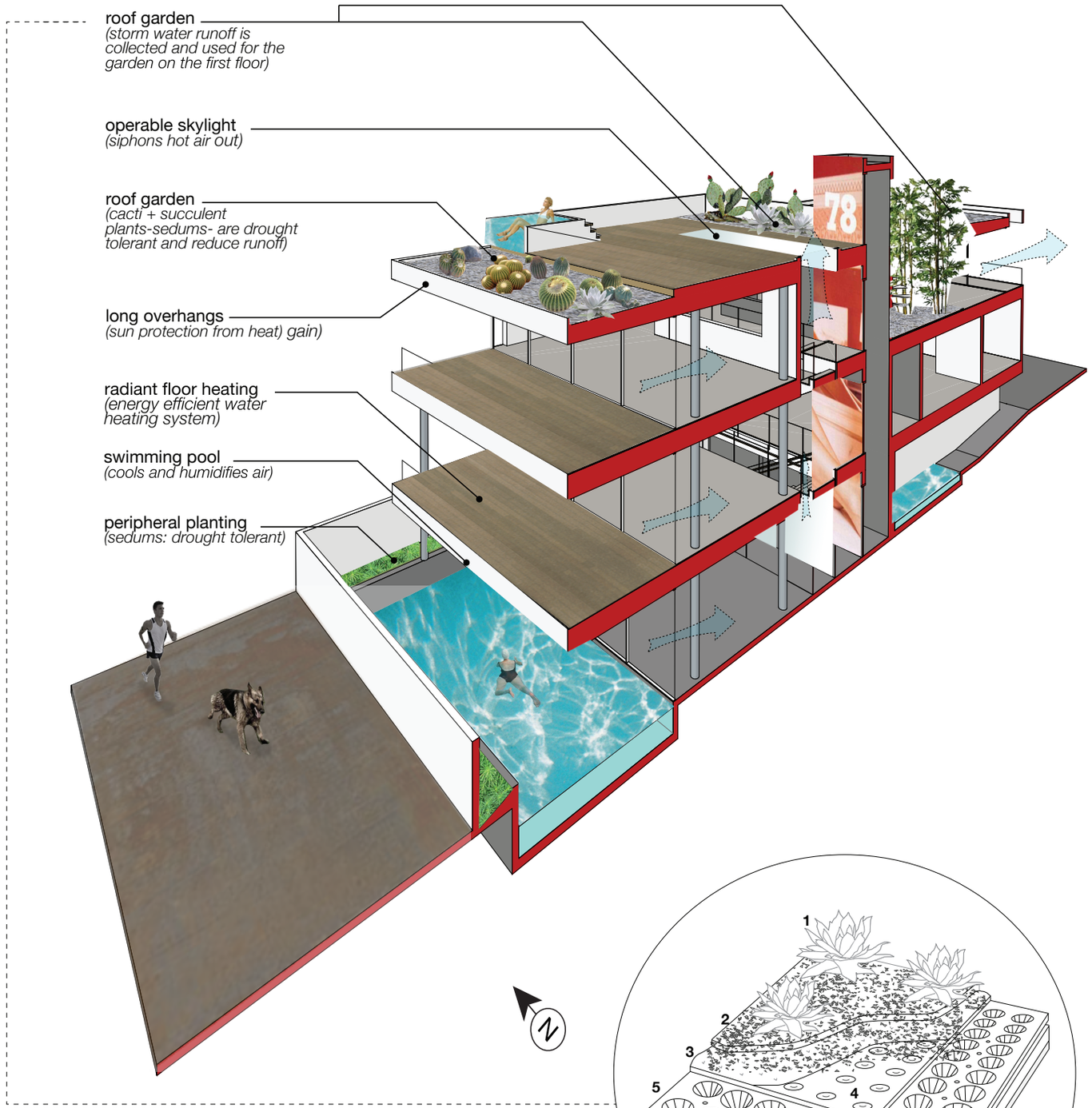
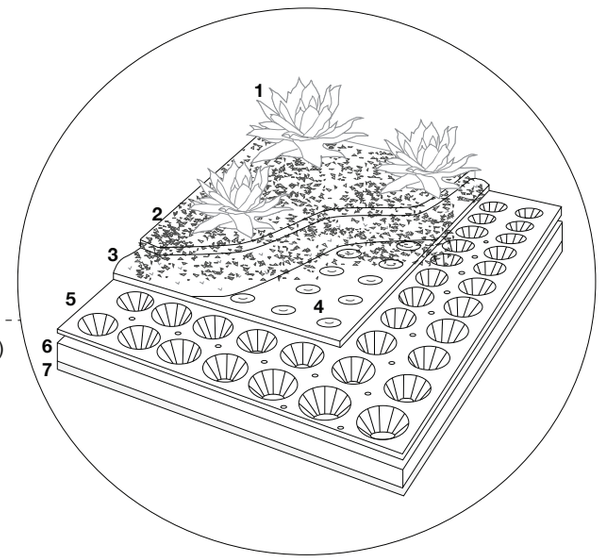
PASSIVE SOLUTIONS

- sun shading
- heat exhaust heat
- natural daylighting
- fresh air intake
- stormwater capture





1. Dudleyya Brittoni (native sedum plant)
2. gravel cover
3. substrate, growing media
4. bio-Blanket
5. water retention and drainage carrier
6. protection and storage layer
7. roof deck, insulation, waterproofing
8. drainage pipe

dba

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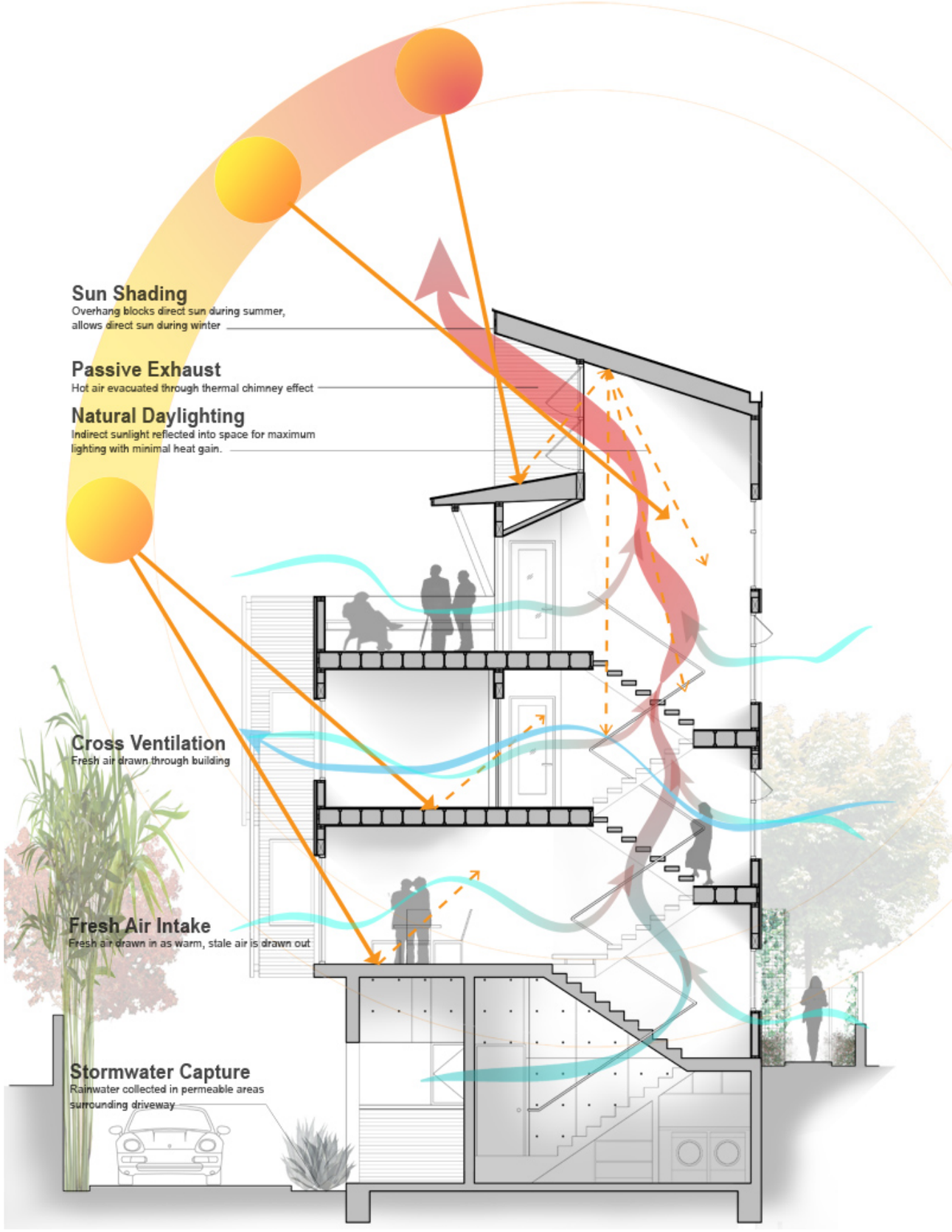
WORKPLAYS **studio*architecture**



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Designing for the Environment

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Facade

PASSIVE SOLUTIONS

+ reduced glass at southern exposure
+ thermal
+ natural daylighting
+ fresh air intake
+ stormwater capture

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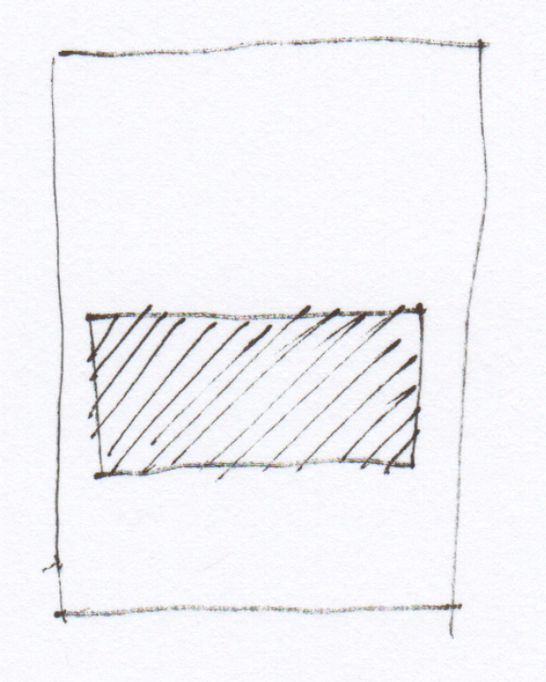
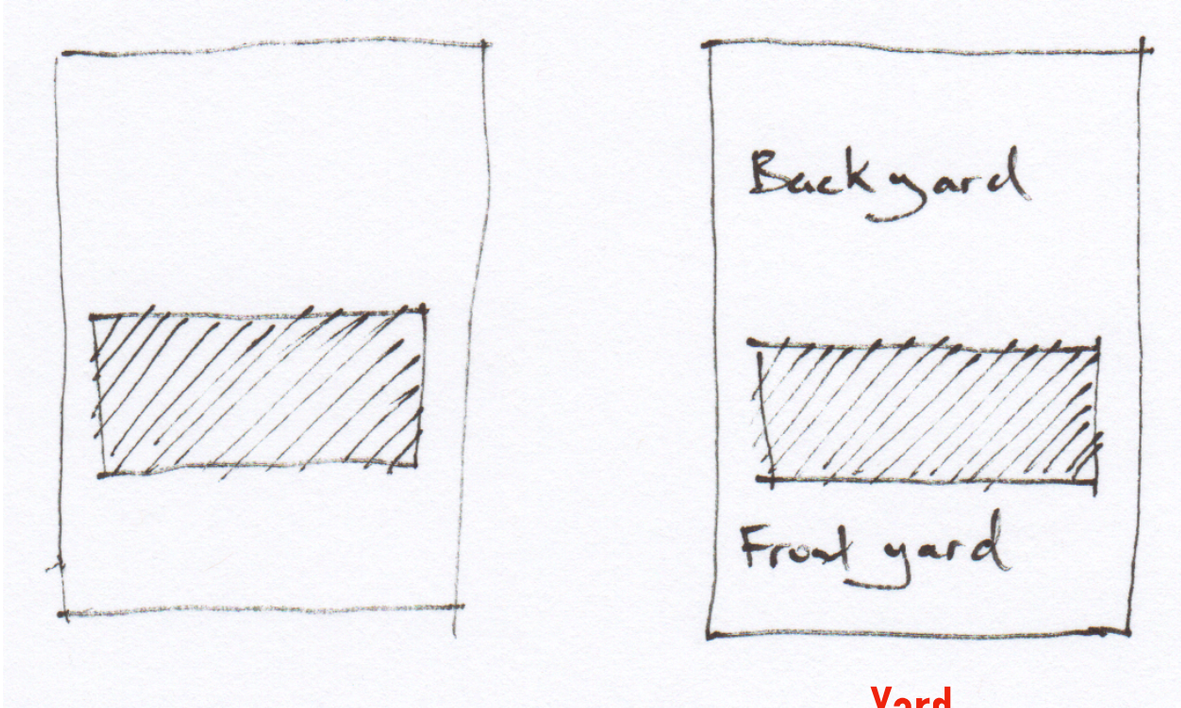
BRIDGE HOUSE

Dan Brunn Architecture
Bone Structure & MODAA Construction

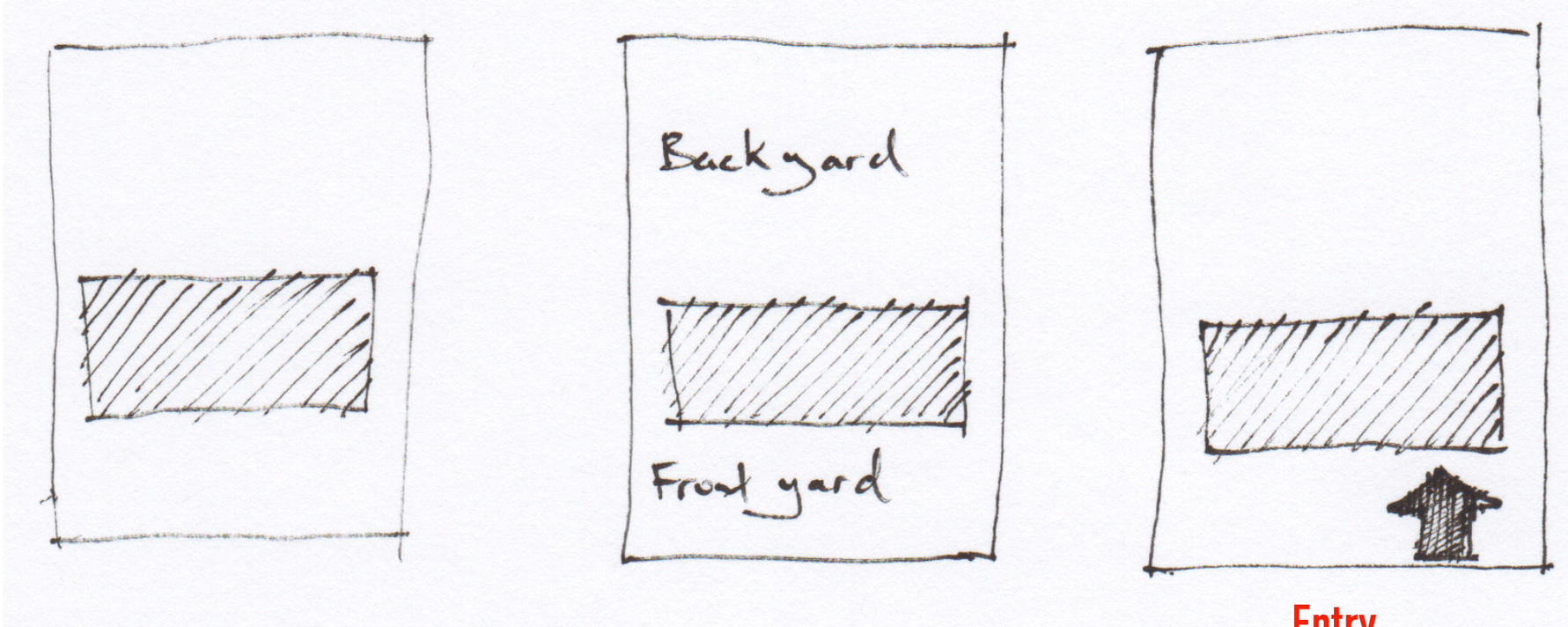
in partnership with dwell



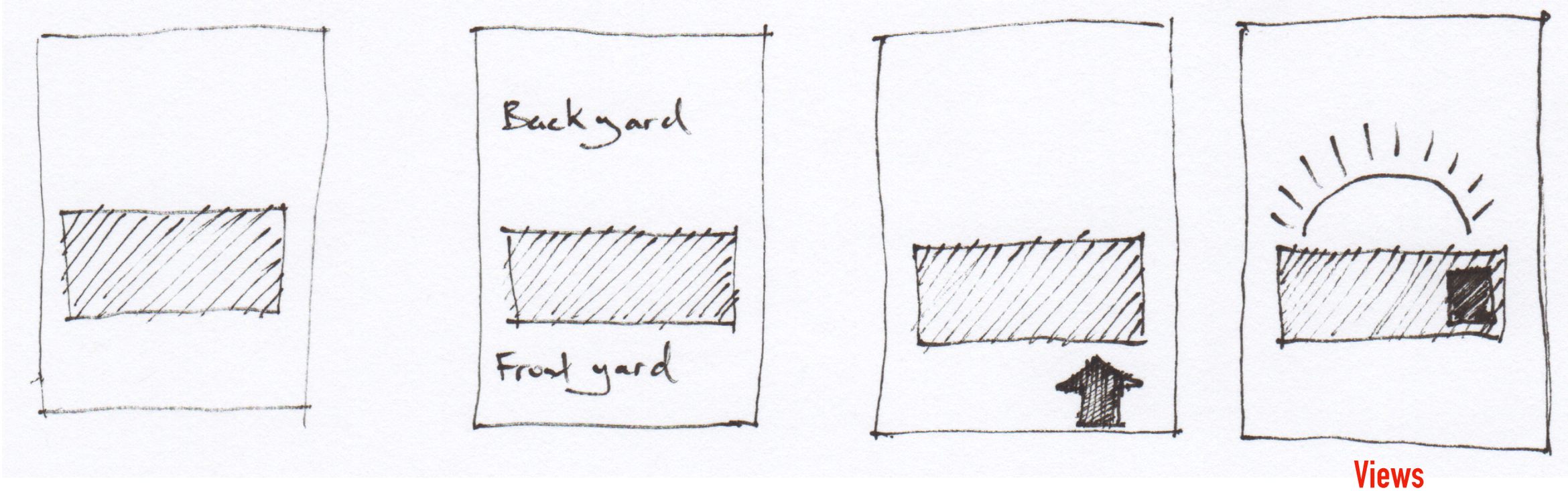
Typical Suburban Home



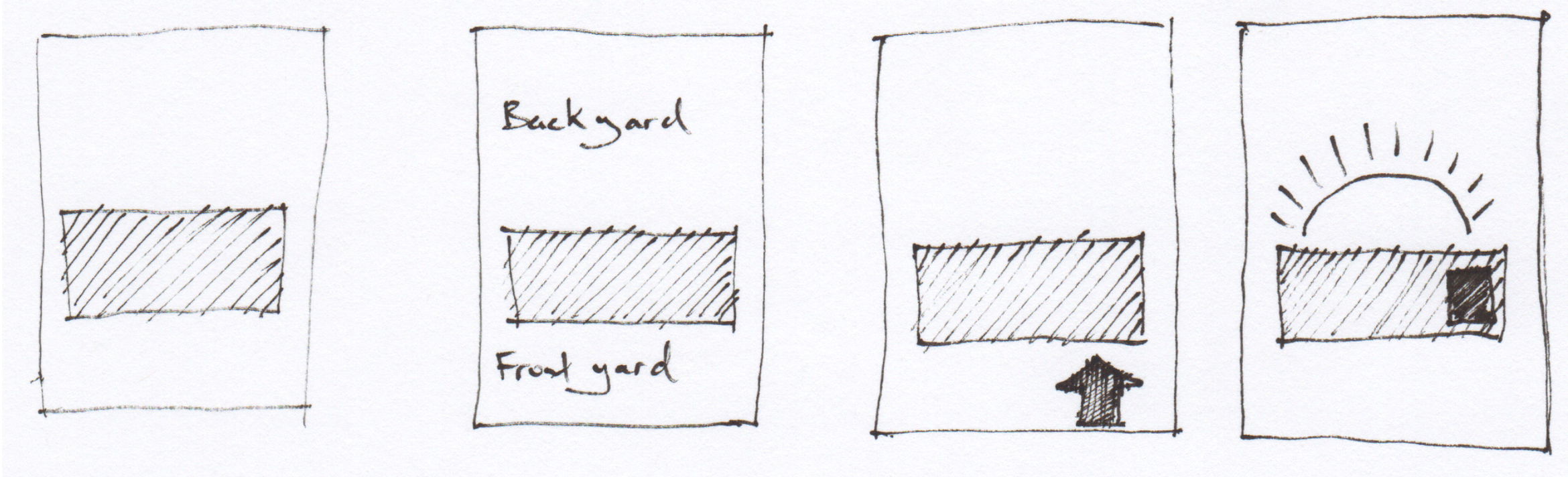
Yard



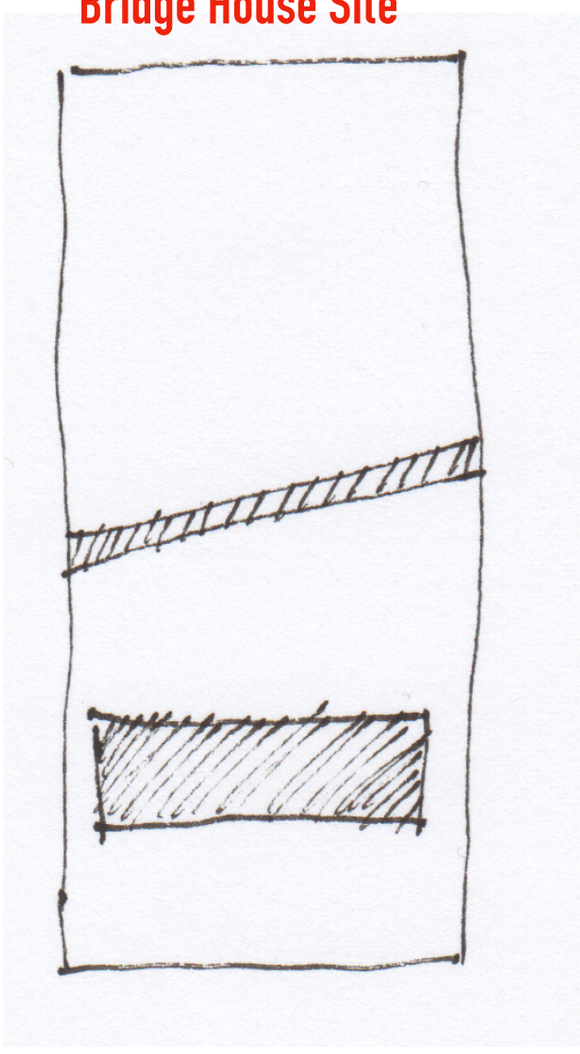
Entry

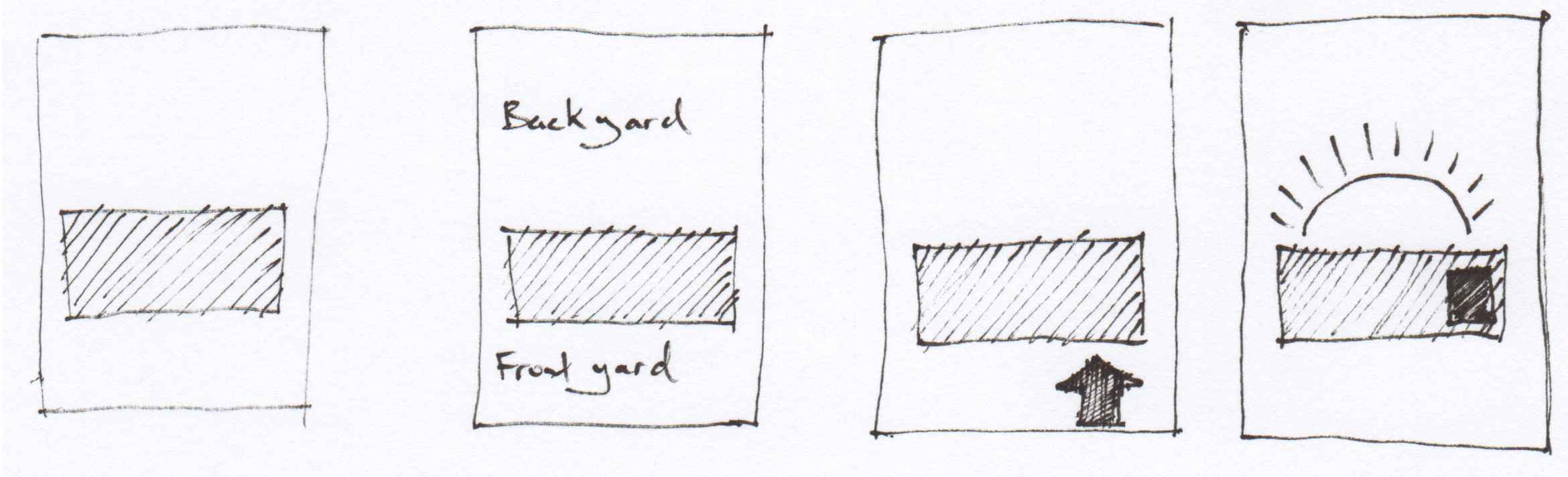


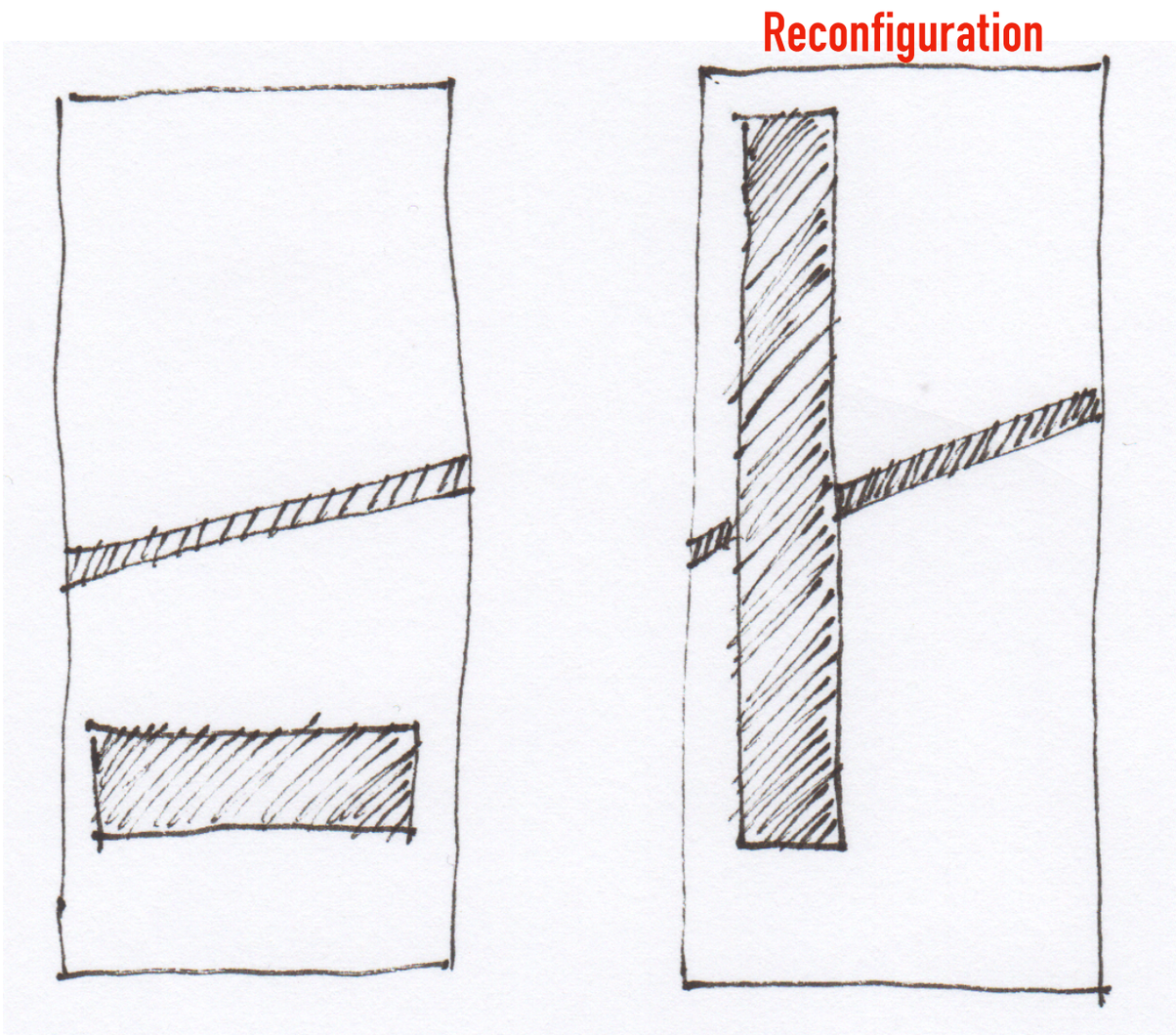
Views

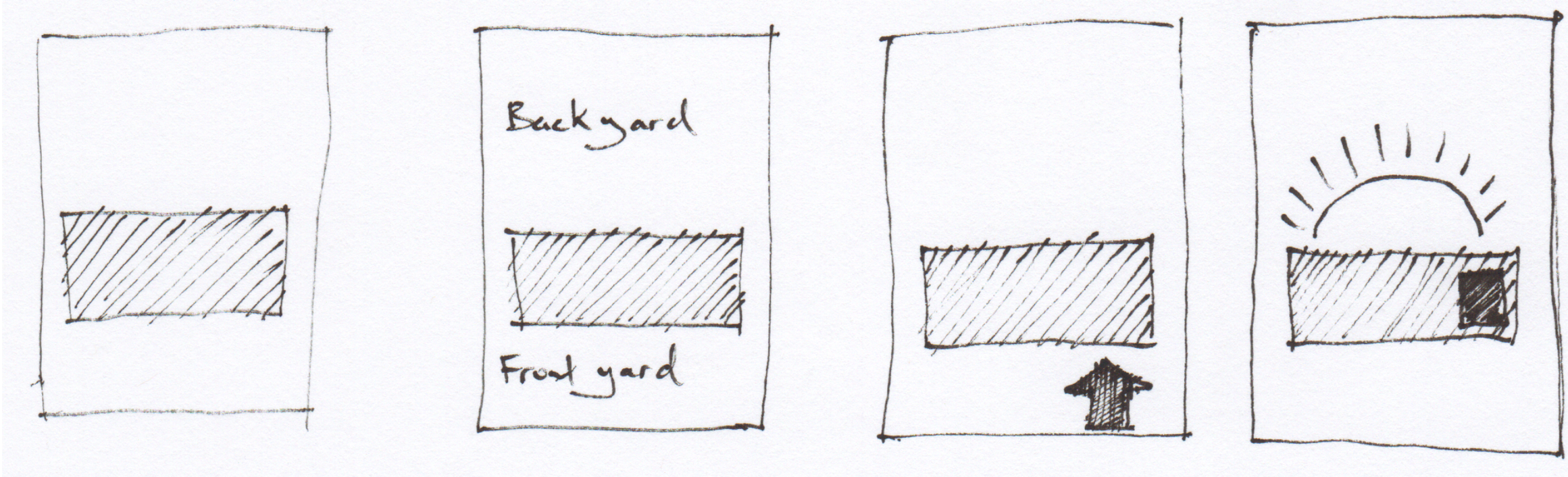


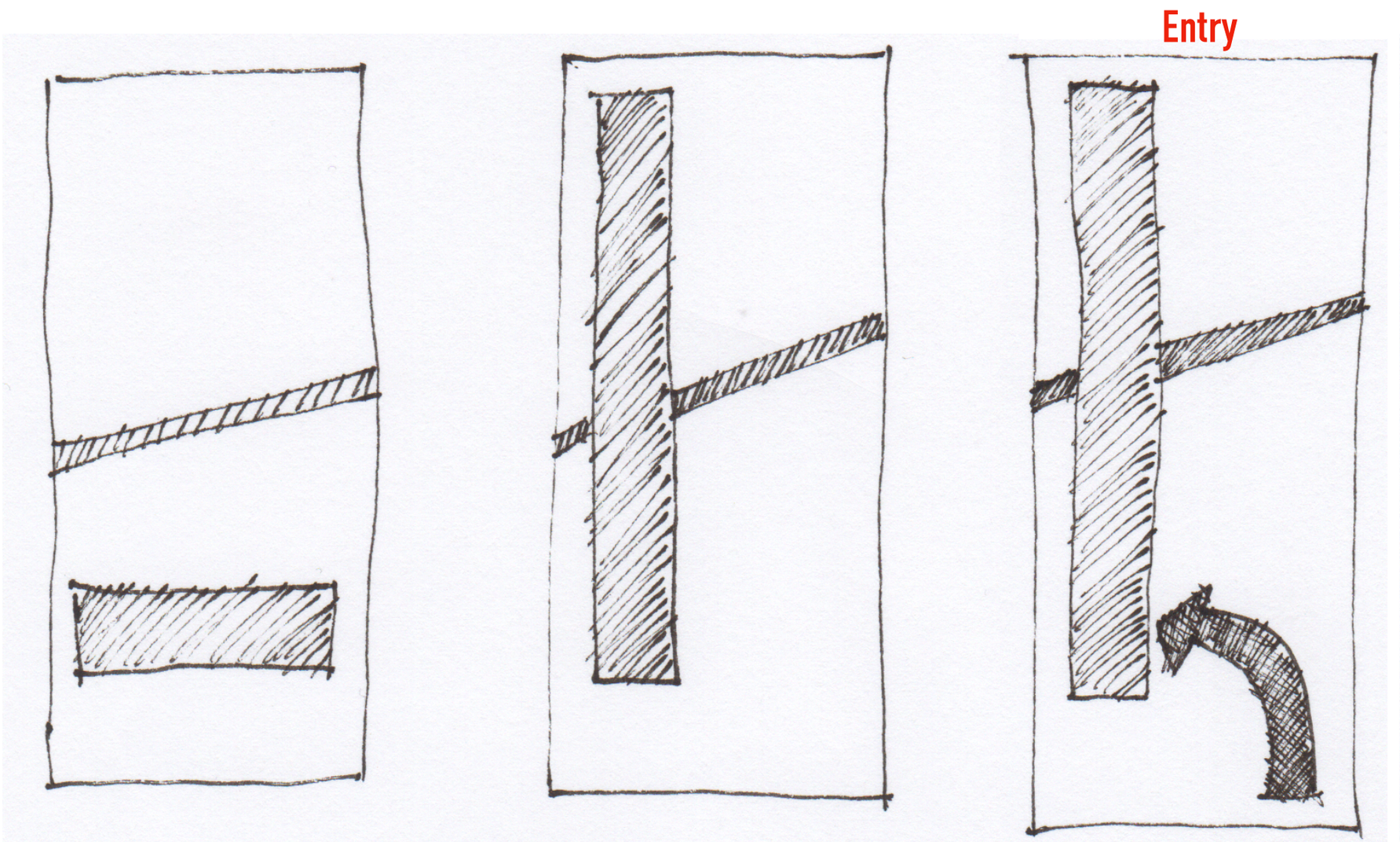
Bridge House Site




Backyard
Front yard


Reconfiguration


Backyard
Front yard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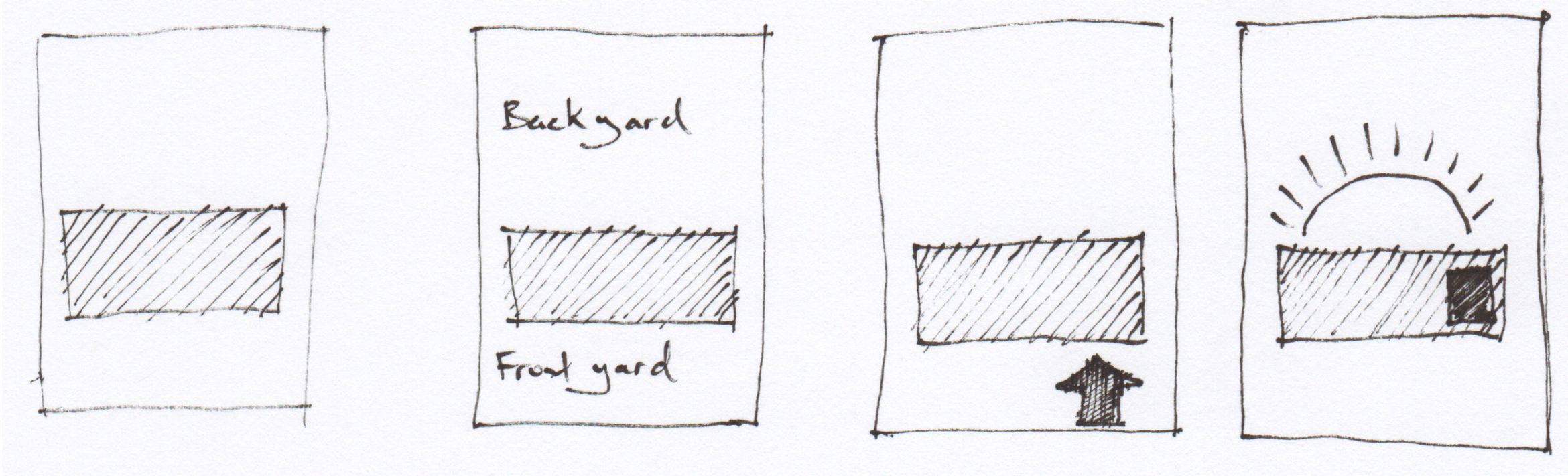
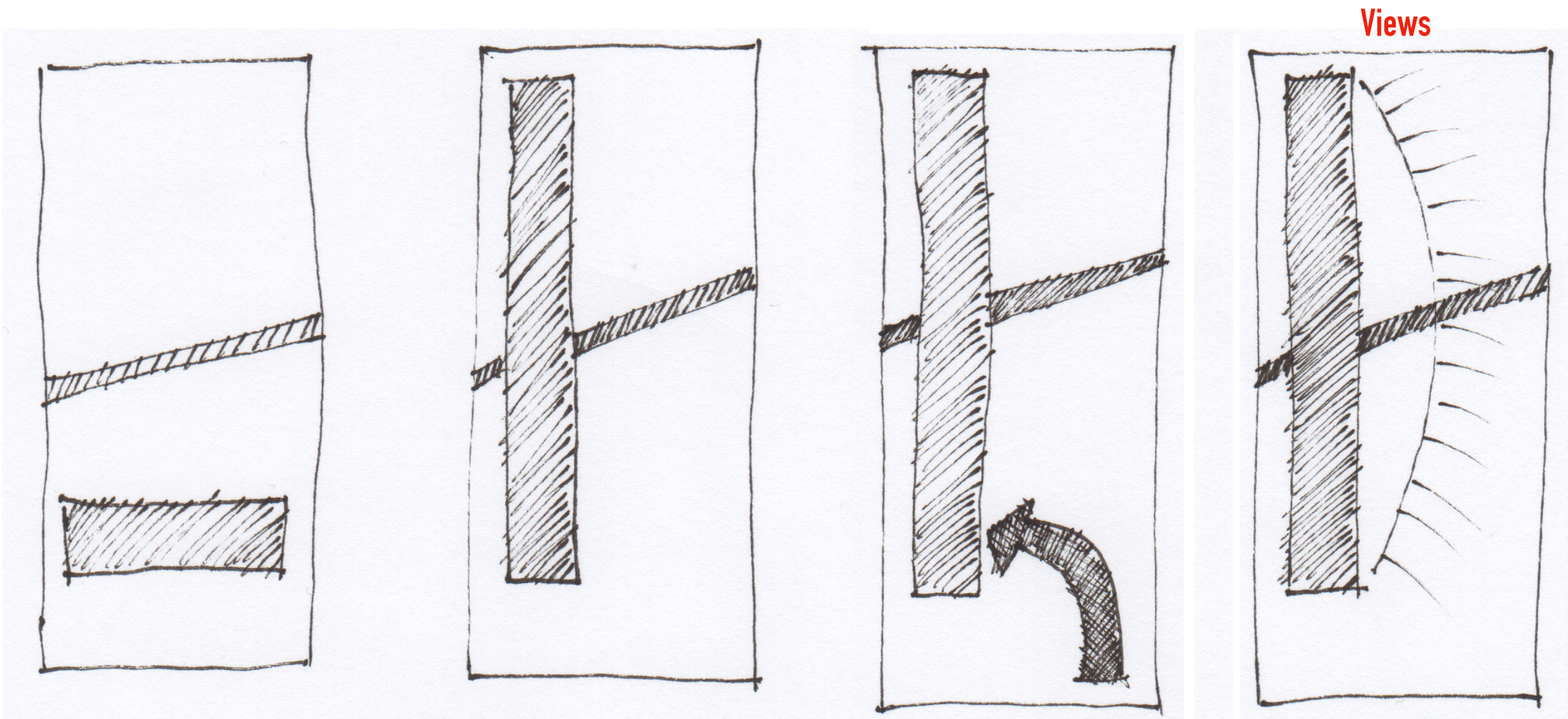
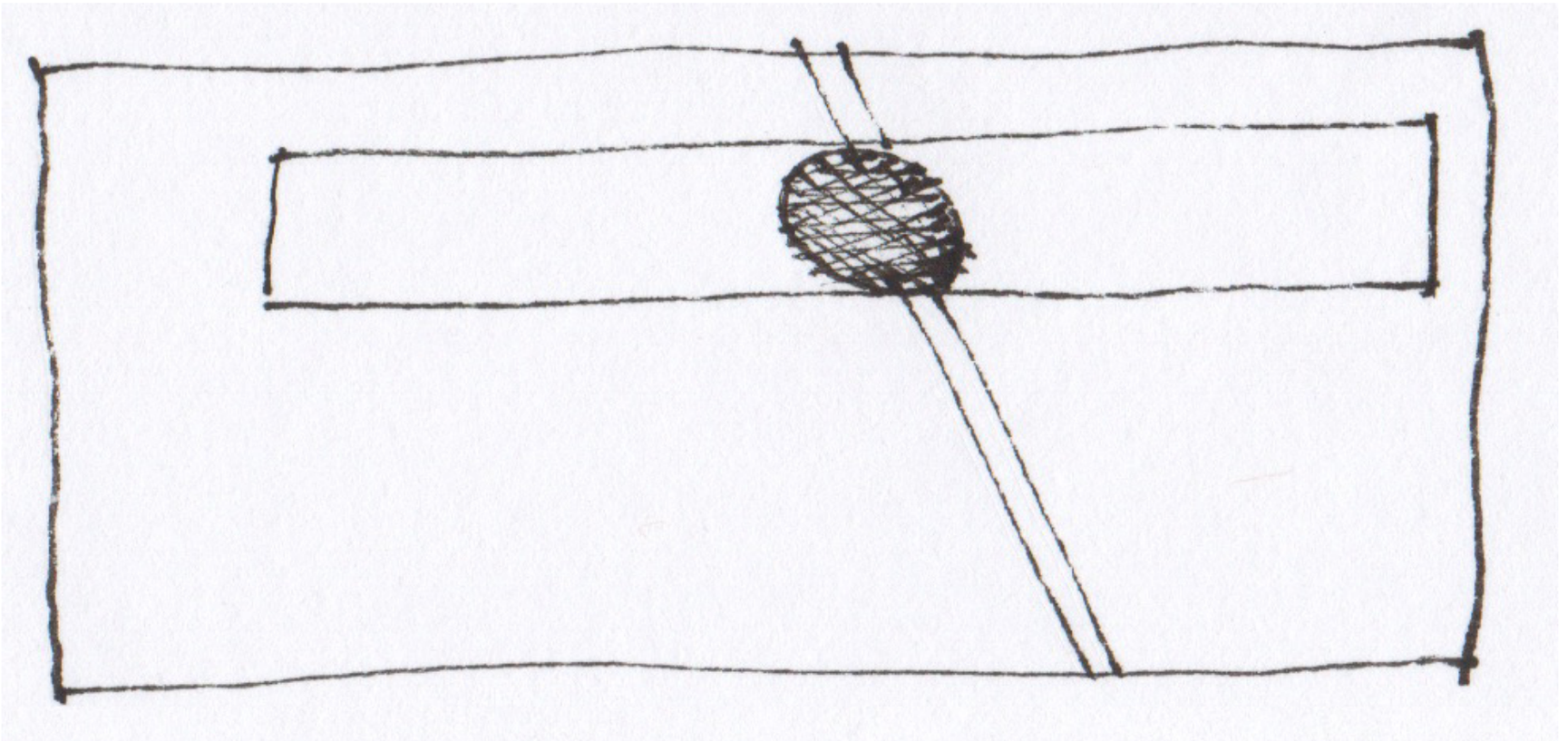
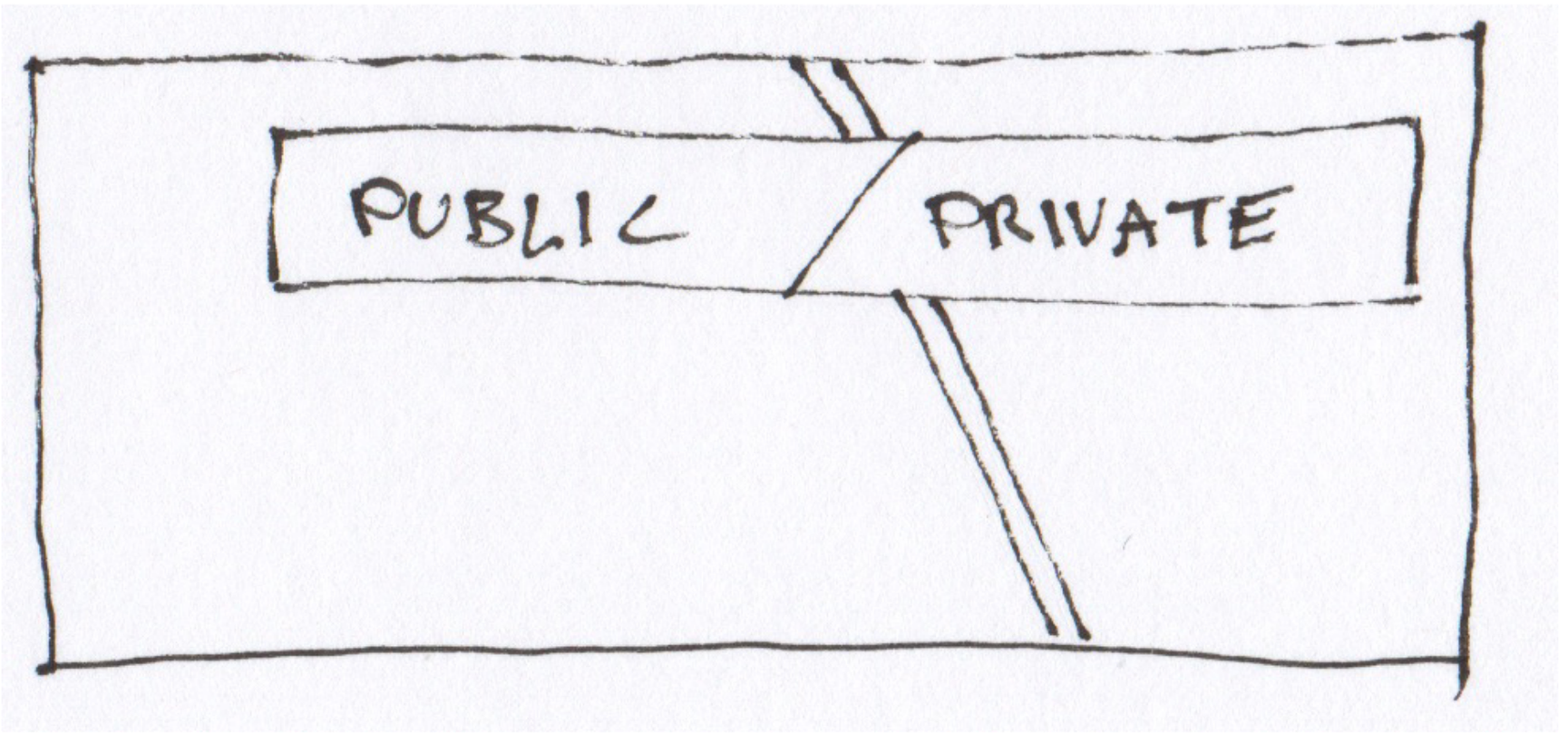
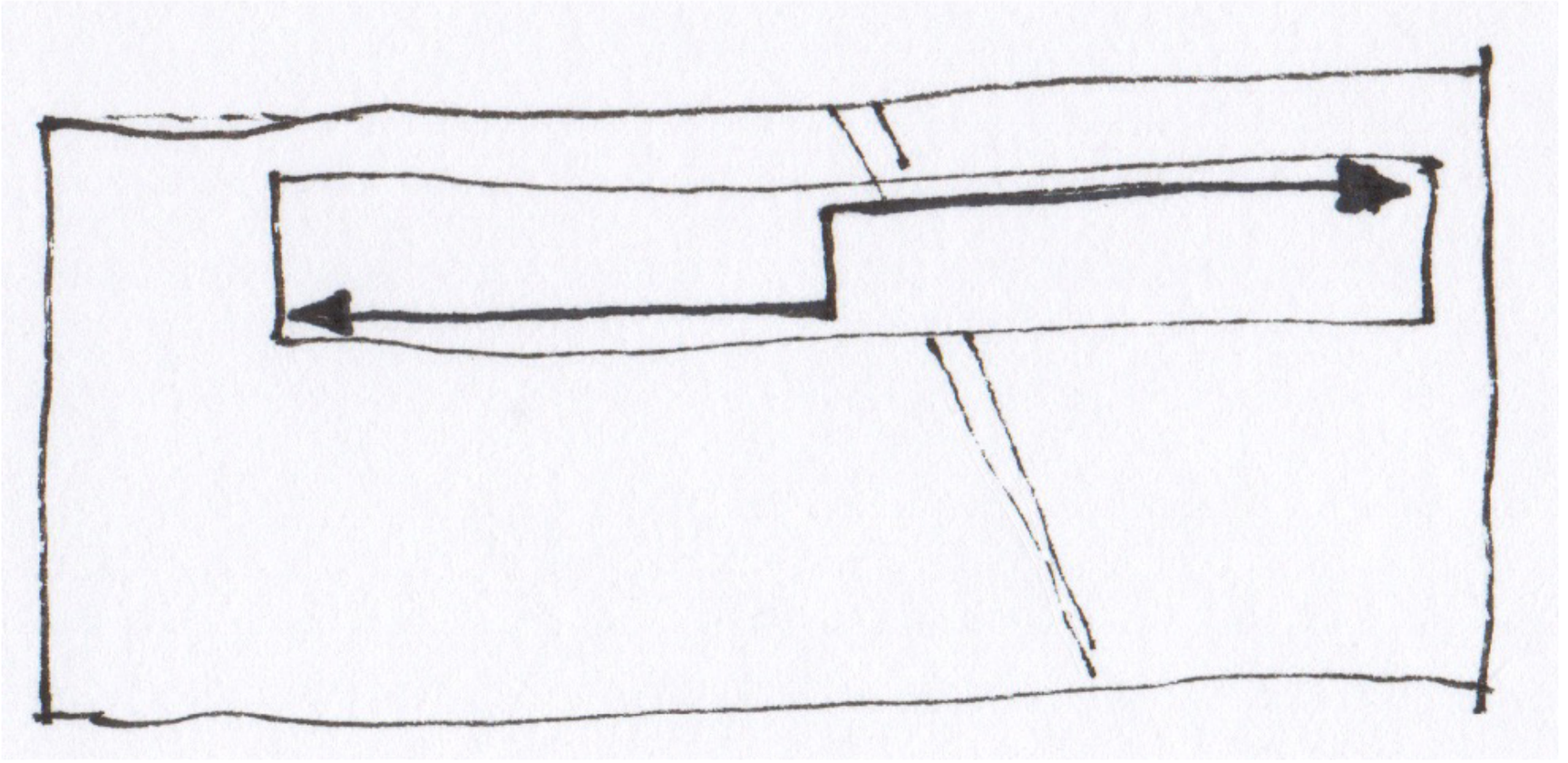
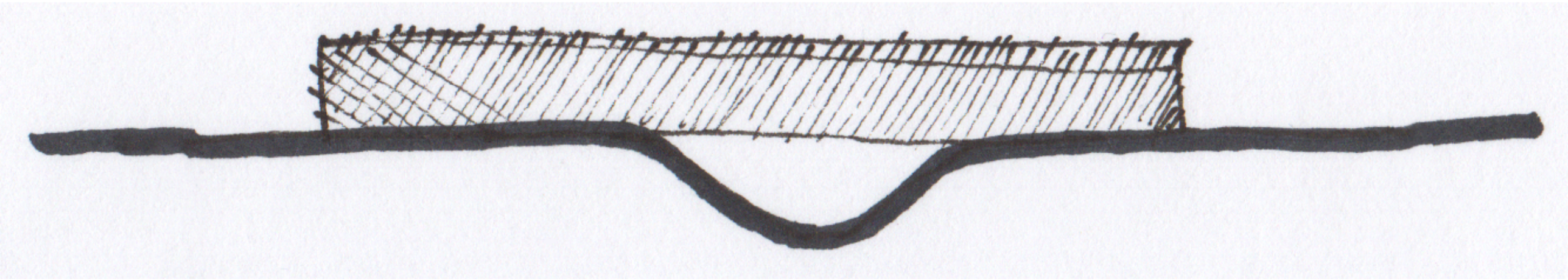

Backyard
Front yard


Views




PUBLIC
PRIVATE





BRIDGE HOUSE

Dan Brunn Architecture
Bone Structure & MODAA Construction

in partnership with dwell

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Moe Fakih, LEED AP (O+M, RATER, QAD), CCP, GBP, BPI, AT TECH, WELL AP

Vice President, VCA Green

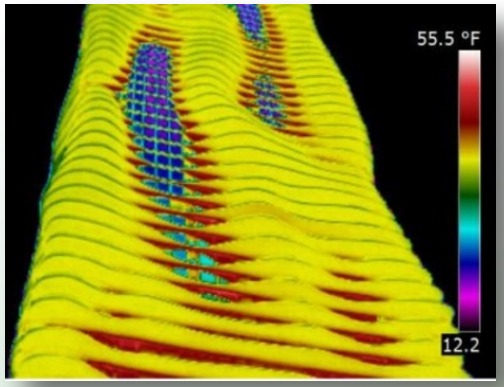
VCA Green

AIA ZNE Seminar: Tools & Implementation

Presented by:
Moe Fakih, LEED AP, CCP, BPI, WELL AP
Principal, VCA Green

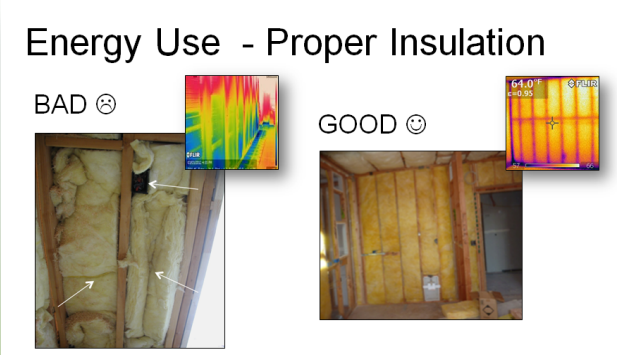
System Selection

- Envelope
- Mechanical
- Lighting
- Plumbing
- Plug loads (not regulated)
- Renewable Energy



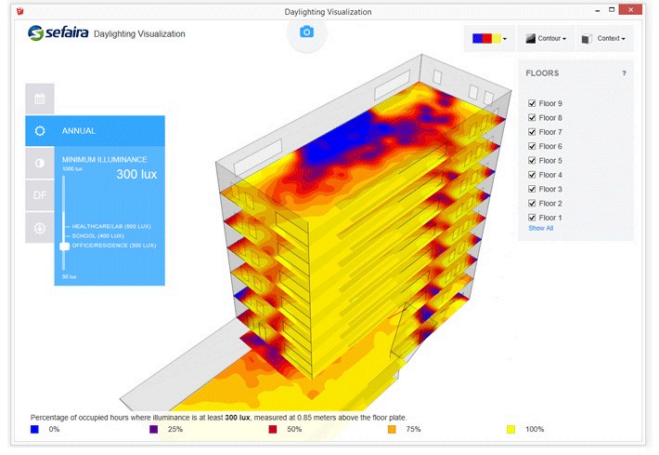
Residential Design Considerations

- Roof/Site Orientation for Solar
- Larger plenum, supply/return to accommodate new HVAC requirements
- Credits for controlled LED and battery storage
- Return on investment vs. first costs
- Energy model in SD/DD phases
- HERS Testing for Insulation



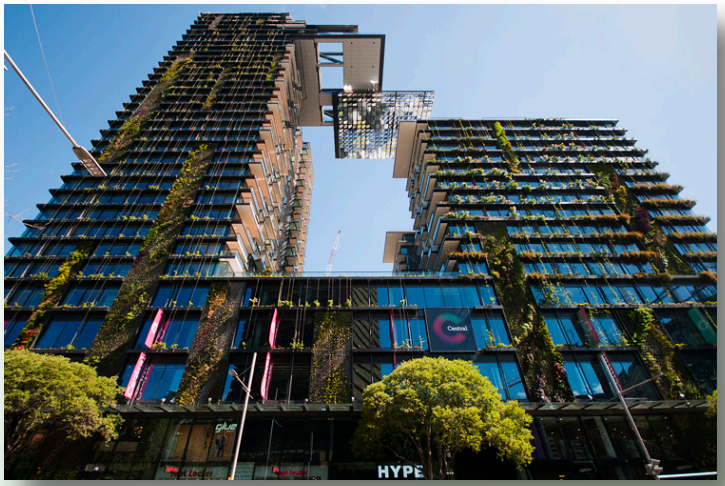
Energy Modeling Tools

- Code Compliant Tools (Time Dependent Value - TDV)
  - EnergyPro
  - CBECC-COMM
  - IES
- Helpful Tools (Non-compliant)
  - Sefaira
  - Revit Energy Plugin



Impacts to Services

- Energy expertise – Key team member
  - Certified Energy Analyst
  - Engage early/Closer Coordination – Entitlement or SD/DD
  - Consider operational performance
- Align Details & Specifications



Prepared to Design for ZNE?





- **John Zinner, LEED Fellow** – Principal & Founder, Zinner Consultants
- **Lisa Matthissen, FAIA** – National Sustainability Design Director, HGA and Chair, AIA|CC Committee On The Environment (COTE)
- **Dan Brunn, AIA** – Founding Principal, Dan Brunn Architecture
- **Moe Fakih, LEED AP (O+M, RATER, QAD), CCP, GBP, BPI, AT TECH, WELL AP** – Vice President, VCA Green

with moderator **Ric. Abramson, FAIA** – Founder & Firm Principal, WORKPLAYS studio*architecture

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AIA
Los Angeles