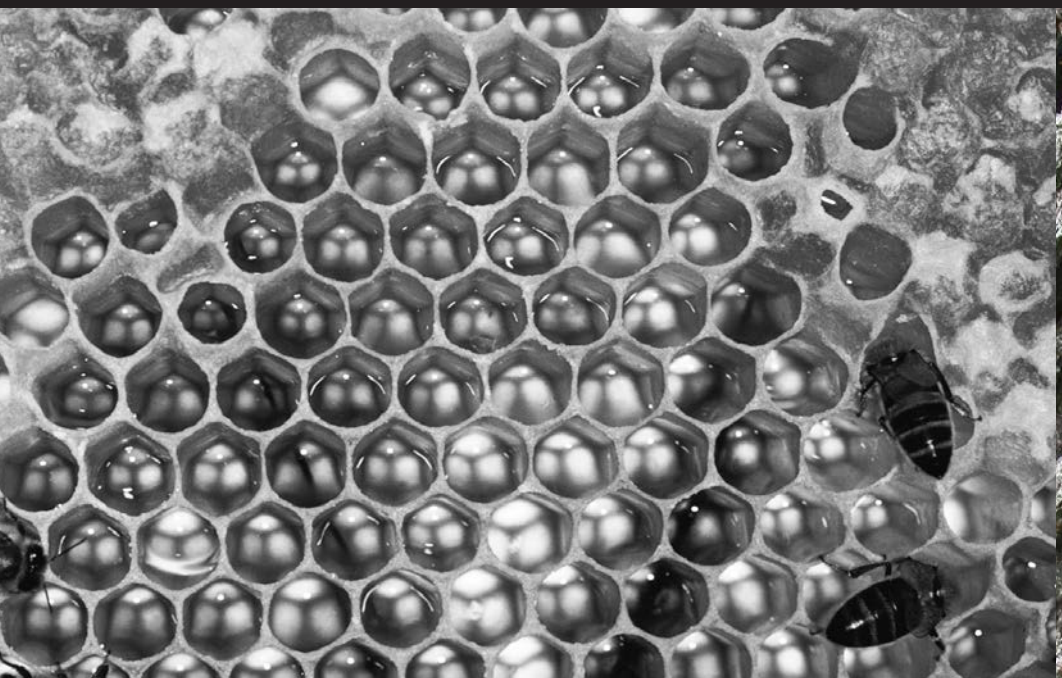


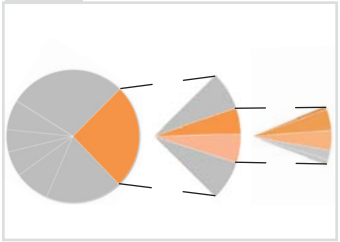

AN ARCHITECTURE OF LEAST RESISTANCE:
Building Performance Analytics in High Performance Building Design

Amanda R. Stacy
Master of Architecture / Master of Science in Sustainable Design / The Catholic University of America

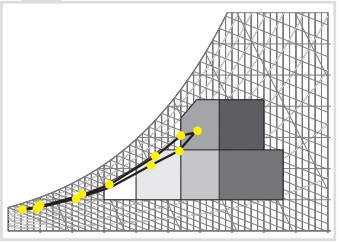



1 AREA OF INTEREST

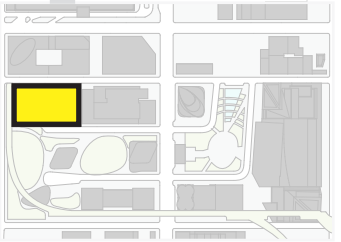
2 IDENTIFY PROBLEM



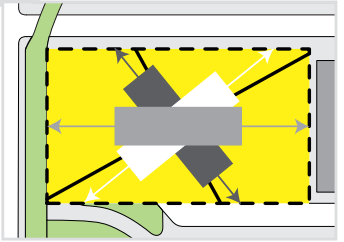
3 CLIMATE ANALYSIS



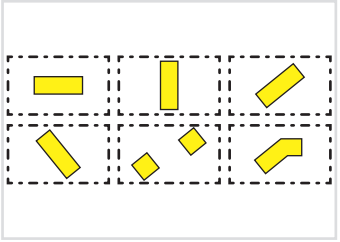
4 SITE SELECTION



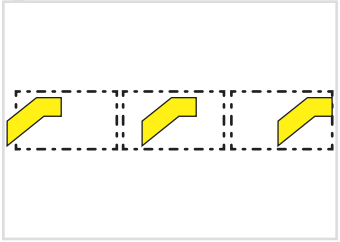
5 ORIENTATION ANALYSIS



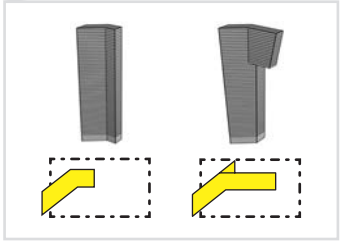
6 MASS COMPARISON



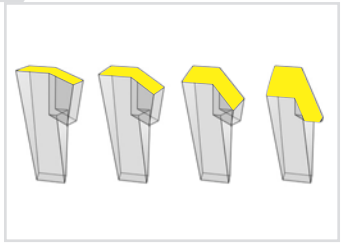
7 MASS LOCATION



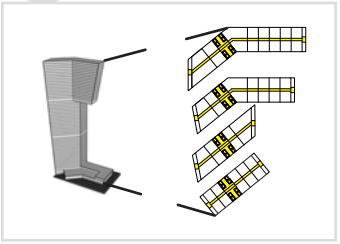
8 MASS OPTIMIZATION



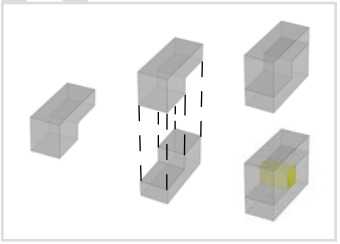
9 ROOF OPTIMIZATION



10 ARCHITECTURAL IMPLICATIONS



11 UNIT ANALYSIS



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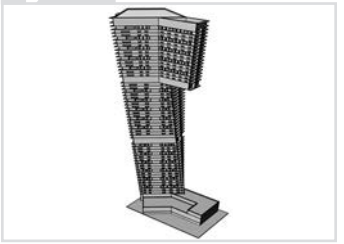
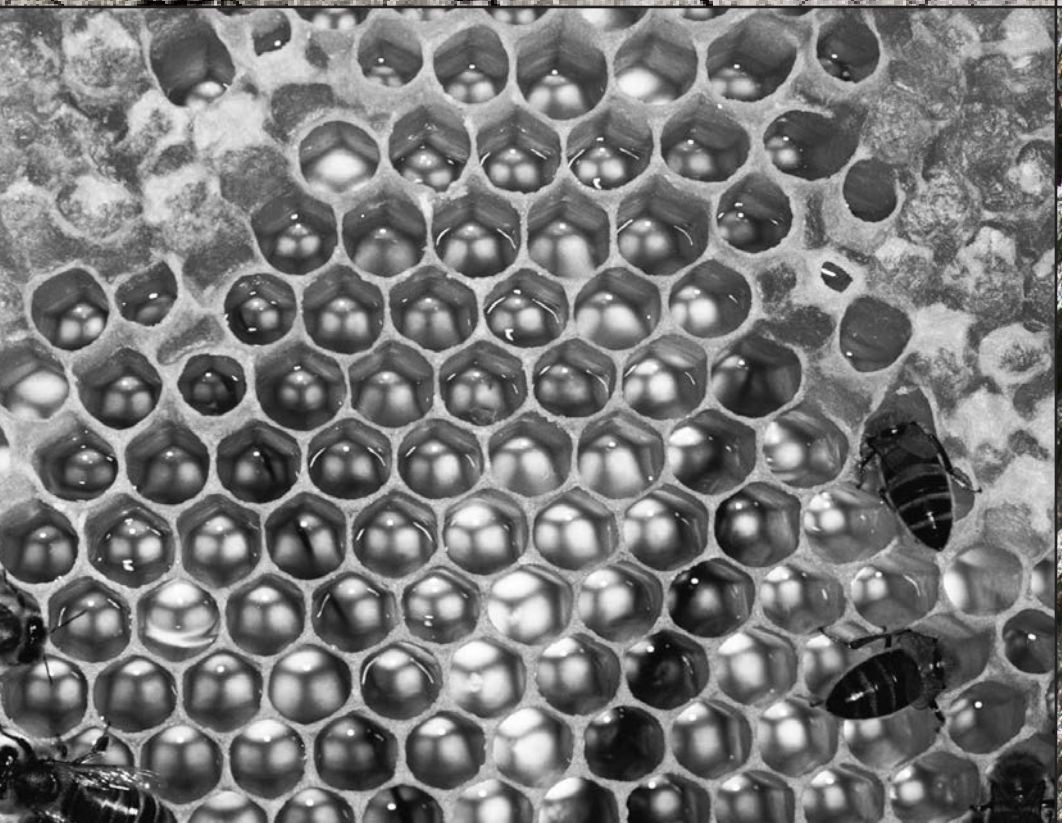
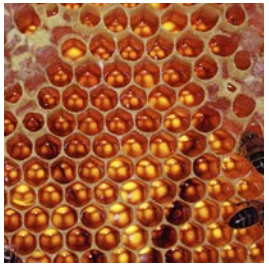


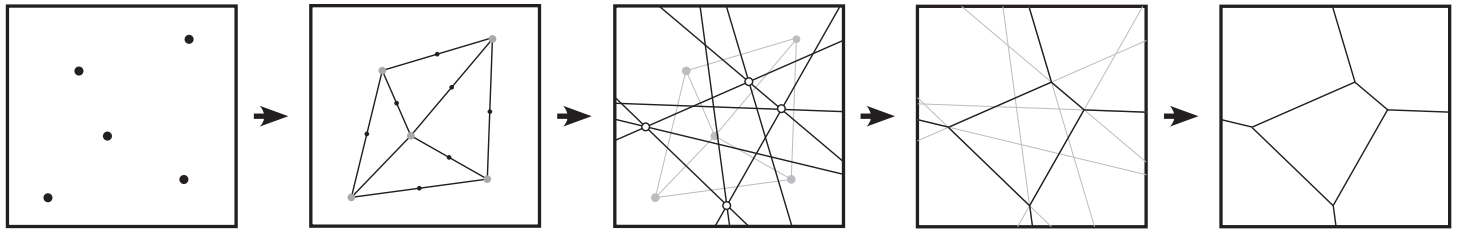

SOAPY WATER 2004



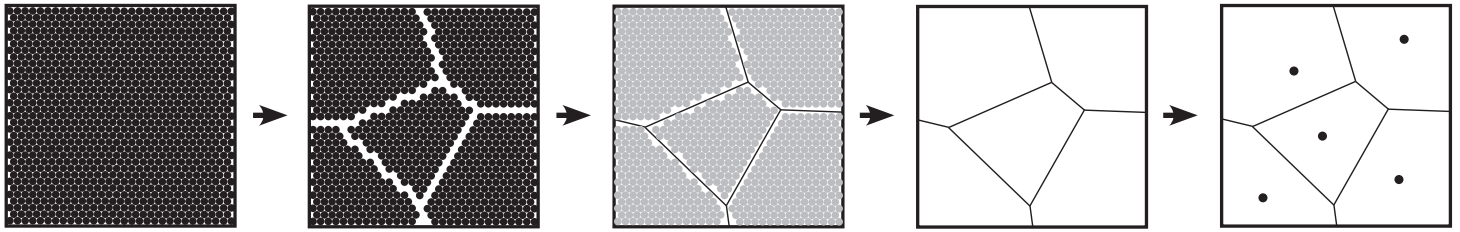
AREA OF INTEREST - Non-Uniform Tessellation



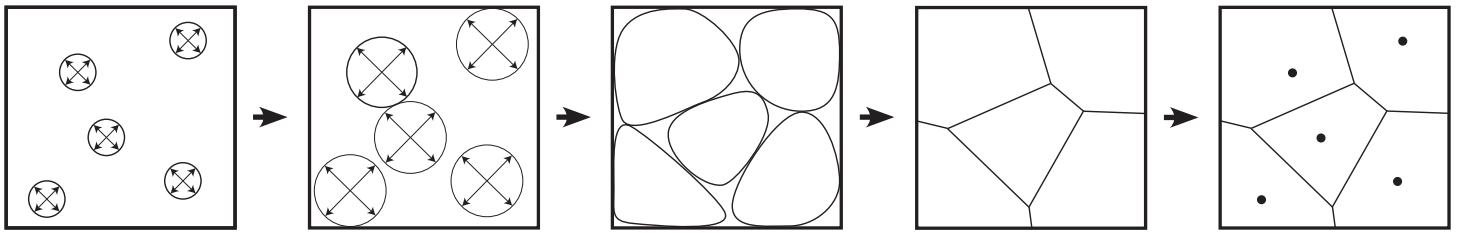
POINT-BASED



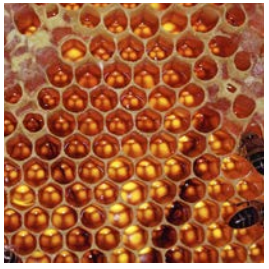
LINE-BASED



VOLUME-BASED



AREA OF INTEREST - Principles in Nature



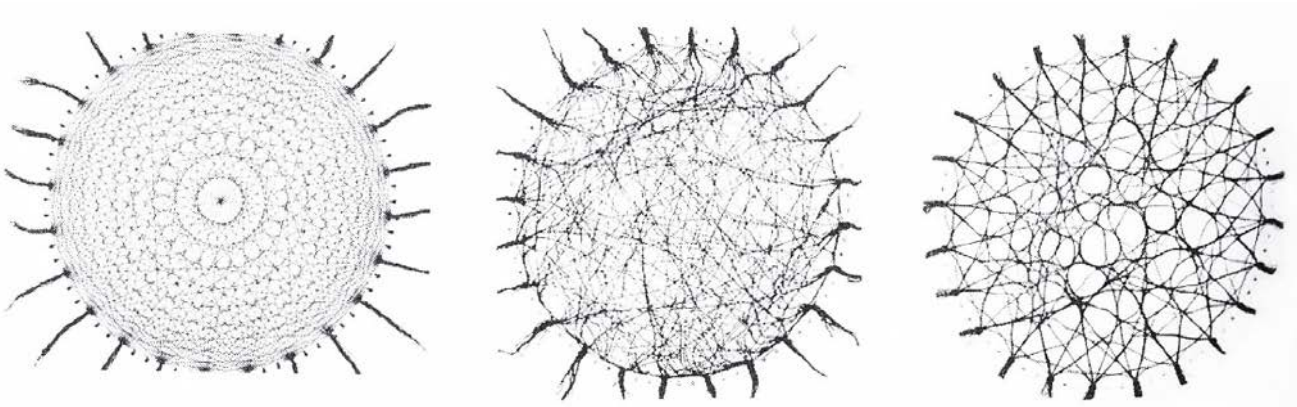
PRINCIPLE OF CONATIVITY:

innate desire for a living organism or system to maintain and increase viability within its population

PRINCIPLE OF LEAST RESISTANCE:

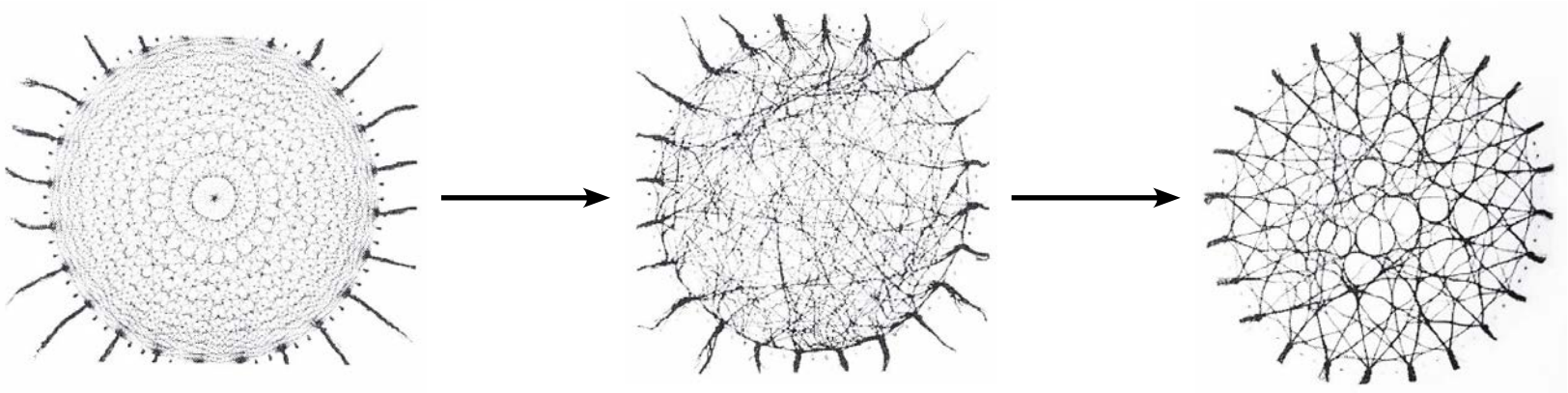
desire to expend the least amount of energy to meet ends

FREI OTTO - OPTIMIZED PATH EXPERIMENT:



AREA OF INTEREST - Equilibrium in Nature

FREI OTTO - OPTIMIZED PATH EXPERIMENT:



Threads Pulled Tight

Threads Loosened by 8%

Threads Submerged in Water, Shaken and Resurfaced

EXTERNAL INFLUENCE

ORIGINAL STATE → **RESULT** → **EQUILIBRIUM IN NATURE**

(Point of Least Resistance)

AREA OF INTEREST - Equilibrium in Architecture

MOISTURE DESICCATION

SOIL, SILT, CLAY → MUD → MUD CRACKS

TREE GROWTH

INNER BARK → OUTER BARK

MOISTURE DESICCATION

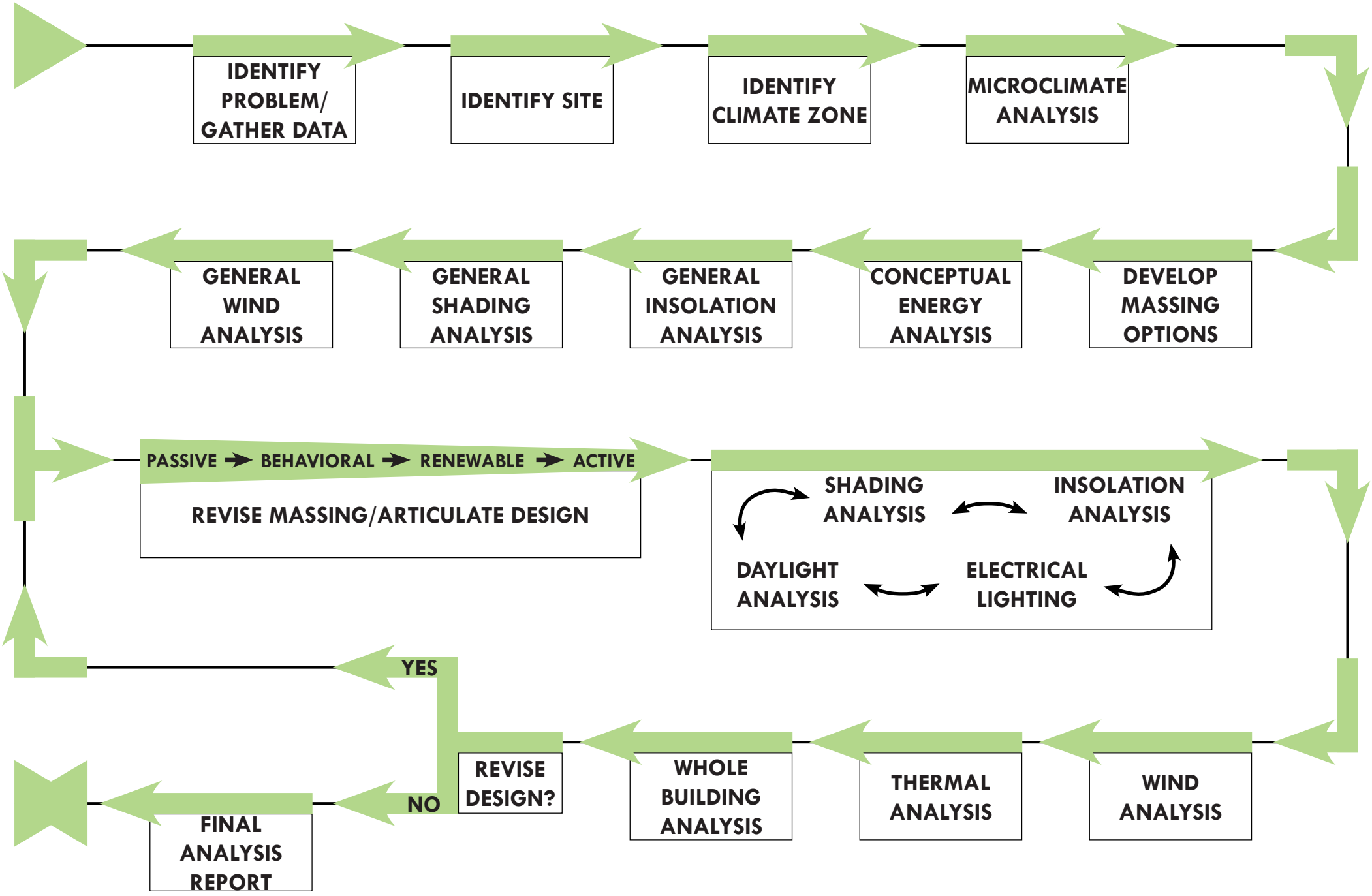
SOAP/WATER MOLECULES → SOAP BUBBLE → FOAM

THE 3 C'S

CONCEPT → (CLIMATE) ITERATION → (CONTEXT) ITERATION → (CLIENT) ITERATION → **EQUILIBRIUM IN ARCHITECTURE**

(Point of Least Resistance)

AREA OF INTEREST - Building Performance Analytics



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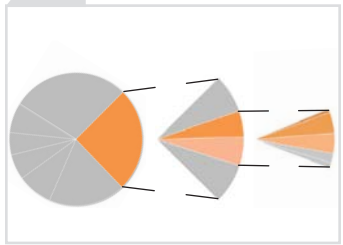

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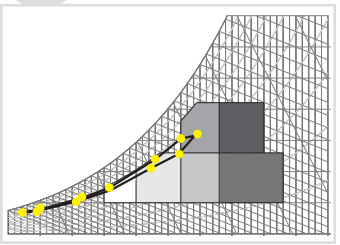

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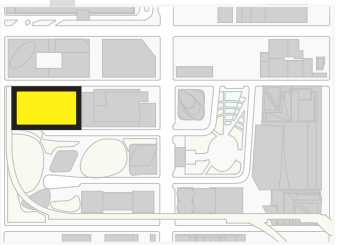

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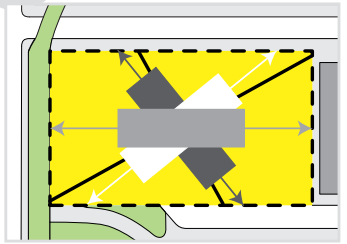

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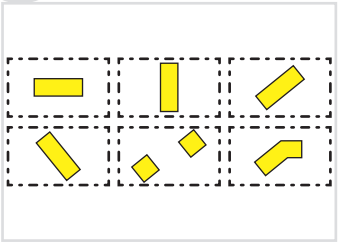

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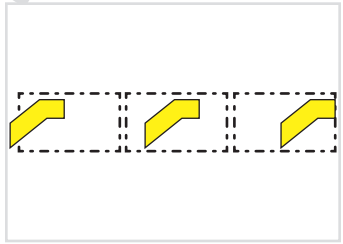

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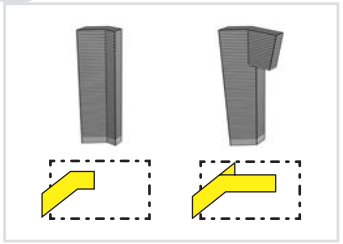

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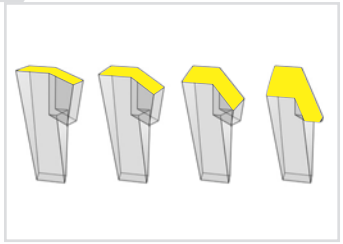

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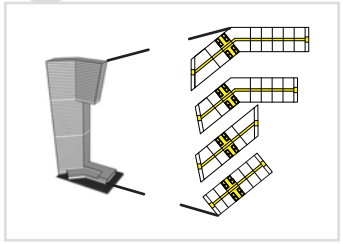

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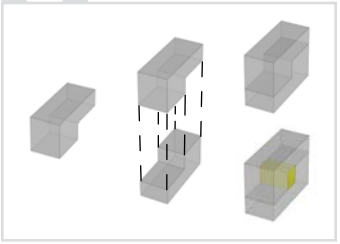

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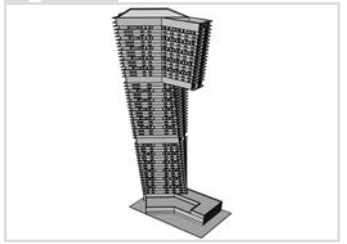
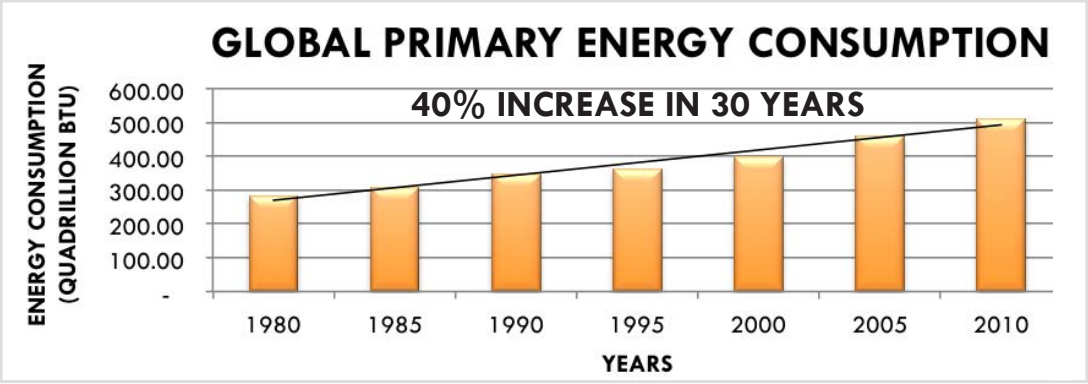


2 IDENTIFY PROBLEM - Global Energy Consumption



SOURCE: "International Energy Statistics." Independent Statistics & Analysis U.S. Energy Information Administration.

THE UNITED STATES IS THE 4TH MOST POPULOUS COUNTRY IN THE WORLD YET CONSUMES THE MOST ENERGY PER PERSON.

MOST POPULOUS COUNTRIES

#	COUNTRY	POPULATION (millions)
1	CHINA	1,349.59
2	INDIA	1,220.80
3	EUROPEAN UNION	503.82
4	**UNITED STATES**	**316.67**
5	INDONESIA	251.16
6	BRAZIL	201.01
7	PAKISTAN	193.24
8	NIGERIA	174.51
9	BANGLADESH	163.65
10	RUSSIA	142.5
-	**WORLD**	**7,095.00**

SOURCE: "The World Factbook." Central Intelligence Agency.

ENERGY CONSUMPTION OF MOST POPULOUS COUNTRIES

#	COUNTRY	ENERGY (QUADRILLION BTU)
1	CHINA	109.62
2	**UNITED STATES**	**97.26**
3	EUROPEAN UNION	71.6
4	RUSSIA	32.77
5	INDIA	23.61
6	JAPAN	20.82
7	BRAZIL	11.66
8	MEXICO	7.81
9	INDONESIA	6.06
10	PAKISTAN	2.56
-	**WORLD**	**510.55**

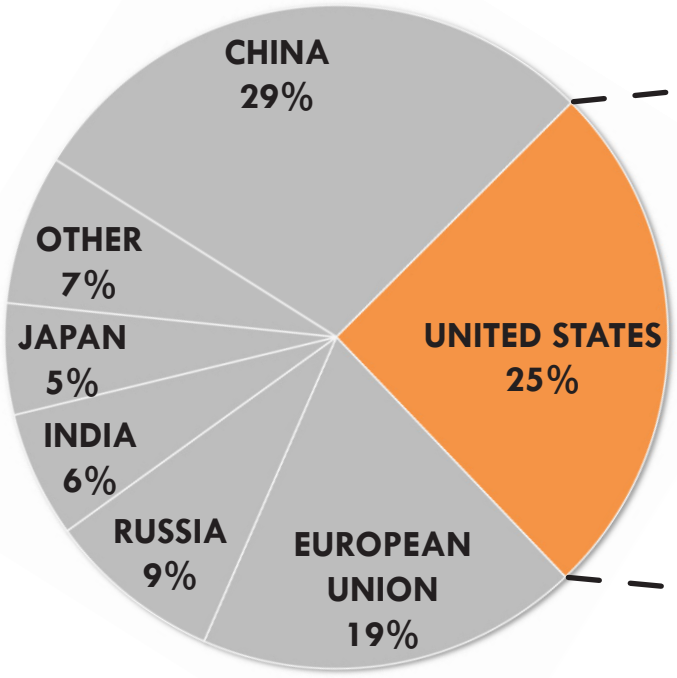
SOURCE: "International Energy Statistics." Independent Statistics & Analysis U.S. Energy Information Administration.

MOST POPULOUS COUNTRIES ENERGY VS. POPULATION RATIO

#	COUNTRY	ENERGY/ POPULATION
1	**UNITED STATES**	**307.13**
2	RUSSIA	229.96
3	JAPAN	163.61
4	EUROPEAN UNION	142.11
5	CHINA	81.22
6	MEXICO	67.18
7	BRAZIL	58.01
8	INDONESIA	24.13
9	INDIA	19.34
10	PAKISTAN	13.25
-	**WORLD**	**71.96**

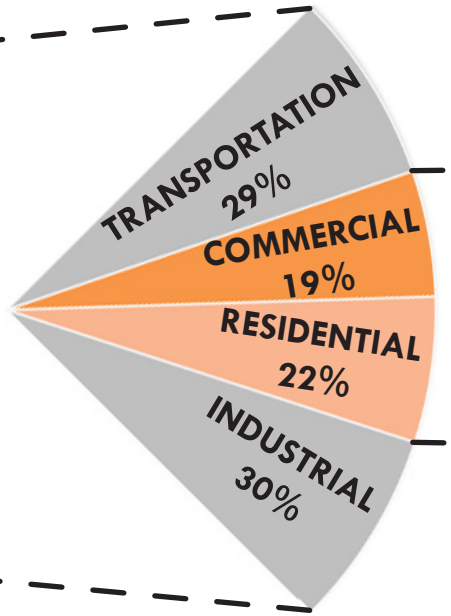
2 IDENTIFY PROBLEM - U.S. Energy Consumption

GLOBAL ENERGY CONSUMPTION



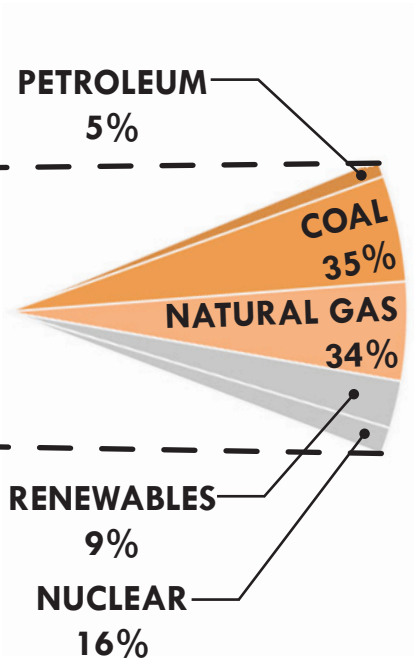
U.S. ENERGY CONSUMPTION

41% Building Industry



U.S. BUILDING ENERGY SOURCES

74% Non-Renewable Resources

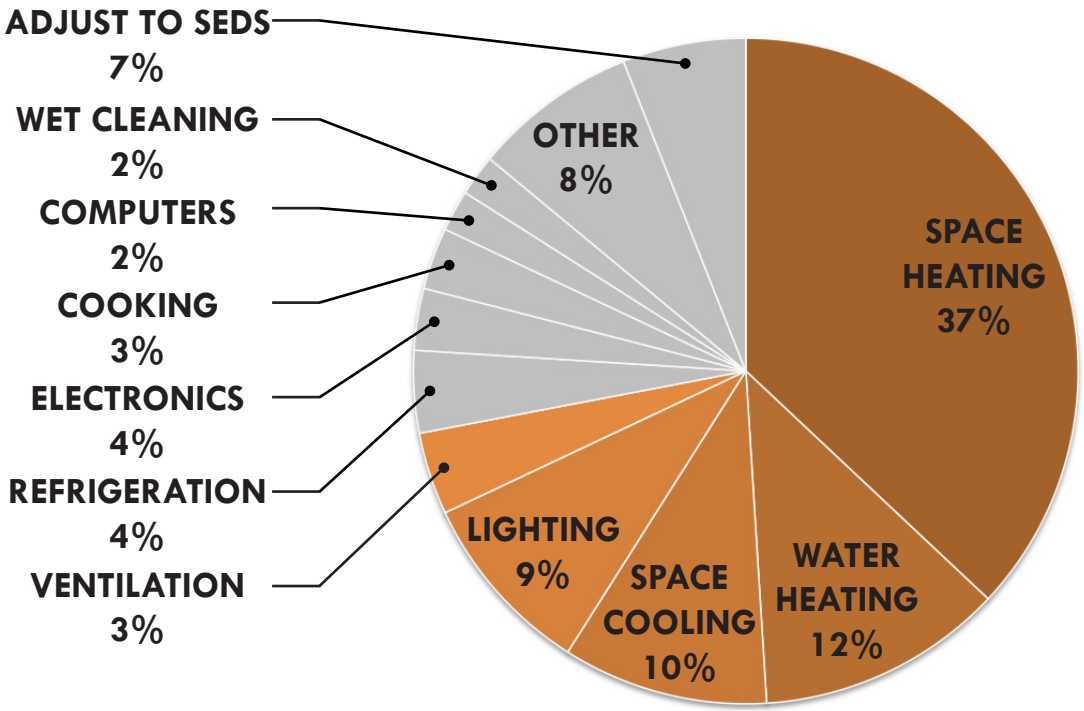


SOURCE: Buildings Energy Data Book. U.S. Department of Energy.

2 IDENTIFY PROBLEM - Energy Consumption End Uses

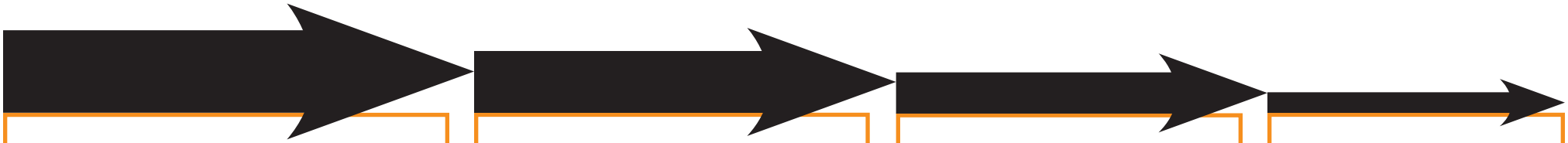
U.S. BUILDING SITE ENERGY CONSUMPTION BY END USE

71% Potential to be Offset by Climate Conditions



SOURCE: Buildings Energy Data Book. U.S. Department of Energy.

2 IDENTIFY PROBLEM - Hierarchy of Energy Saving Strategies



PASSIVE

NO ENERGY CONSUMPTION, CLIMATE CONDITIONS

Passive Solar Heating
Passive Solar Cooling
Natural Day Lighting
Natural Ventilation
Thermal Mass
Night Flush
Stack Effect
Evaporative Cooing
Internal Heat Gains
Dehumidification
Prevent Thermal Transmission
Improve Indoor Air Quality

BEHAVIORAL

HUMAN EFFORT

Occupant Act As Sensor & Activator

Modify Systems to Alter Environmental Comfort

RENEWABLE

ENERGY FROM NATURAL SOURCES

Wind Energy
Photovoltaic Panels
Solar Thermal Water
Geothermal
Hydropower
Biomass Energy

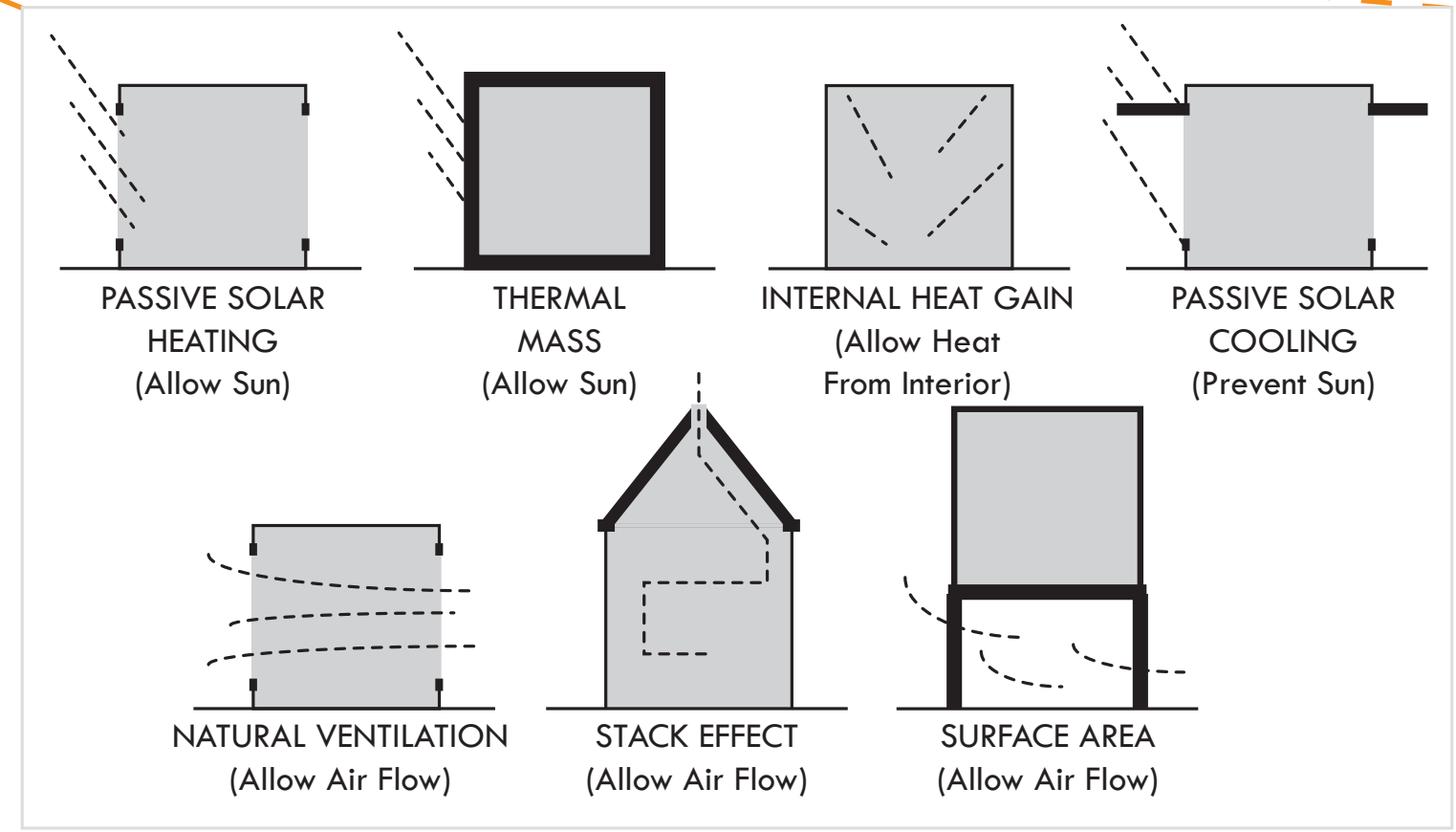
ACTIVE

ENERGY EFFICIENT SYSTEMS

Space Heating
Space Cooling
Water Heating
Ventilation
Lighting
Power

2 IDENTIFY PROBLEM - Passive Strategies

PASSIVE → **BEHAVIORAL** → **RENEWABLE** → **ACTIVE**



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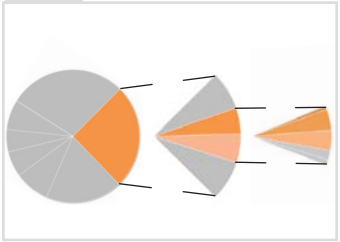

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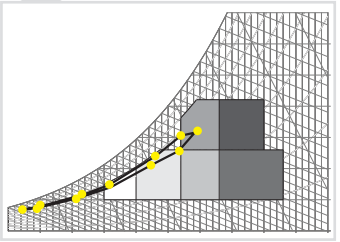

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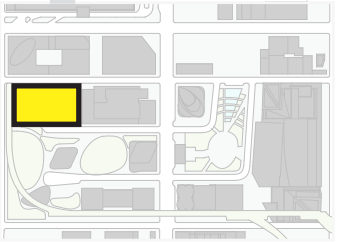

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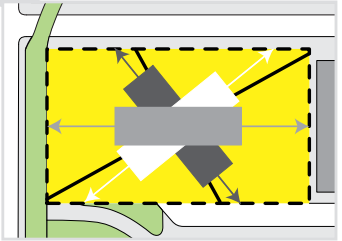

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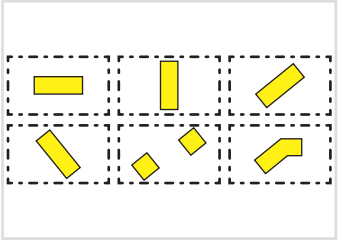

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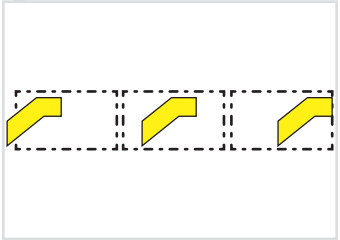

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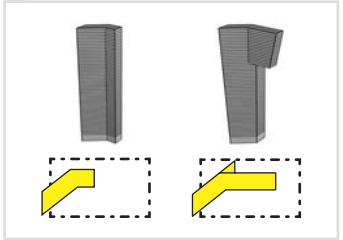

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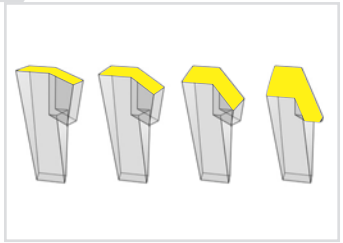

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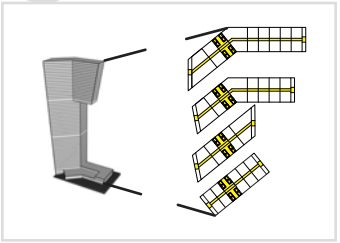

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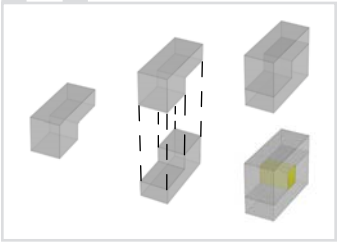
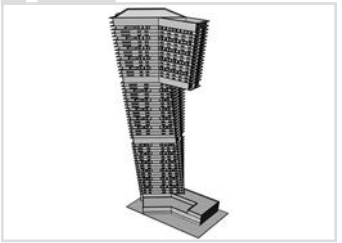


12 FINAL ANALYSIS



CLIMATE ANALYSIS - Global Similarities

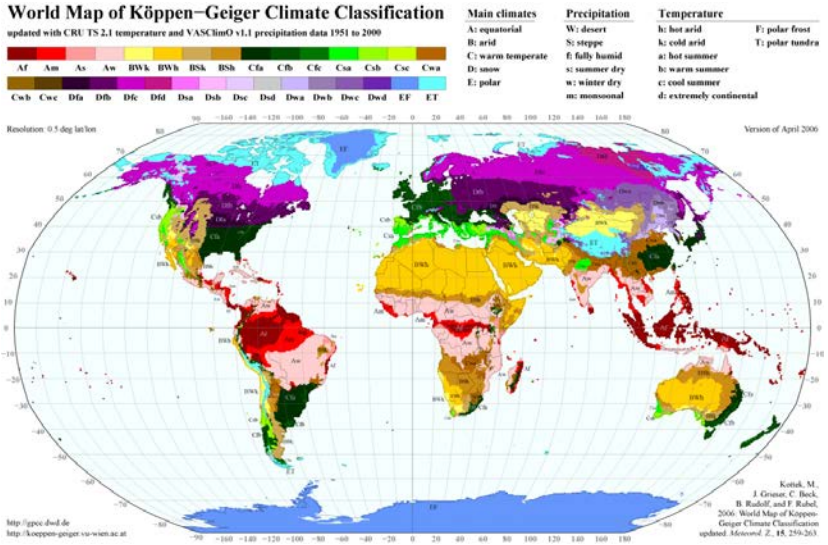
MOST POPULOUS GLOBAL CITIES AND CLIMATE CONDITIONS

#	COUNTRY	POPULATION (millions)	CLIMATE
1	TOKYO, JAPAN	36.67	WARM TEMPERATE, FULLY HUMID, HOT SUMMER
2	DELHI, INDIA	22.16	WARM TEMPERATE, WINTER DRY, WARM SUMMER
3	SAO PAULO, BRAZIL	20.26	WARM TEMPERATE, FULLY HUMID, HOT SUMMER
4	MUMBAI, INDIA	20.04	EQUATORIAL, DESERT
5	MEXICO CITY, MEXICO	19.46	WARM TEMPERATE, FULLY HUMID, HOT SUMMER
6	**NEW YORK CITY, UNITED STATES**	**19.43**	**WARM TEMPERATE, FULLY HUMID, HOT SUMMER**
7	SHANGHAI, CHINA	16.16	WARM TEMPERATE, FULLY HUMID, HOT SUMMER
8	KOKATA, INDIA	15.55	EQUATORIAL, DESERT
9	DHAKA, BANGLADESH	14.65	EQUATORIAL, WINTER DRY
10	KARACHI, PAKISTAN	13.13	ARID, DESERT, HOT ARID

SOURCE: "The World Factbook." Central Intelligence Agency.

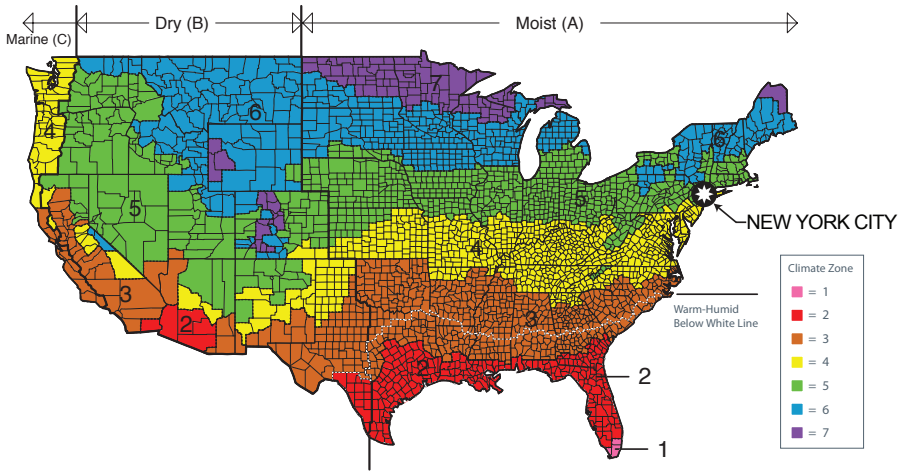
50% SHARE THE SAME CLIMATE

GLOBAL CLIMATE ZONES - Cfa



SOURCE: Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger Climate Classification Updated.

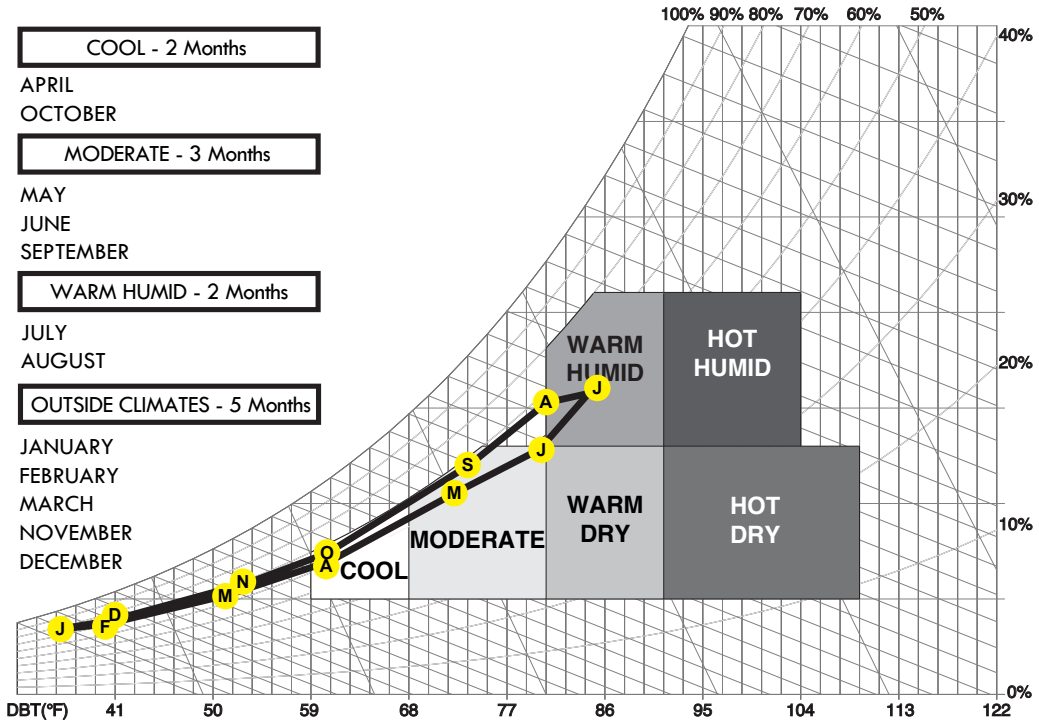
NATIONAL CLIMATE ZONES - Mixed Humid



SOURCE: Pacific Northwest National Laboratory and Oak Ridge National Laboratory. U.S. Department of Energy.

CLIMATE ANALYSIS - Climate Classification

CLIMATE CLASSIFICATION CHART
NEW YORK CITY - CENTRAL PARK



CLIMATE ANALYSIS - Comfort Analysis

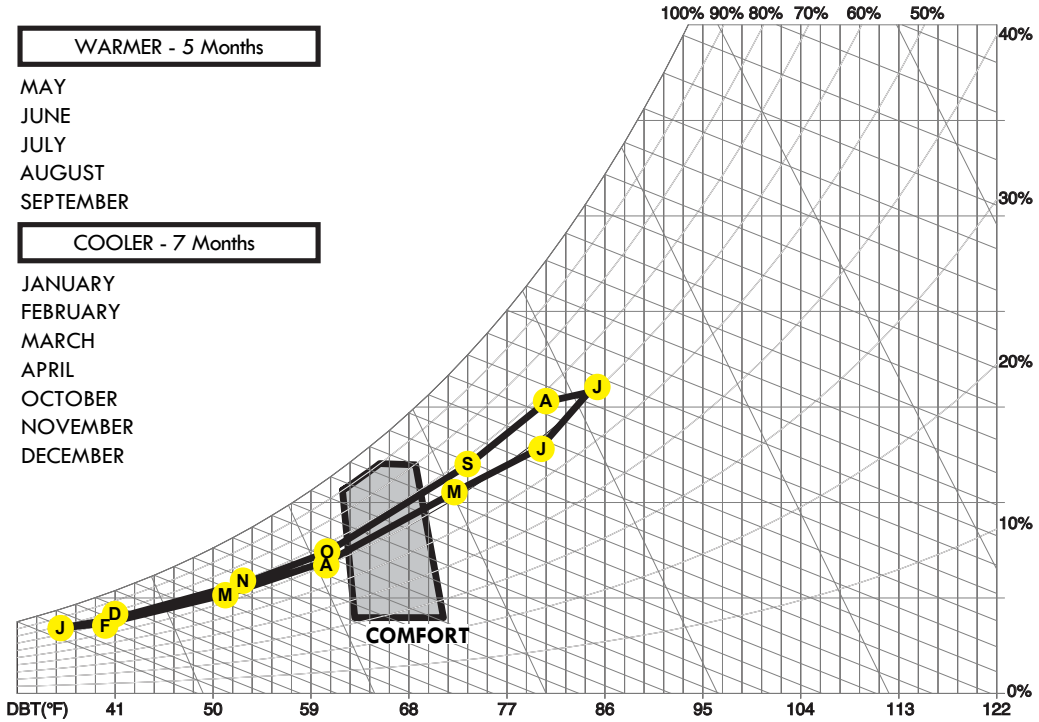
PSYCHROMETRIC CHART
NEW YORK CITY - CENTRAL PARK

WARMER - 5 Months

MAY
JUNE
JULY
AUGUST
SEPTEMBER

COOLER - 7 Months

JANUARY
FEBRUARY
MARCH
APRIL
OCTOBER
NOVEMBER
DECEMBER



COOLING

HUMIDIFICATION

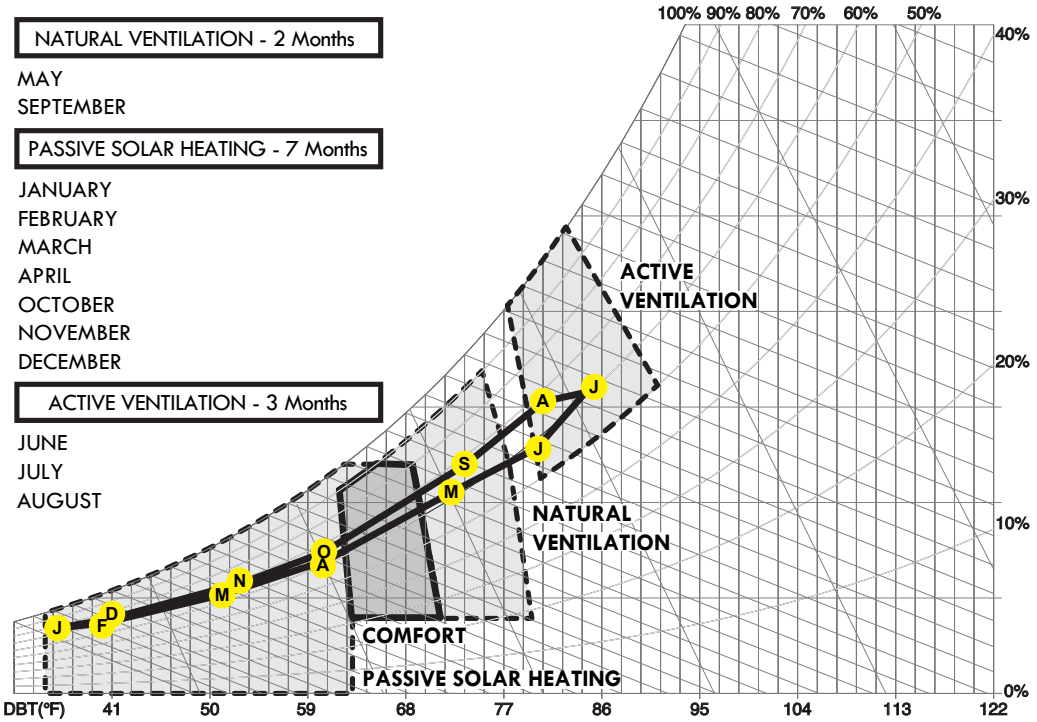
HEATING

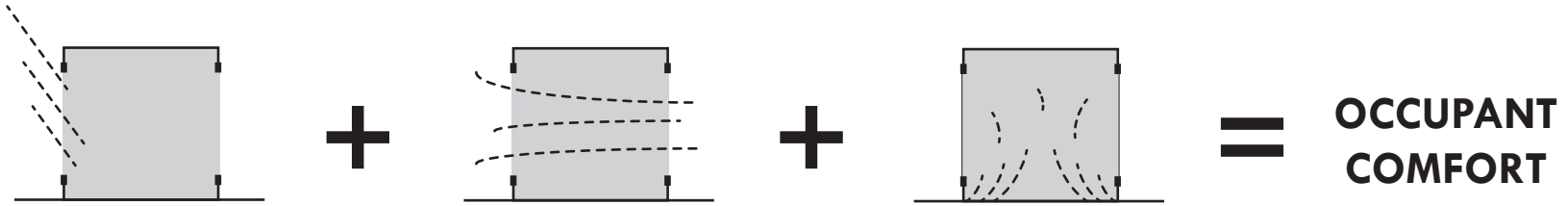
DEHUMIDIFICATION

CLIMATE ANALYSIS - Comfort Strategies

PASSIVE & ACTIVE STRATEGIES

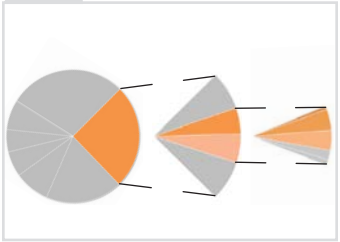
NEW YORK CITY - CENTRAL PARK



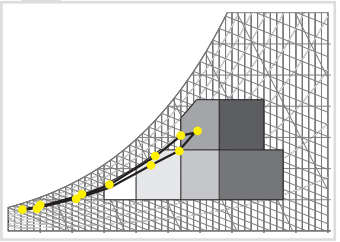


1 AREA OF INTEREST

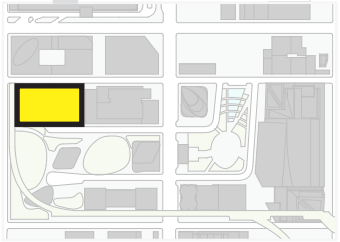
2 IDENTIFY PROBLEM



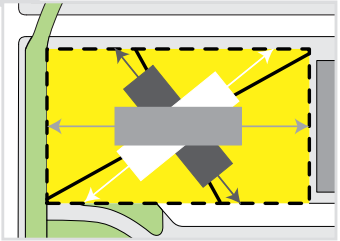
3 CLIMATE ANALYSIS



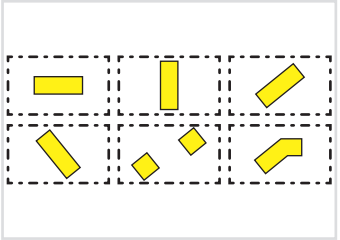
4 SITE SELECTION



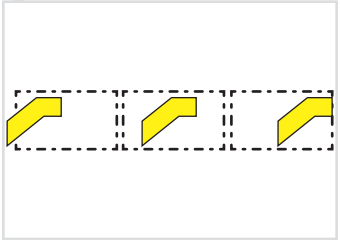
5 ORIENTATION ANALYSIS



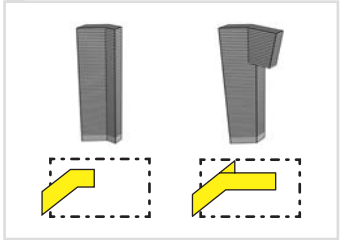
6 MASS COMPARISON



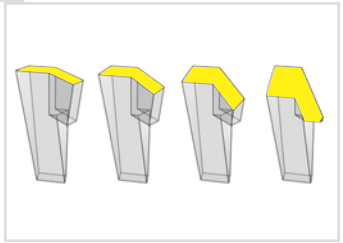
7 MASS LOCATION



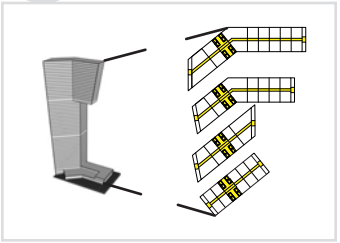
8 MASS OPTIMIZATION



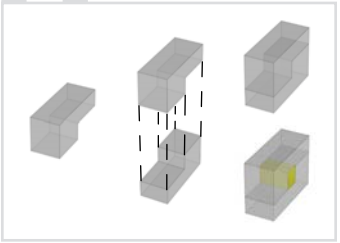
9 ROOF OPTIMIZATION



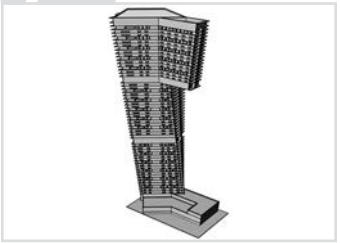
10 ARCHITECTURAL IMPLICATIONS



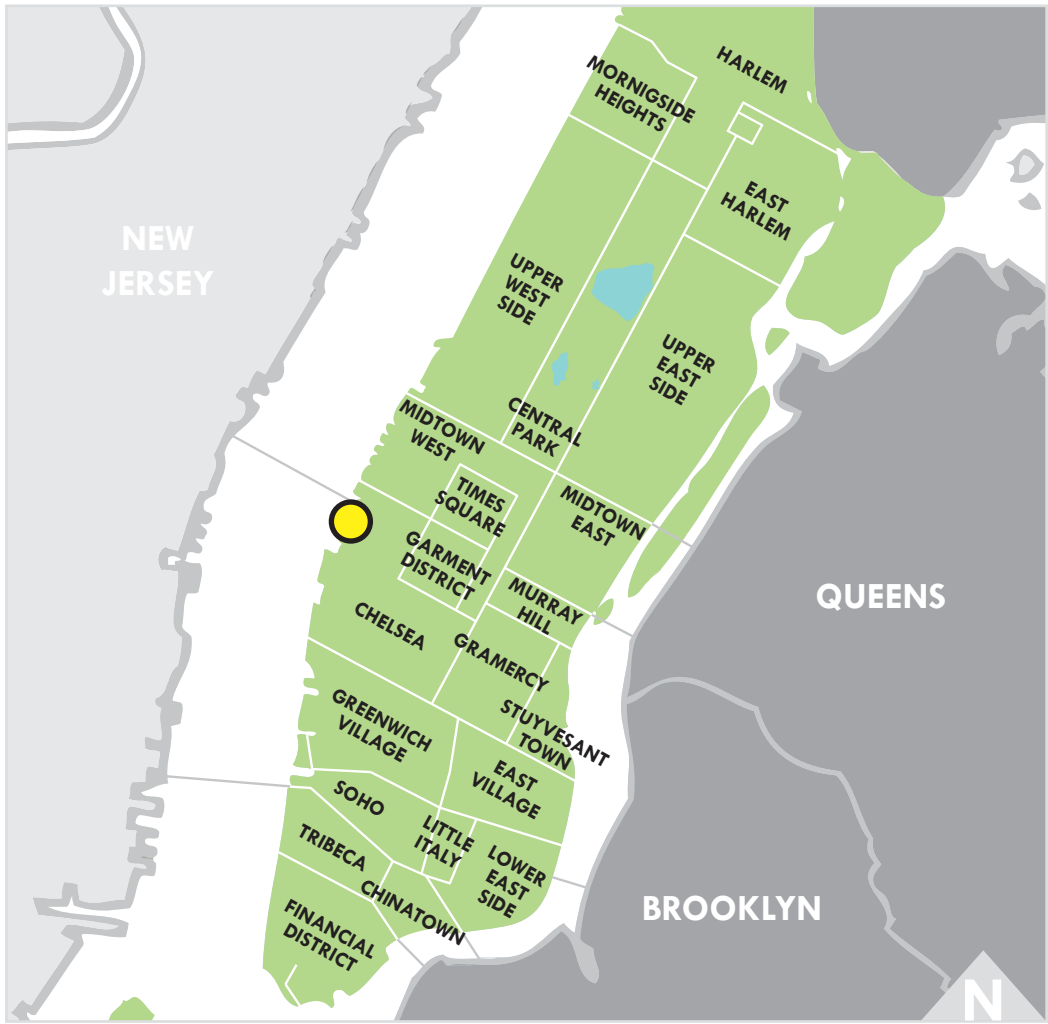
11 UNIT ANALYSIS



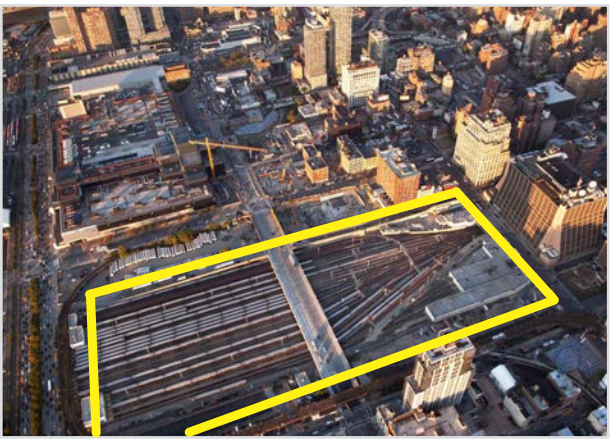
12 FINAL ANALYSIS



SITE SELECTION - Manhattan

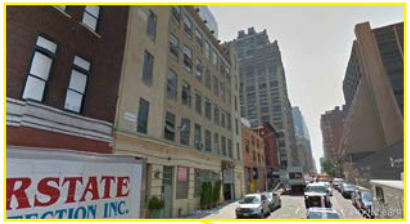


SITE SELECTION - Hudson Yards



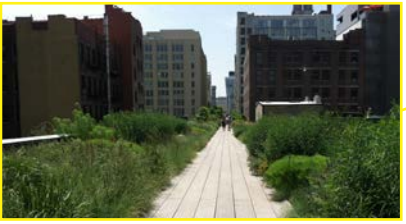
SITE SELECTION - Existing Hudson Yards







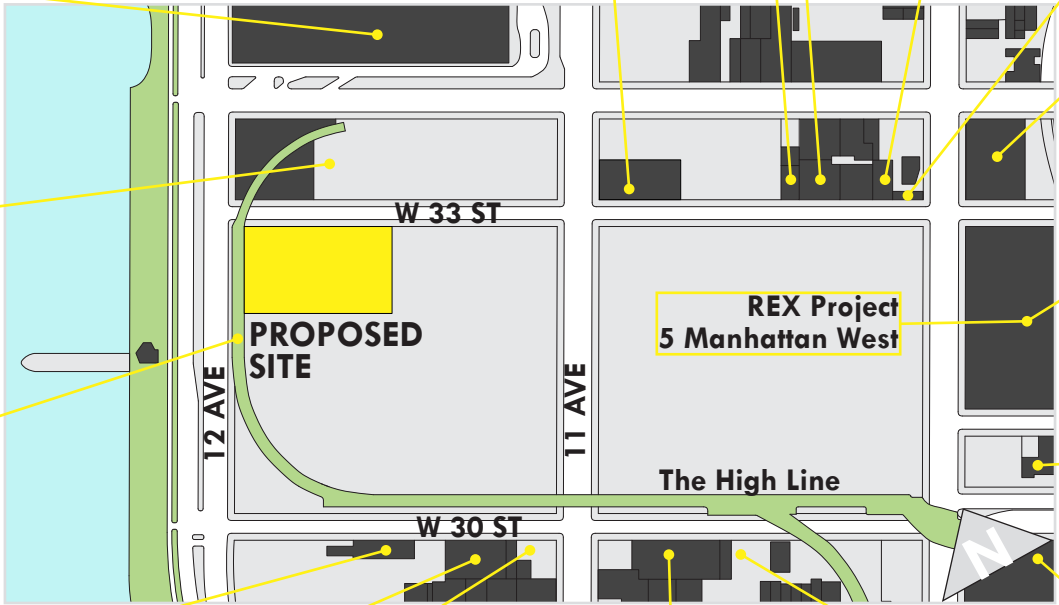




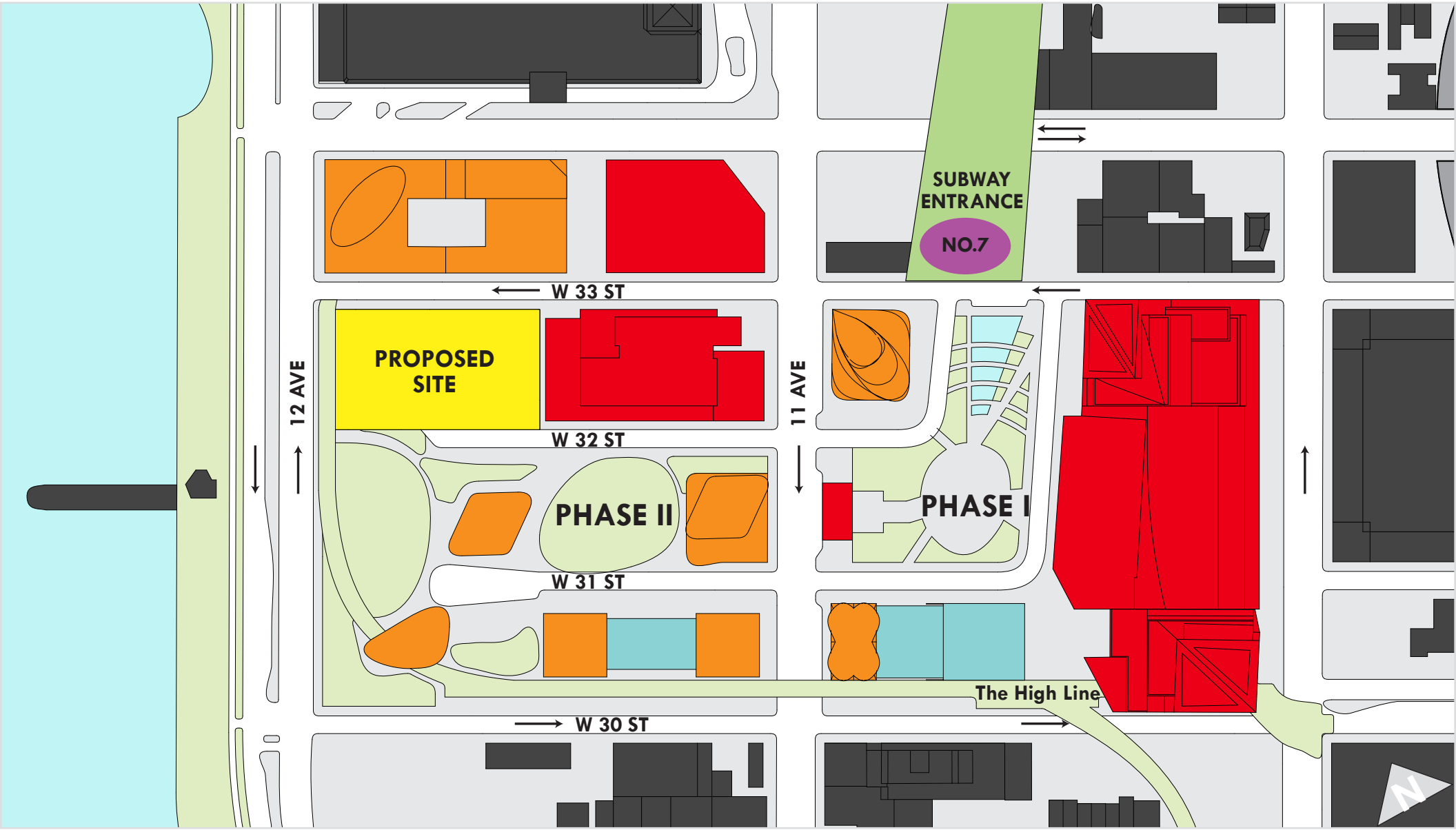




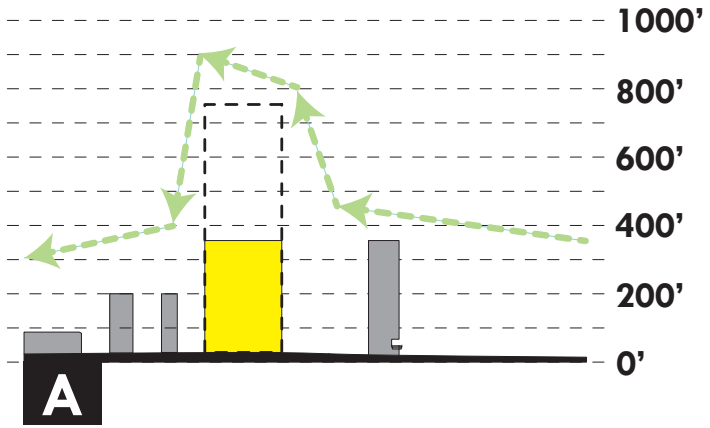



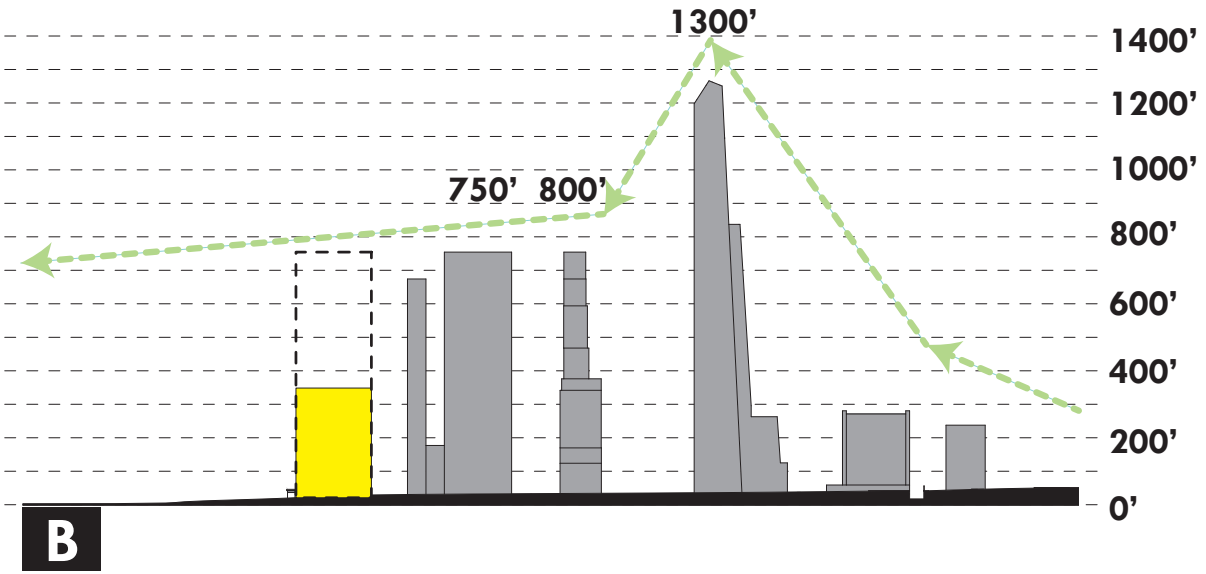
SITE SELECTION - Development Plan

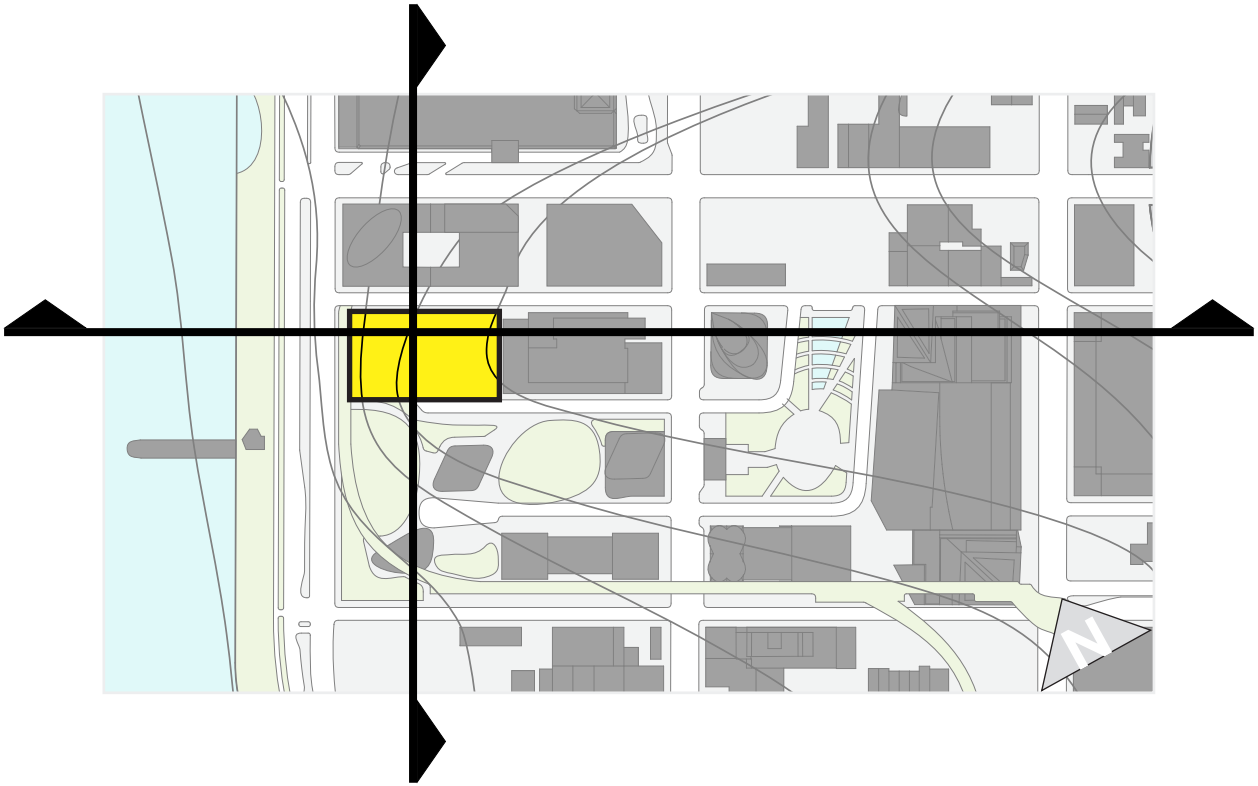
26 OPEN ACRES DEVELOPED INTO 13.3 MILLION SF OF BUILT PROGRAM



SITE SELECTION - Building Program







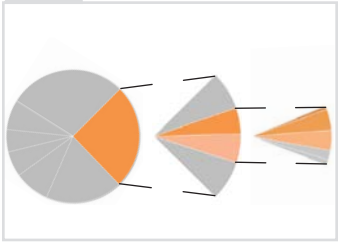
PROPOSED BUILDING PROGRAM

Square Footage = ~645,000 SF
Height = ~800 Feet Tall
# of Stories = 58 Stories

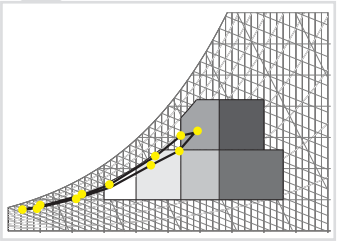
Program = Residential Tower
Retail Plinth

1 AREA OF INTEREST

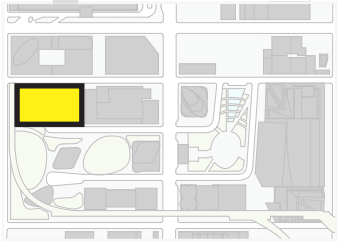
2 IDENTIFY PROBLEM



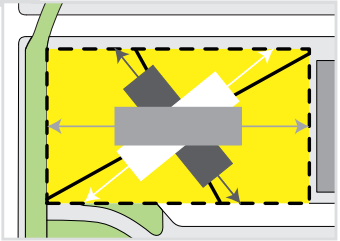
3 CLIMATE ANALYSIS



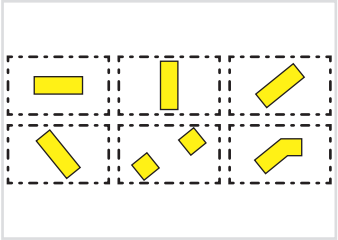
4 SITE SELECTION



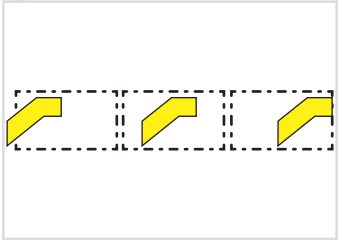
5 ORIENTATION ANALYSIS



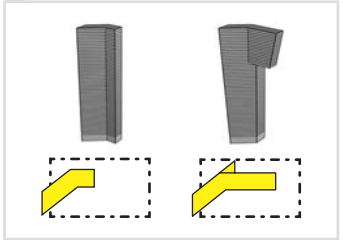
6 MASS COMPARISON



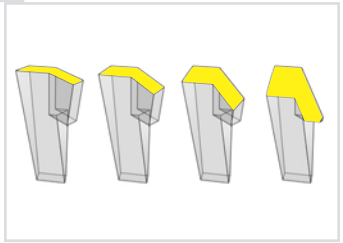
7 MASS LOCATION



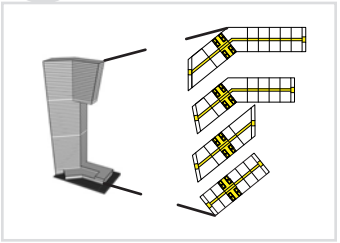
8 MASS OPTIMIZATION



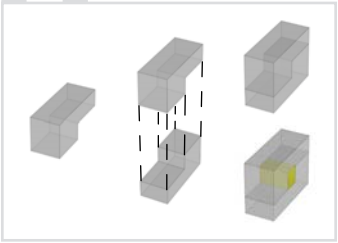
9 ROOF OPTIMIZATION



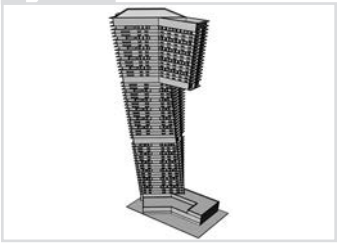
10 ARCHITECTURAL IMPLICATIONS



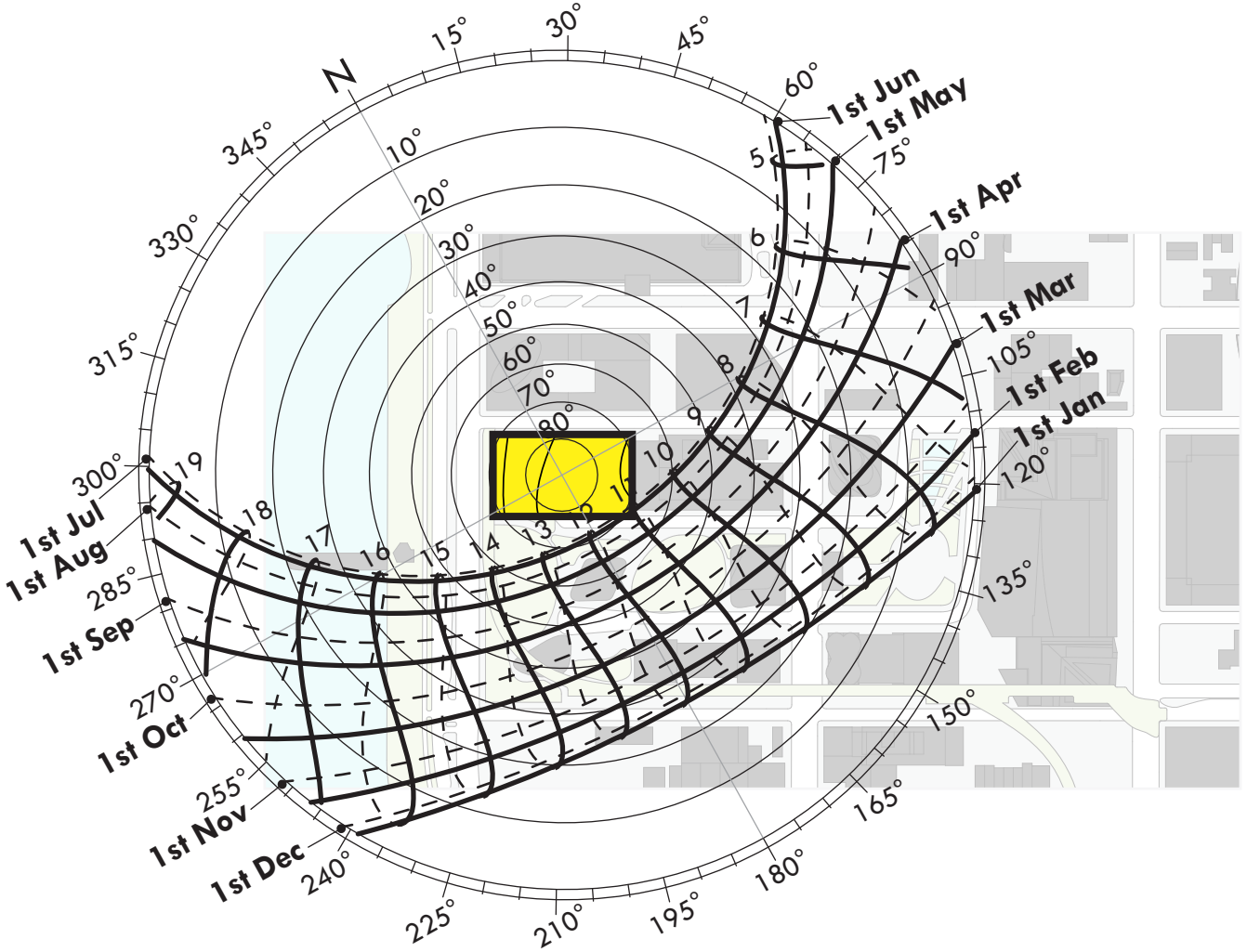
11 UNIT ANALYSIS



12 FINAL ANALYSIS

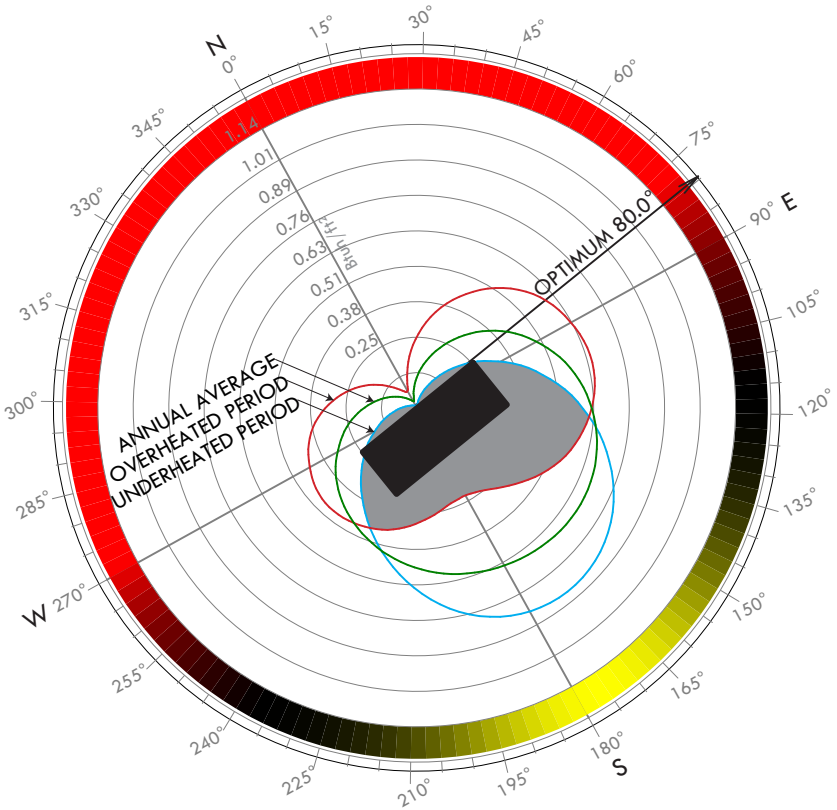


ORIENTATION ANALYSIS - Stereographic Chart

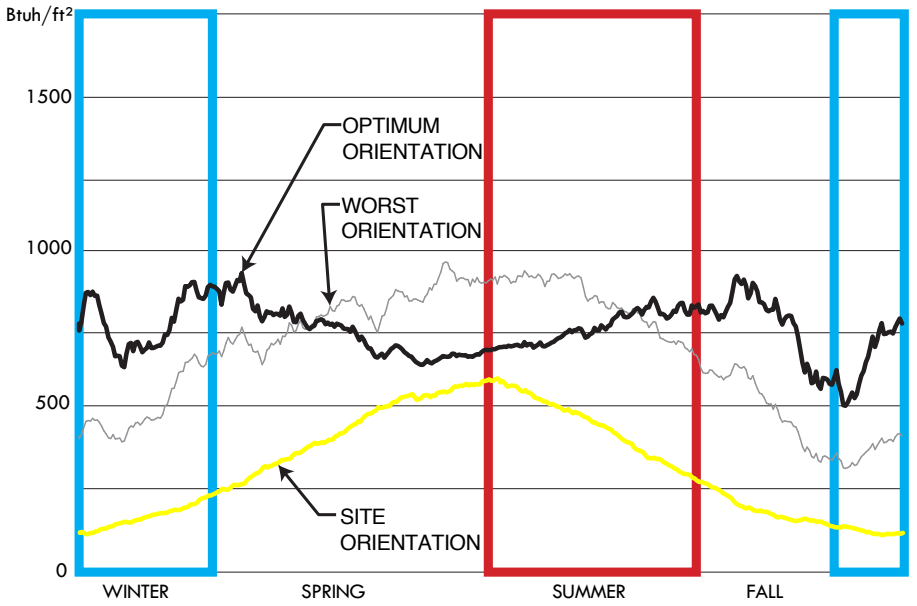


ORIENTATION ANALYSIS - Solar Implications

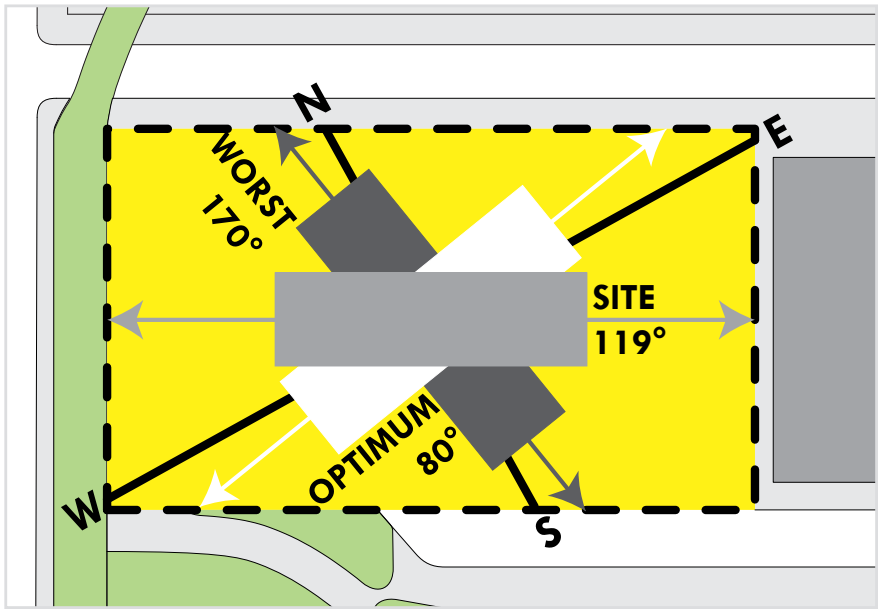
ORIENTATION ANALYSIS



INCIDENT SOLAR RADIATION

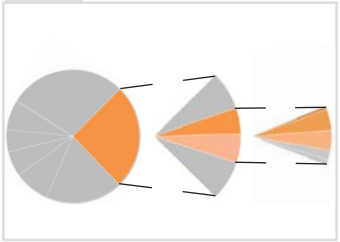


ORIENTATION COMPARISON

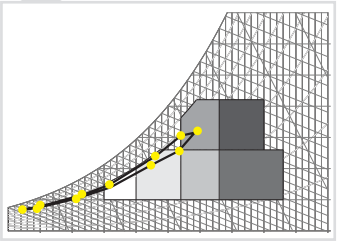


1 AREA OF INTEREST

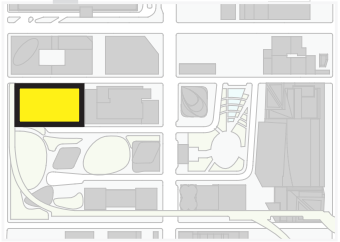
2 IDENTIFY PROBLEM



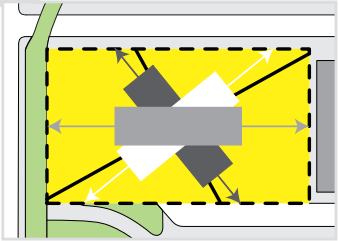
3 CLIMATE ANALYSIS



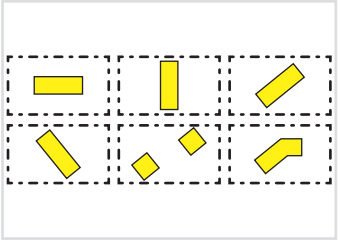
4 SITE SELECTION



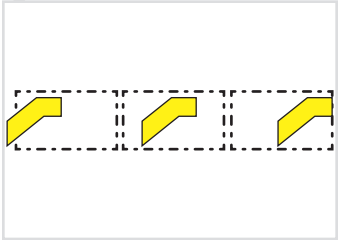
5 ORIENTATION ANALYSIS



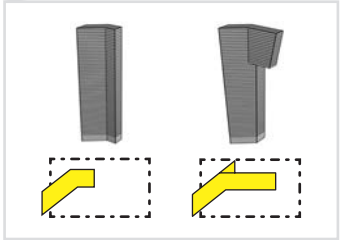
6 MASS COMPARISON



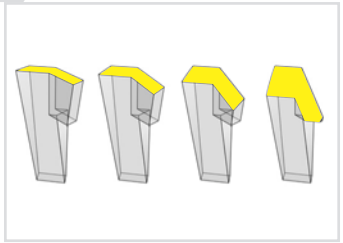
7 MASS LOCATION



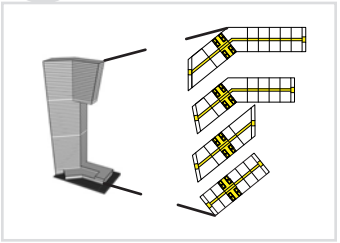
8 MASS OPTIMIZATION



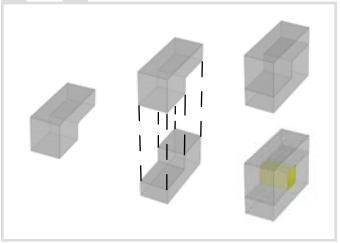
9 ROOF OPTIMIZATION



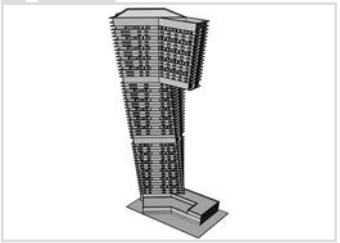
10 ARCHITECTURAL IMPLICATIONS



11 UNIT ANALYSIS

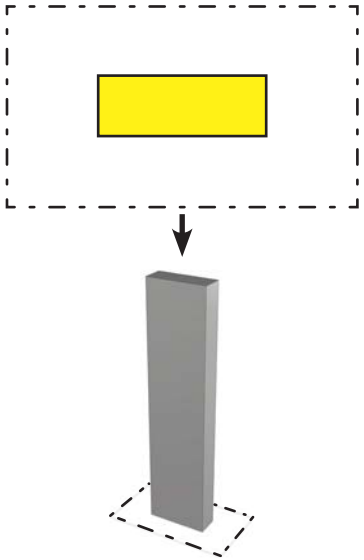


12 FINAL ANALYSIS

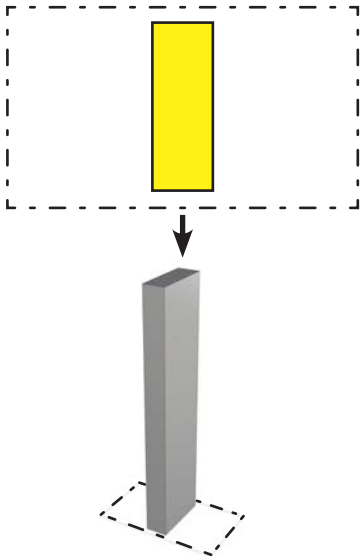


MASS COMPARISON - Mass Options

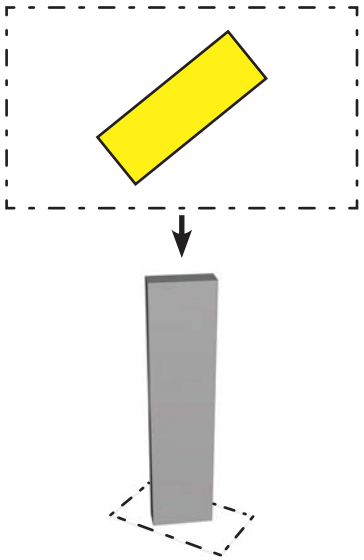
EW



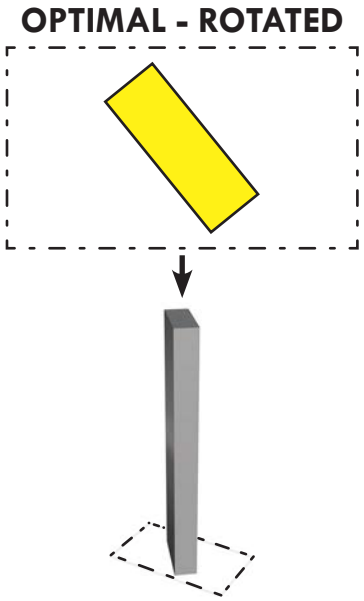
NS



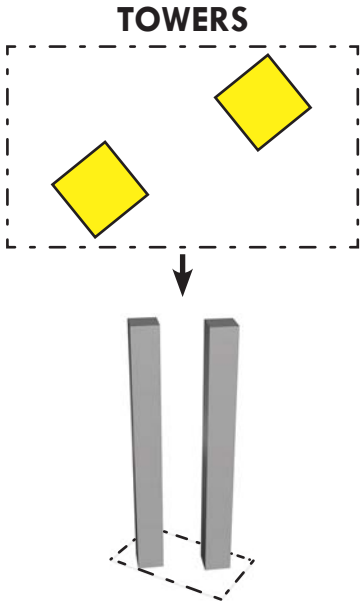
OPTIMAL



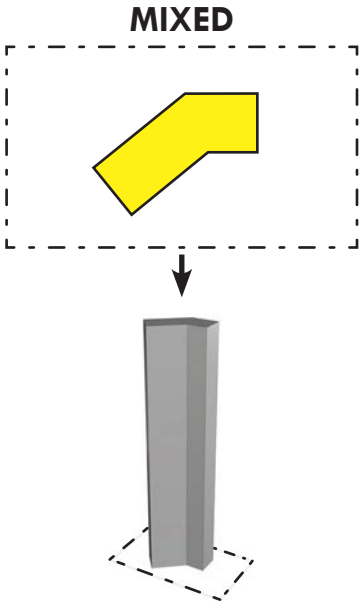
OPTIMAL - ROTATED



TOWERS

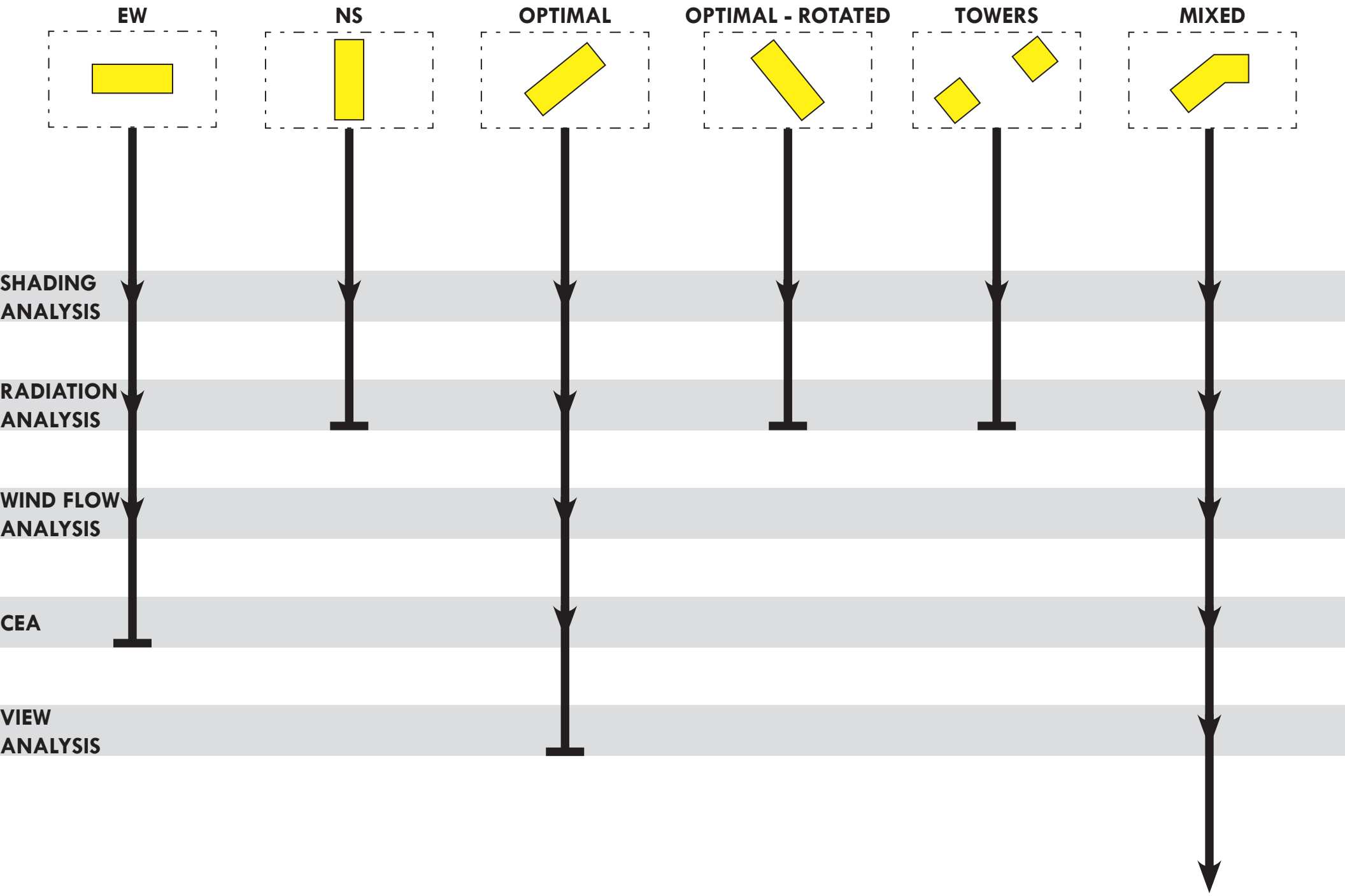


MIXED

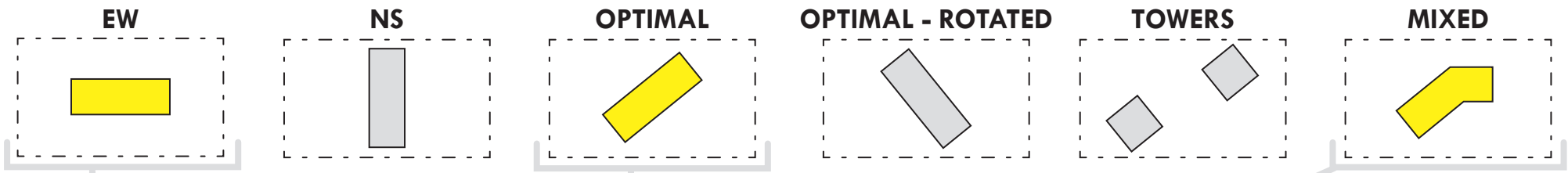


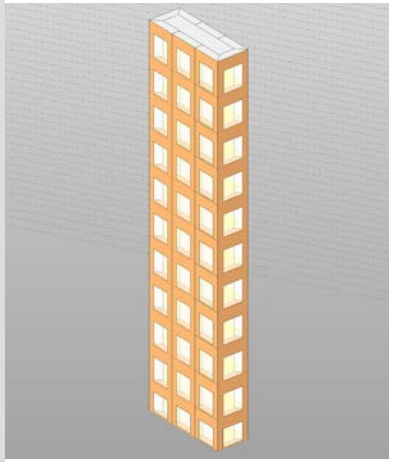
6

MASS COMPARISON



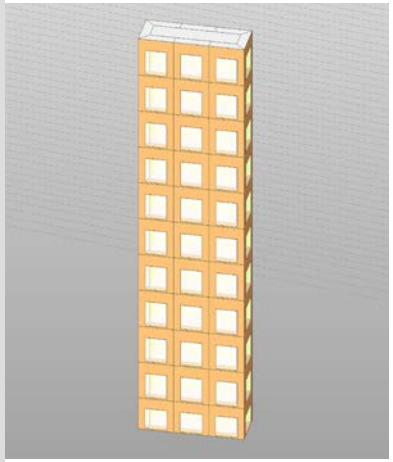
MASS COMPARISON - Conceptual Energy Analysis





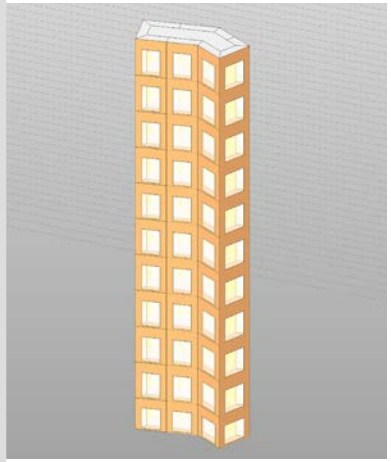
Total EUI =
346 kBtu/sf/yr

Life Cycle Energy Cost =
$11,664,452



Total EUI =
326 kBtu/sf/yr

Life Cycle Energy Cost =
$10,890,368



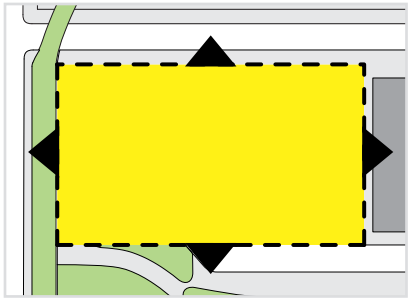
Total EUI =
329 kBtu/sf/yr

Life Cycle Energy Cost =
$11,331,691

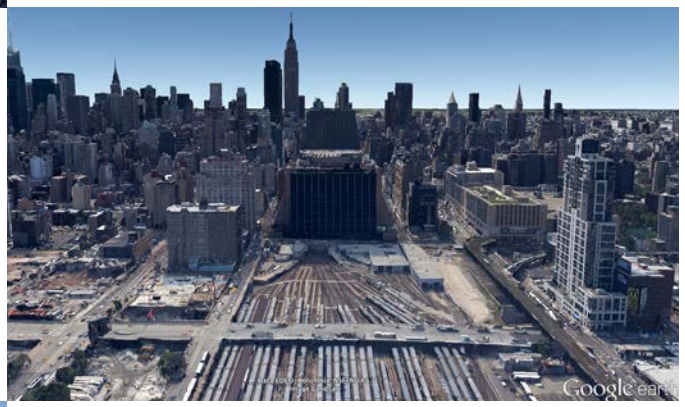
MASS COMPARISON - Existing View Corridors

VIEW TO UPTOWN

VIEW TO NEW JERSEY

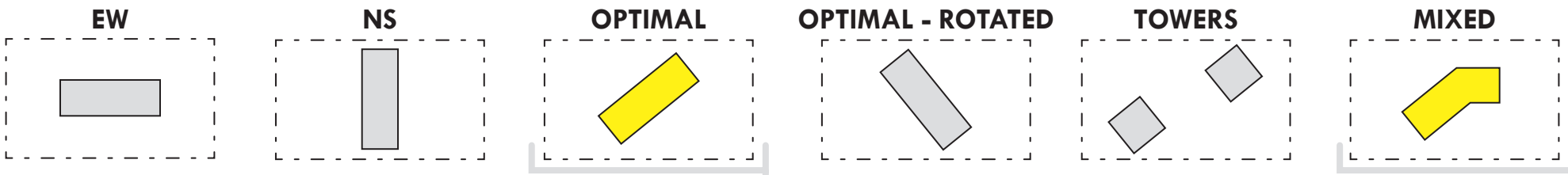


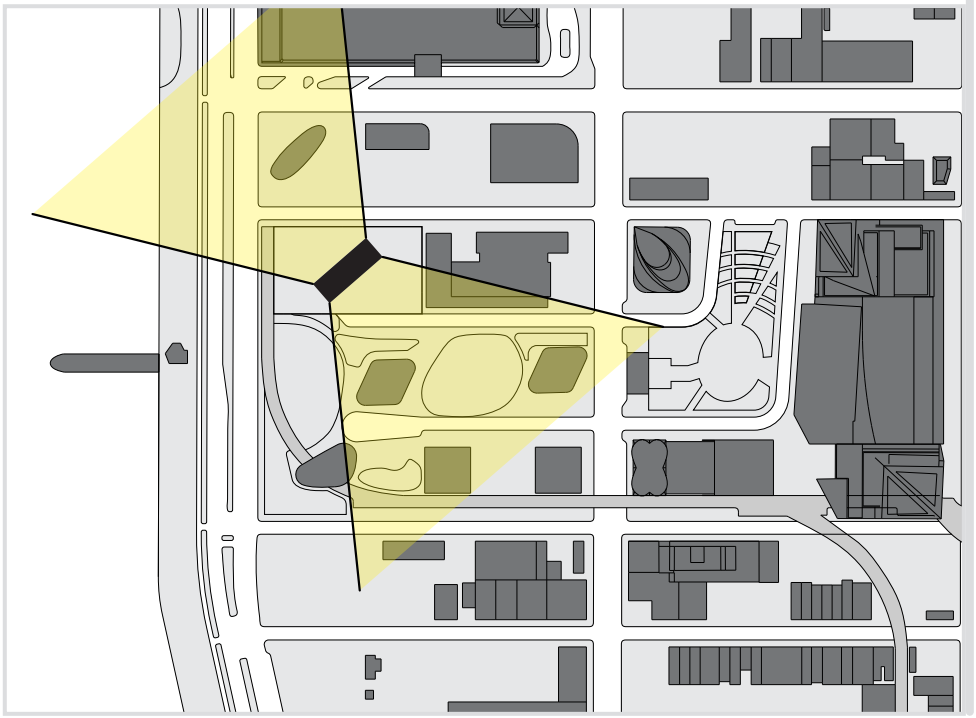
VIEW TO EASTSIDE

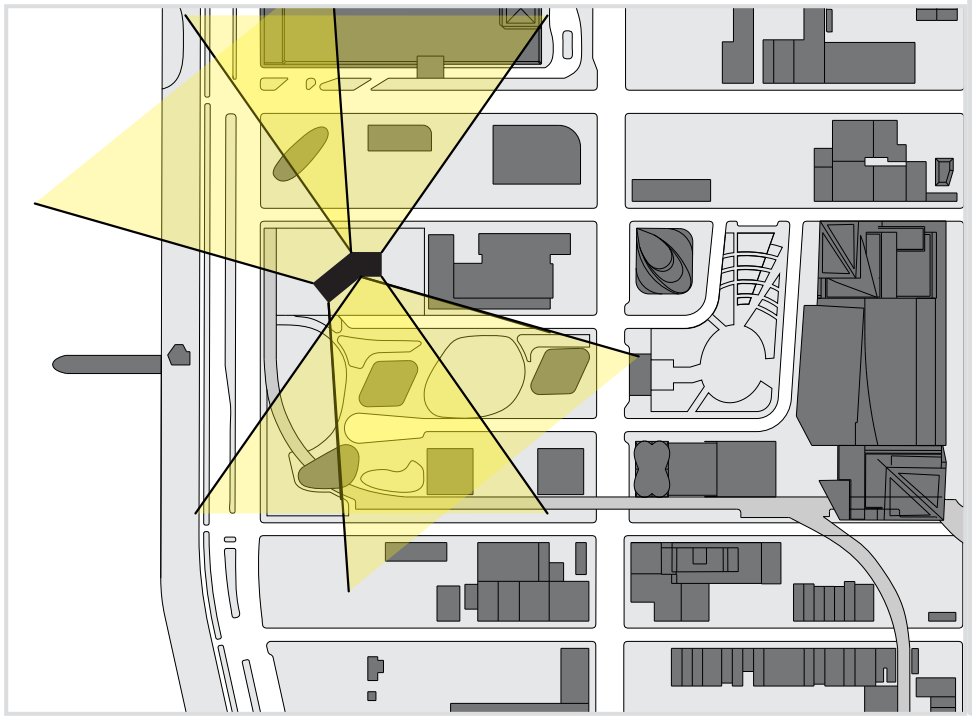


VIEW TO DOWNTOWN

MASS COMPARISON - View Corridor Analysis

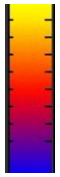




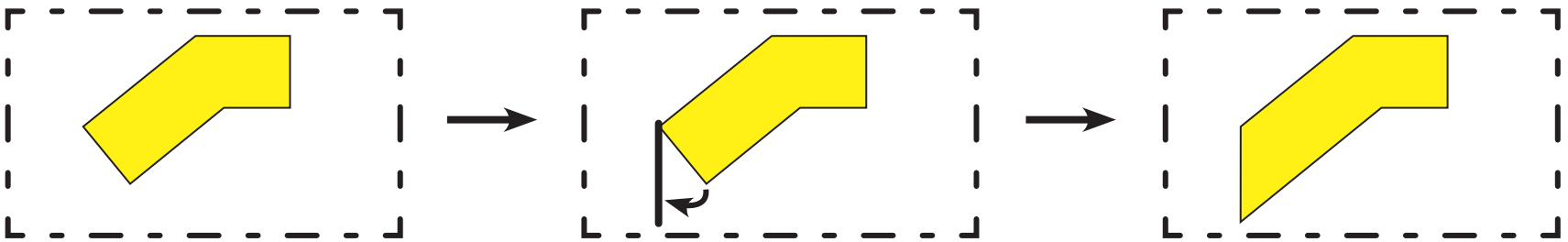


MASS COMPARISON - Insolation Analysis

HIGHER RADIATION

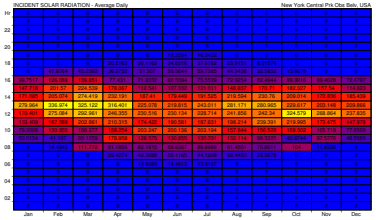


LOWER RADIATION

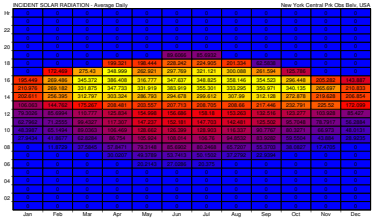


TRUE NORTH

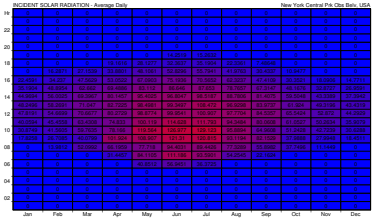
119°



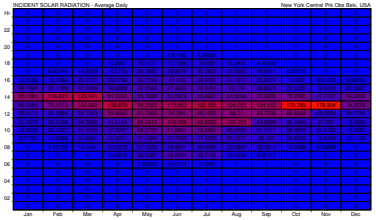
South



West



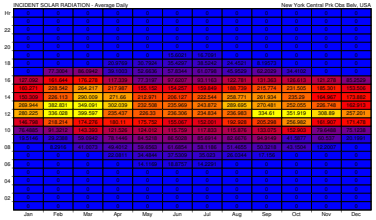
North



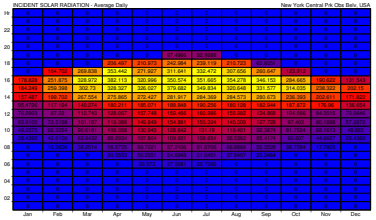
East

OPTIMAL NORTH

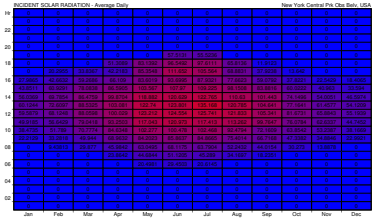
119°



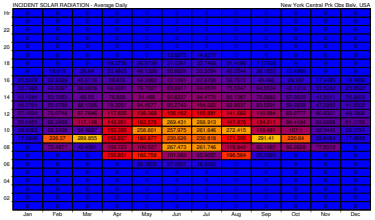
South



West



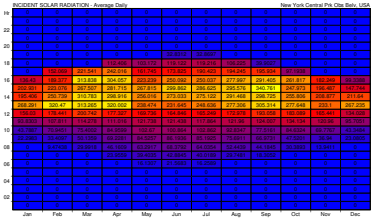
North



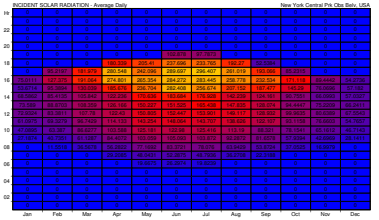
East

SITE NORTH

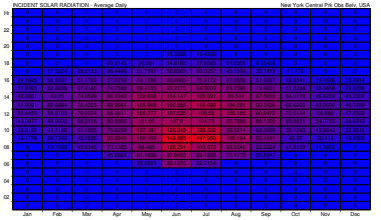
119°



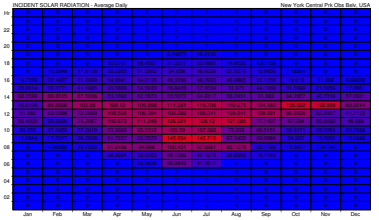
South



West



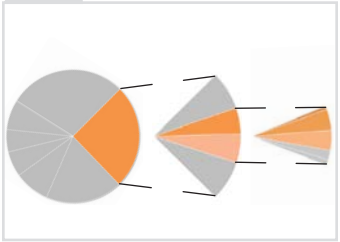
North



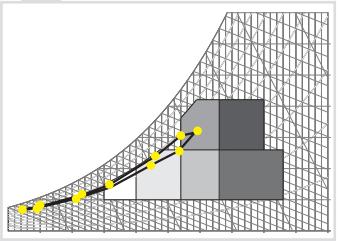
East

1 AREA OF INTEREST

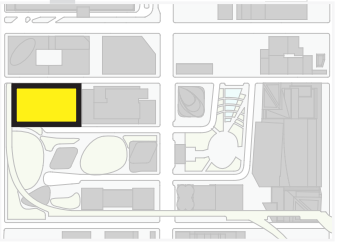
2 IDENTIFY PROBLEM



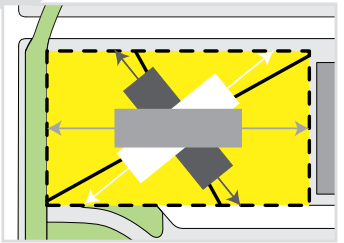
3 CLIMATE ANALYSIS



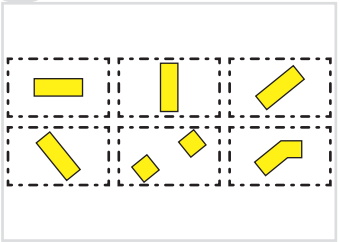
4 SITE SELECTION



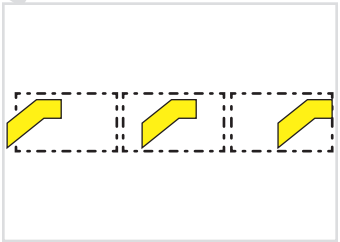
5 ORIENTATION ANALYSIS



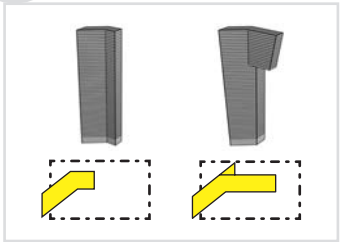
6 MASS COMPARISON



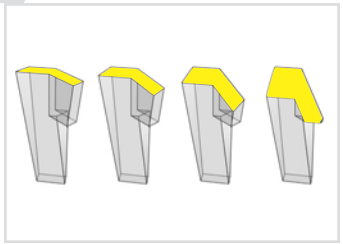
7 MASS LOCATION



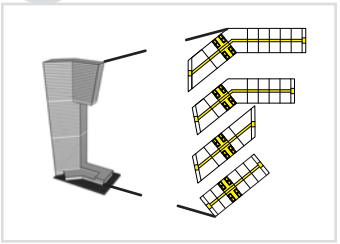
8 MASS OPTIMIZATION



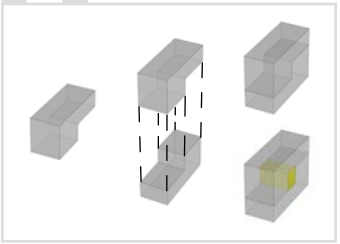
9 ROOF OPTIMIZATION



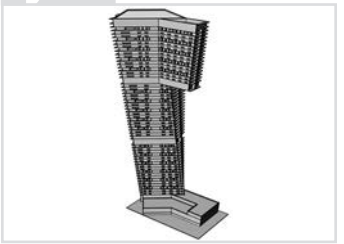
10 ARCHITECTURAL IMPLICATIONS



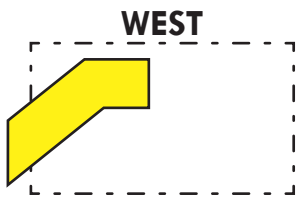
11 UNIT ANALYSIS

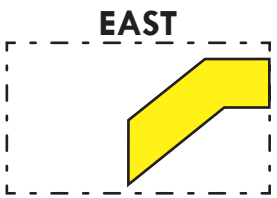


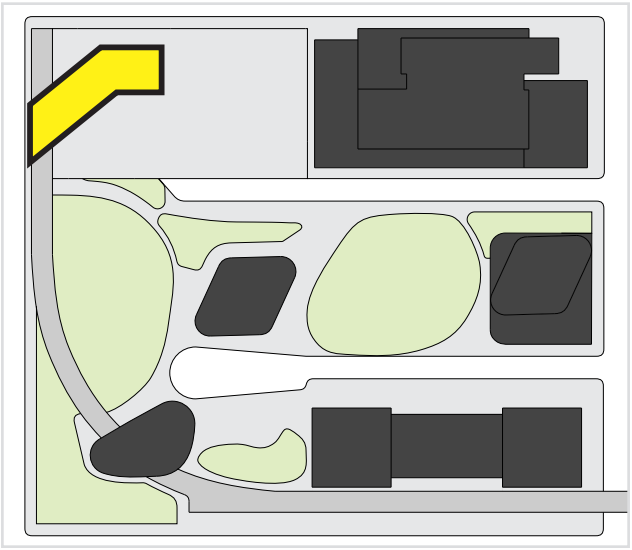
12 FINAL ANALYSIS

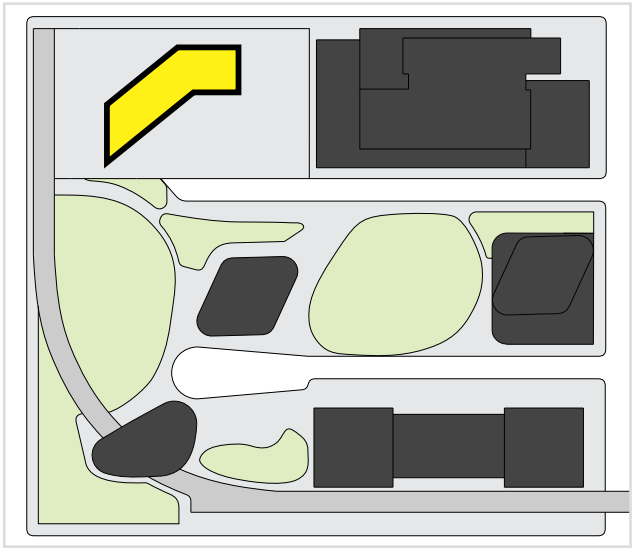


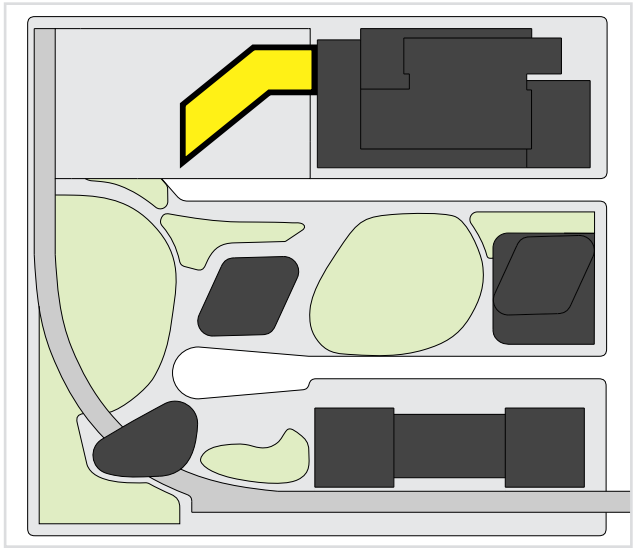
MASS LOCATION - Site Plans



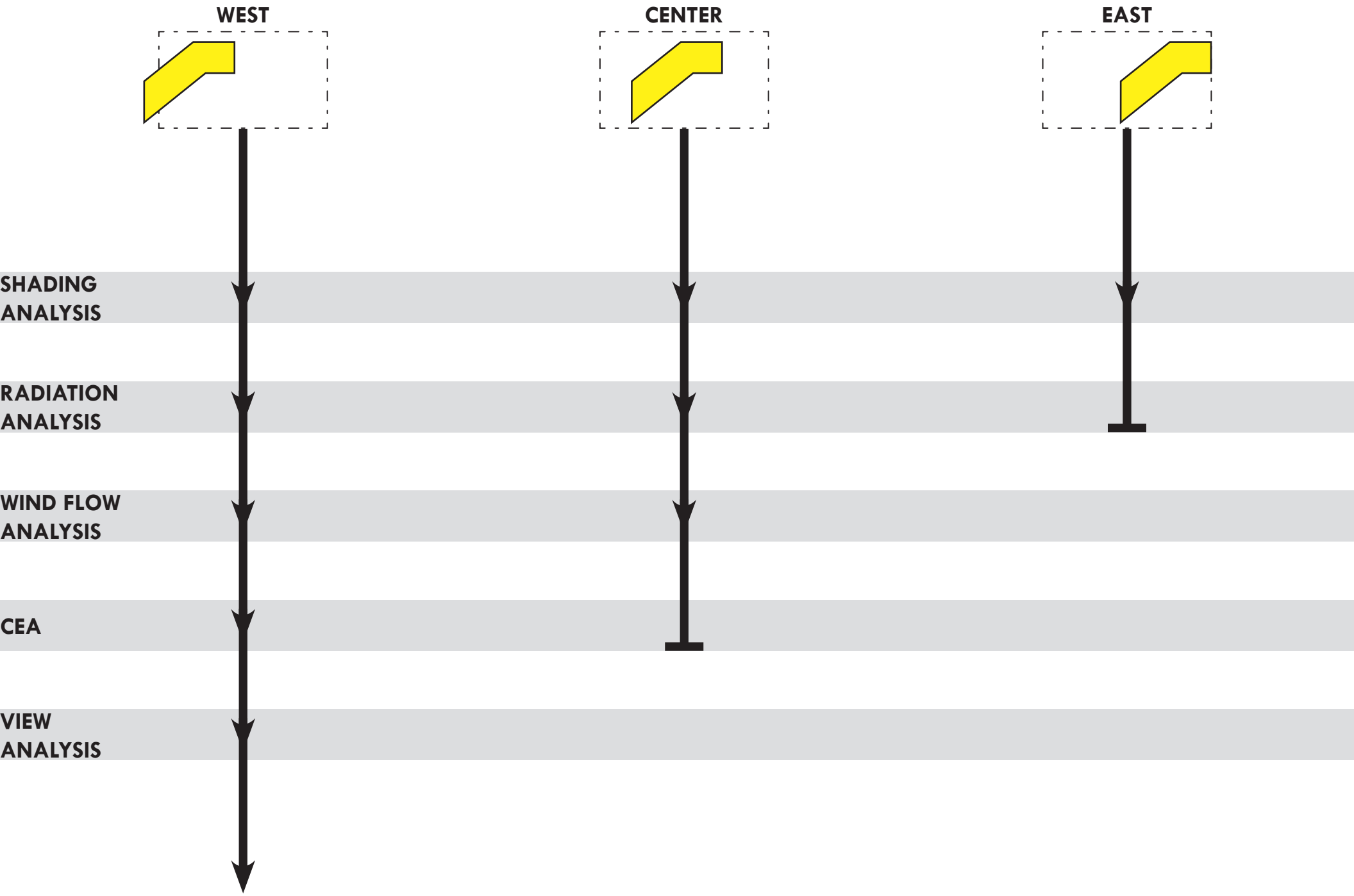




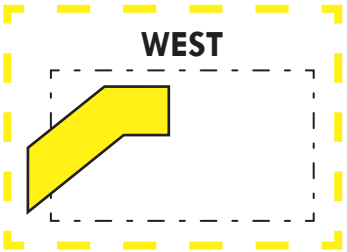


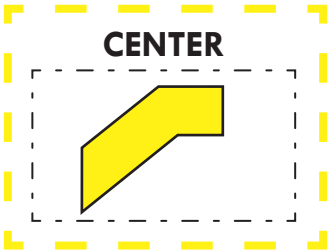


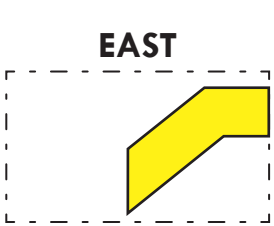
MASS LOCATION

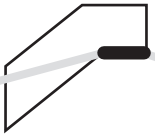


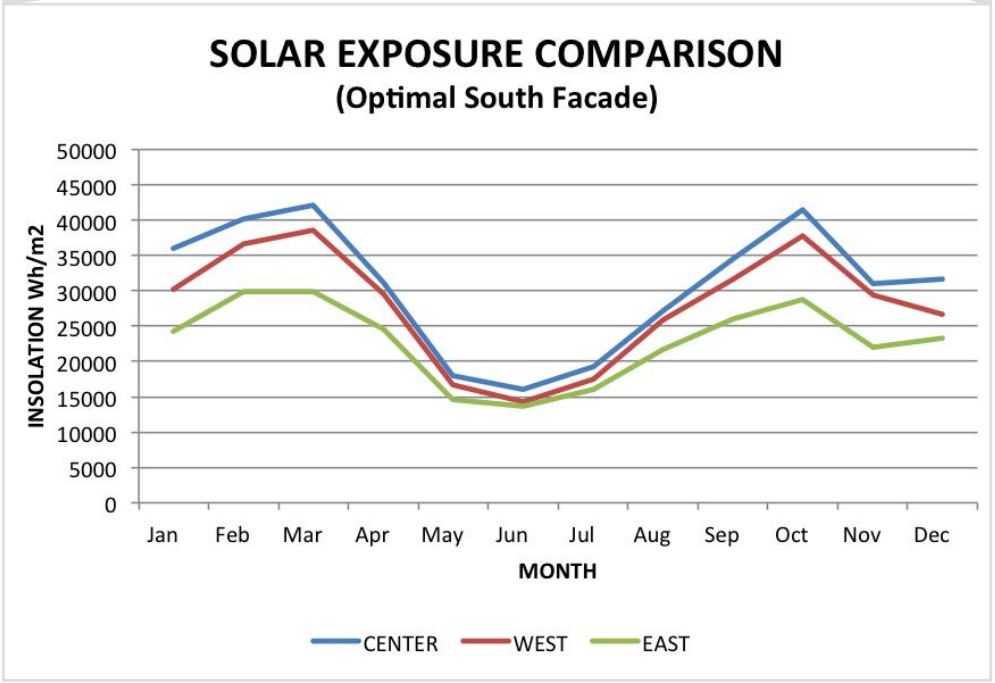
MASS LOCATION - Radiation Analysis

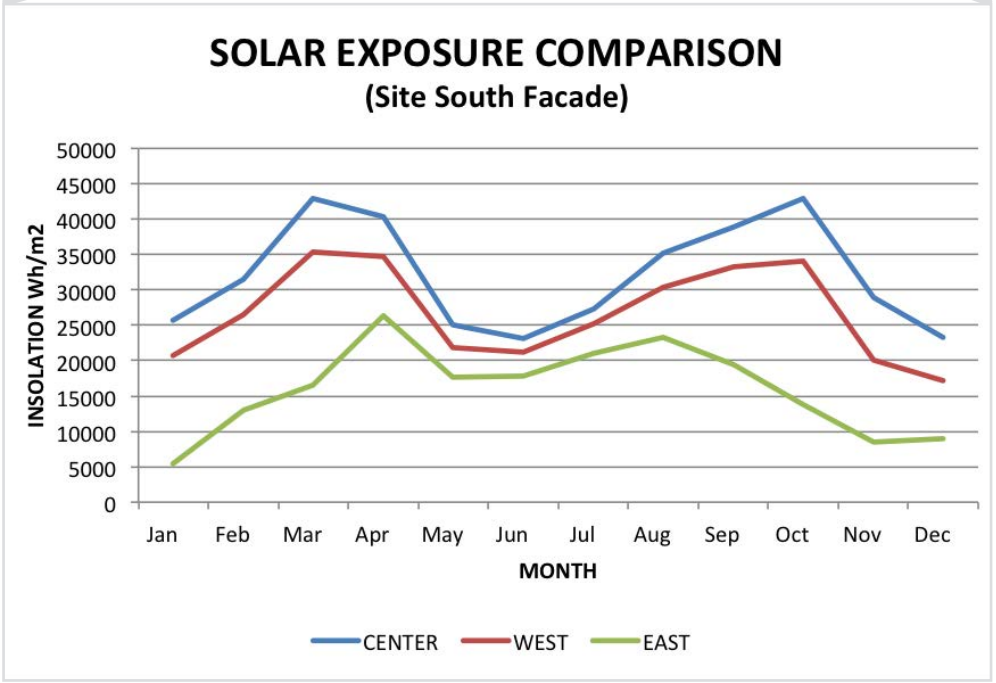






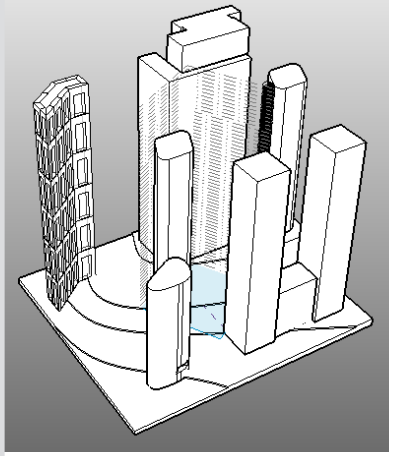






MASS LOCATION - Conceptual Energy Analysis

WEST



EUI

Electricity:	31 kWh/sf/yr
Fuel:	327 kBtu/sf/yr
Total:	431 kBtu/sf/yr

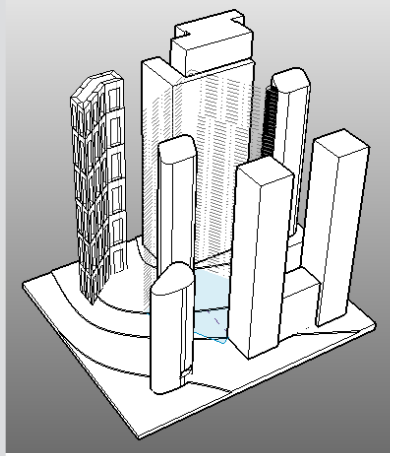
LIFE CYCLE

Electricity:	67,901,760 kWh
Fuel Use:	7,252,227 Therms
Energy Cost:	$7,467,479

HVAC LOADS

Cooling:	Window Solar
Heating:	Window Conductive

CENTER



EUI

Electricity:	43 kWh/sf/yr
Fuel:	352 kBtu/sf/yr
Total:	499 kBtu/sf/yr

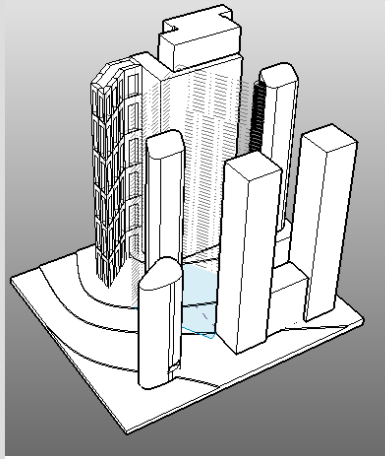
LIFE CYCLE

Electricity:	95,661,300 kWh
Fuel Use:	7,816,002 Therms
Energy Cost:	$9,523,828

HVAC LOADS

Cooling:	Window Solar
Heating:	Window Conductive

EAST



EUI

Electricity:	39 kWh/sf/yr
Fuel:	337 kBtu/sf/yr
Total:	469 kBtu/sf/yr

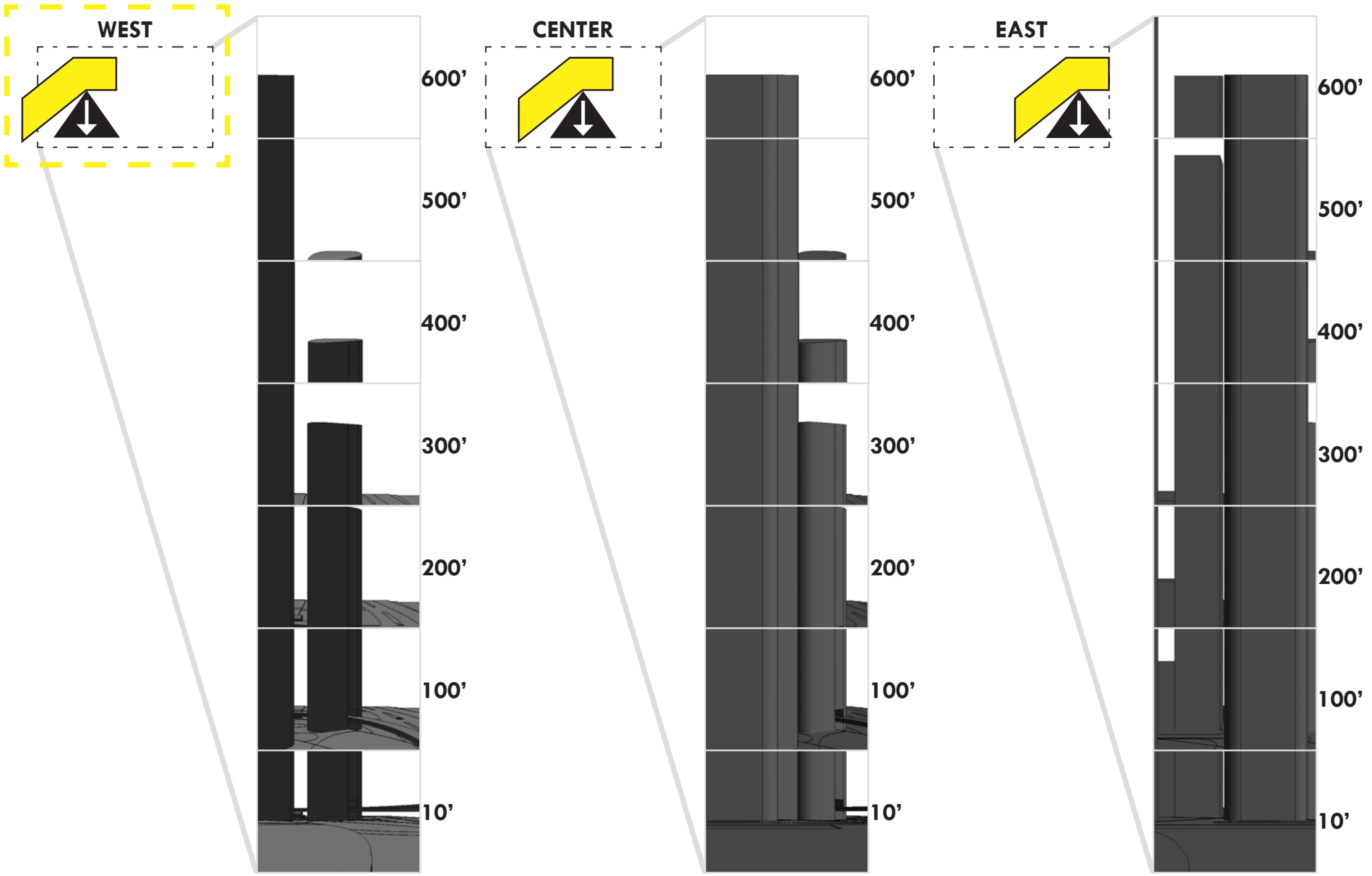
LIFE CYCLE

Electricity:	85,614,810 kWh
Fuel Use:	7,489,551 Therms
Energy Cost:	$8,728,807

HVAC LOADS

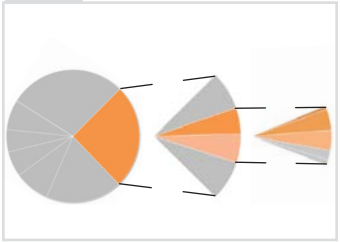
Cooling:	Window Solar
Heating:	Window Conductive

MASS LOCATION - Southern View Corridors

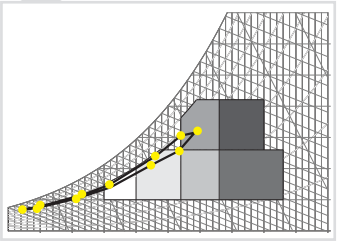


1 AREA OF INTEREST

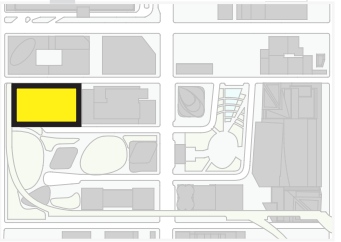
2 IDENTIFY PROBLEM



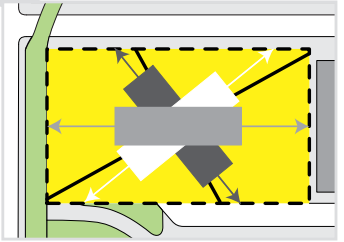
3 CLIMATE ANALYSIS



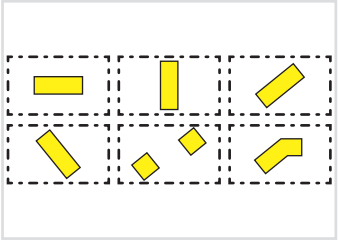
4 SITE SELECTION



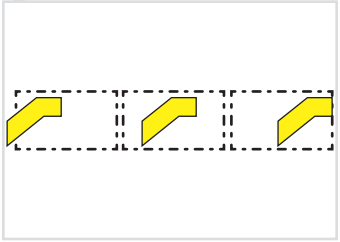
5 ORIENTATION ANALYSIS



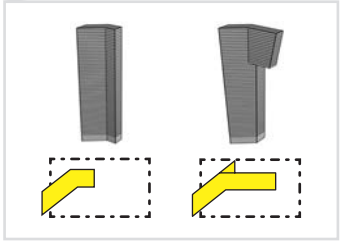
6 MASS COMPARISON



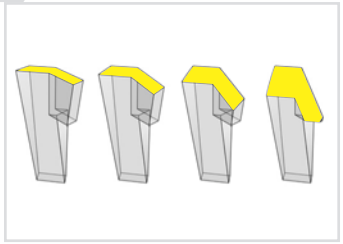
7 MASS LOCATION



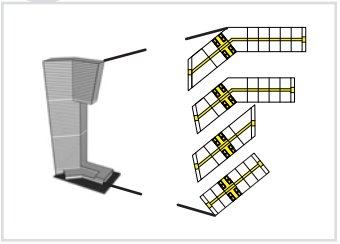
8 MASS OPTIMIZATION



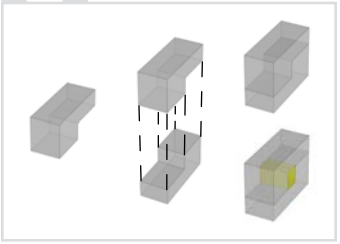
9 ROOF OPTIMIZATION



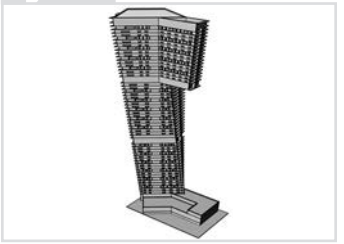
10 ARCHITECTURAL IMPLICATIONS



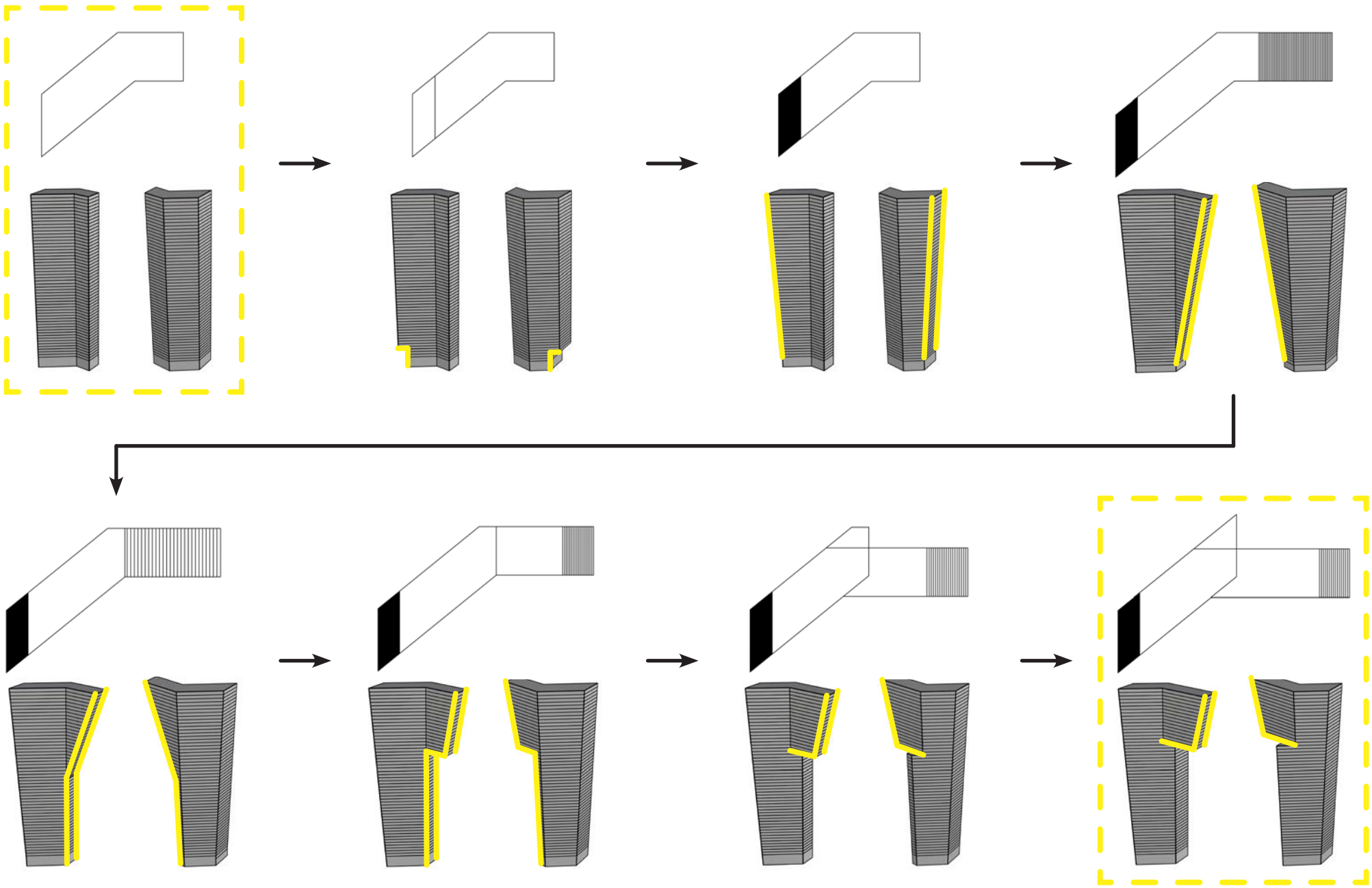
11 UNIT ANALYSIS



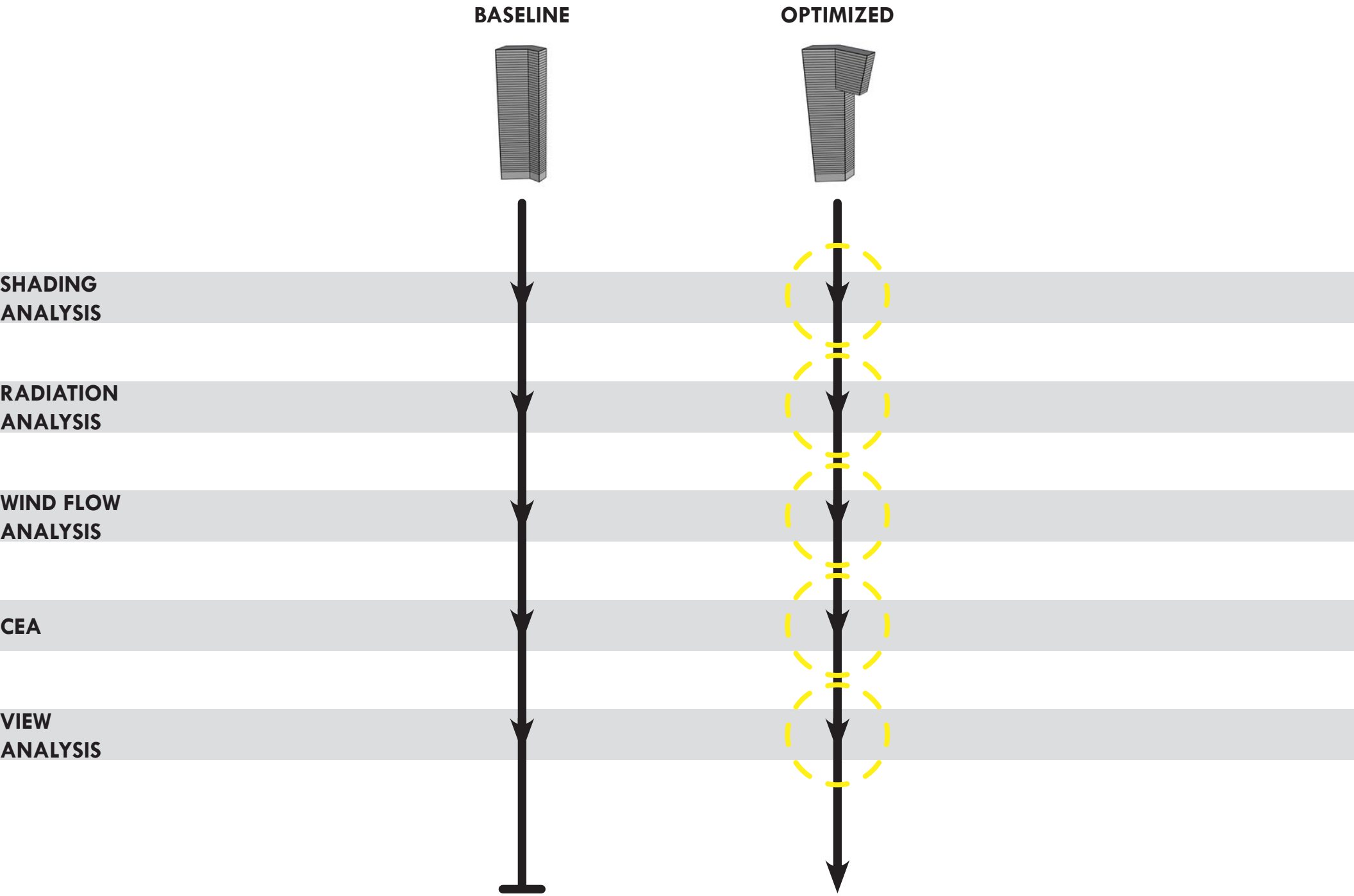
12 FINAL ANALYSIS



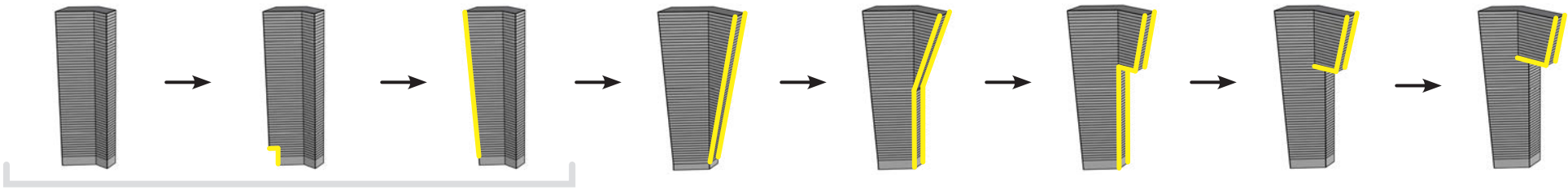
MASS OPTIMIZATION - Mass Evolution

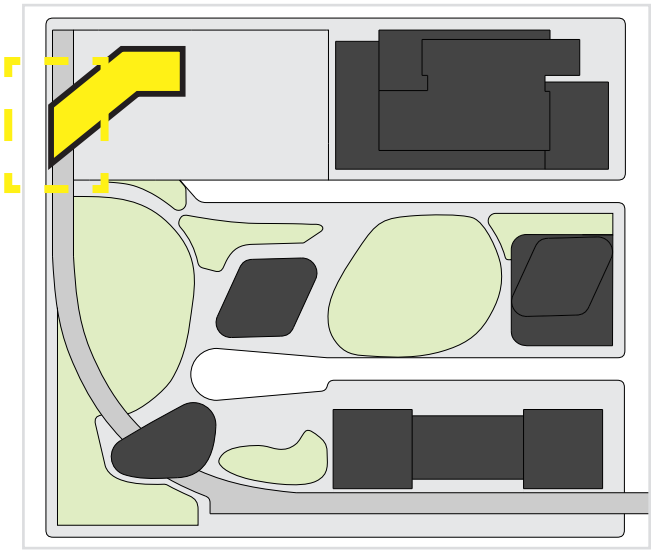


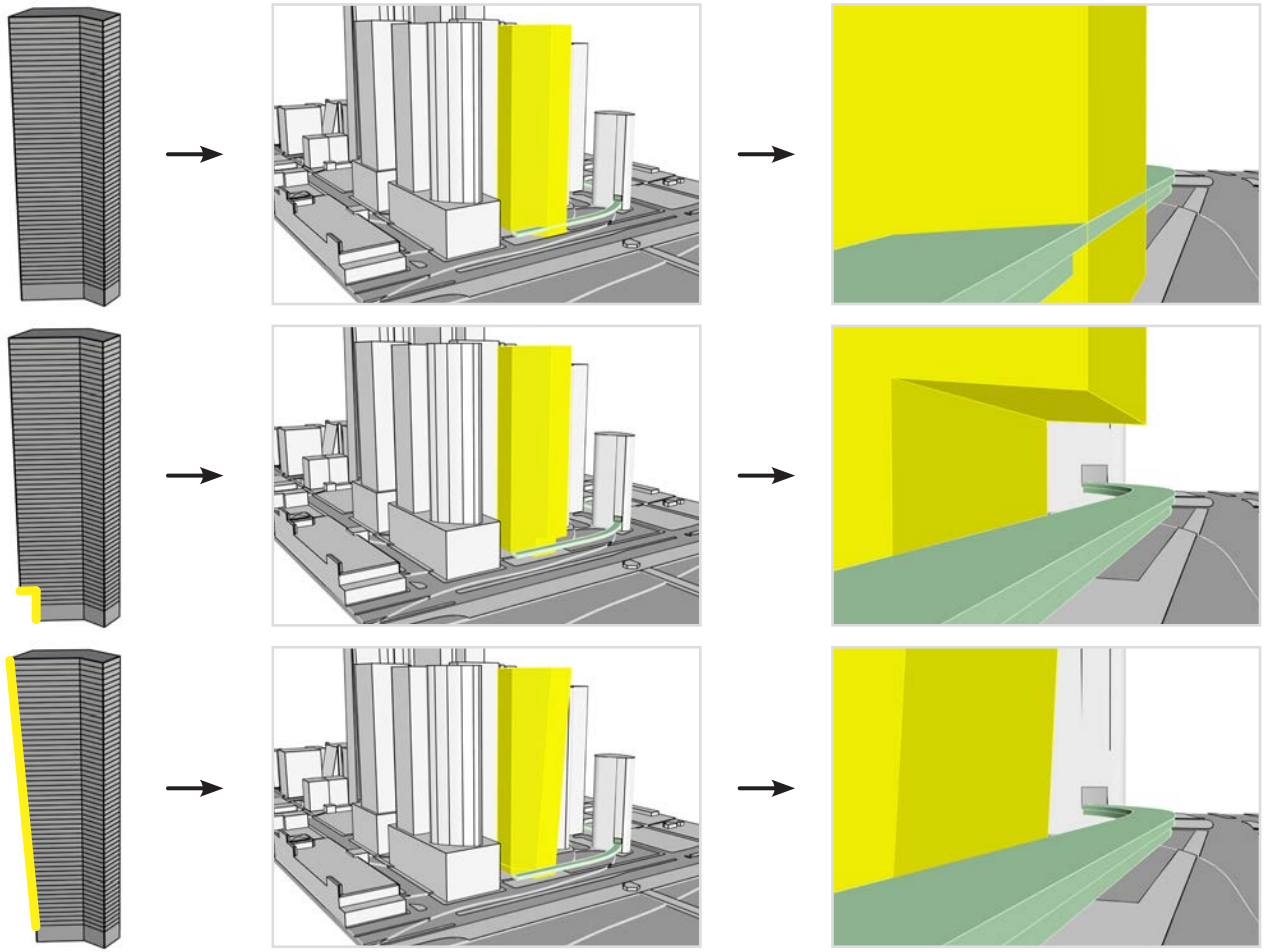
MASS OPTIMIZATION



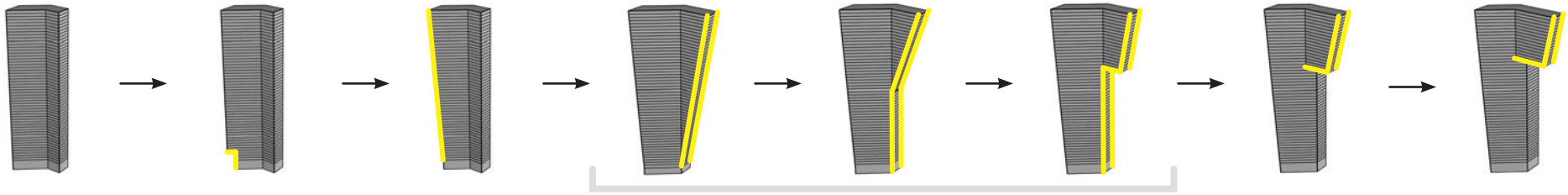
MASS OPTIMIZATION - High Line Interaction

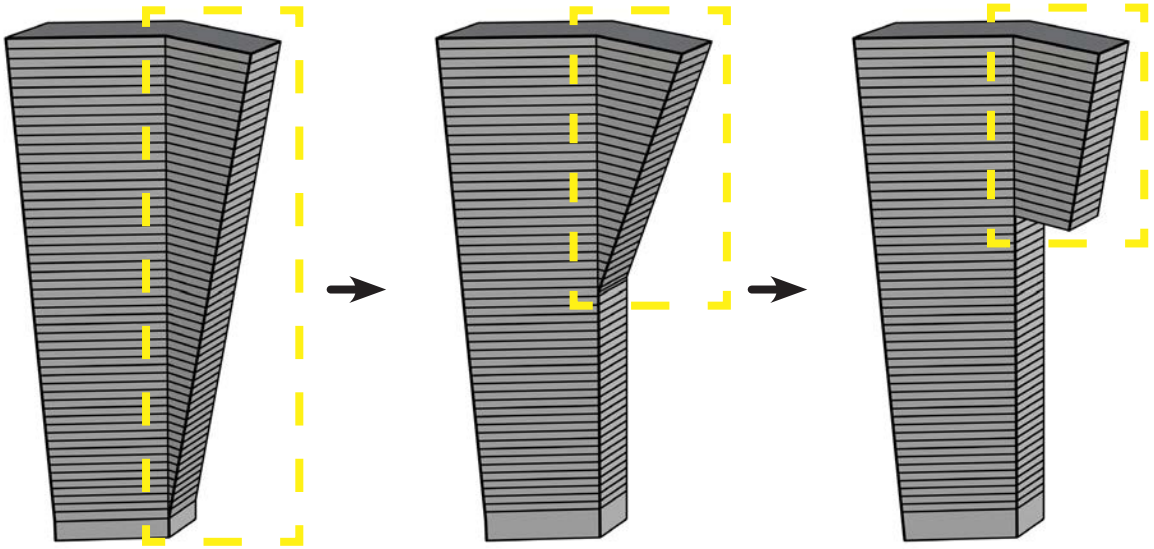






MASS OPTIMIZATION - Maximize Winter Insolation



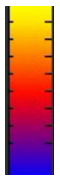


Maximize Winter Insolation; Bring Massing to Top

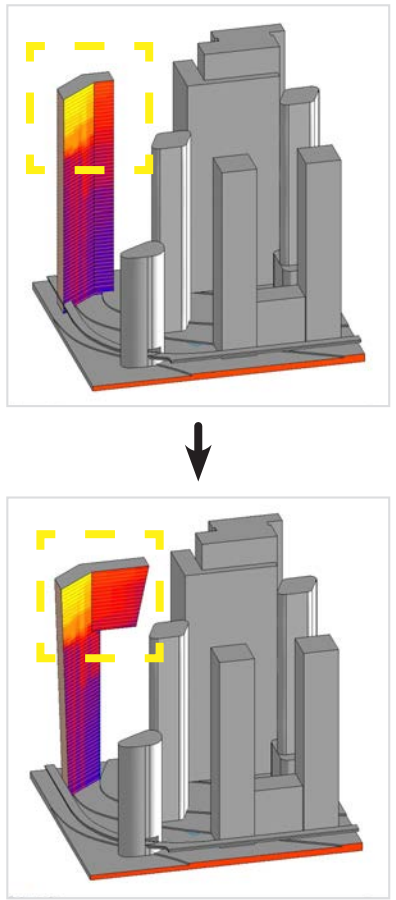
Adjust Floor Plates to Desired Square Footage

Maximize Winter Insolation; Reduce Inefficient Floors

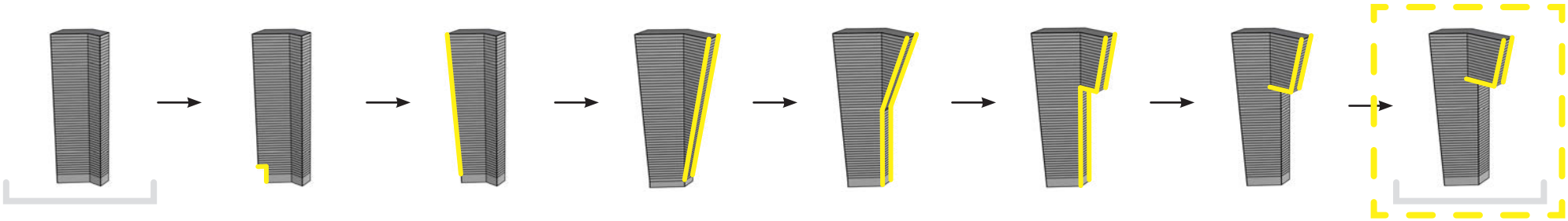
HIGHER RADIATION

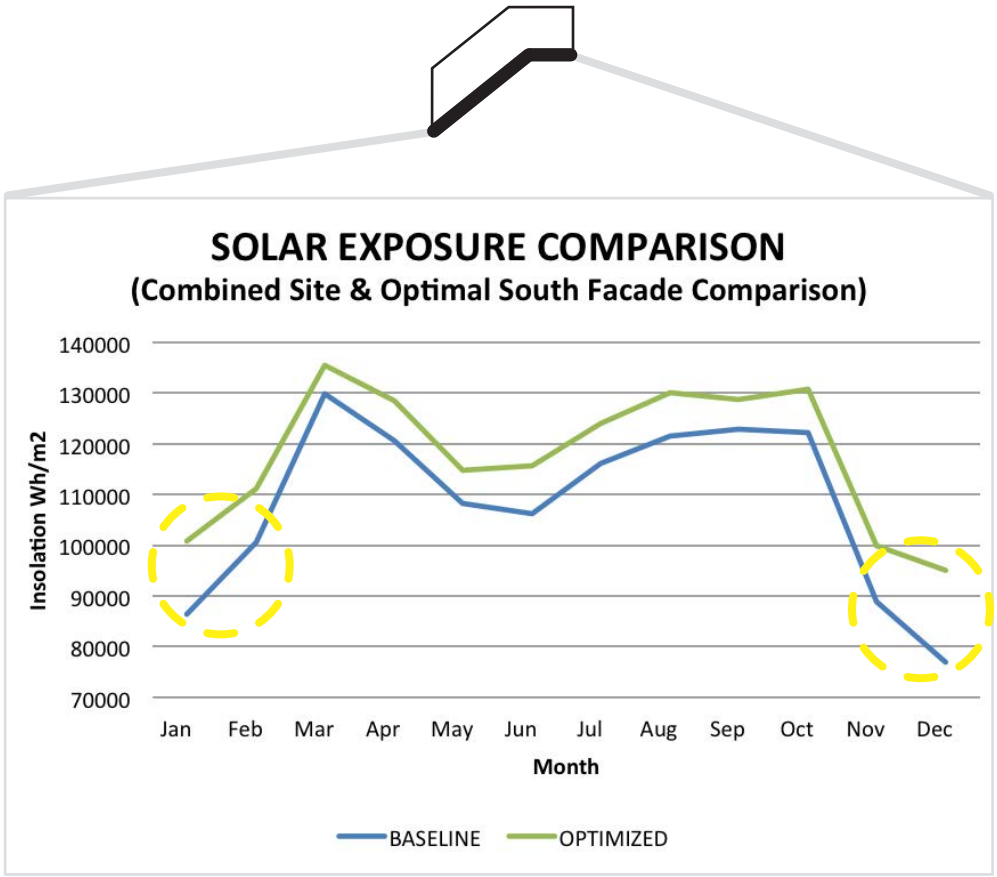


LOWER RADIATION

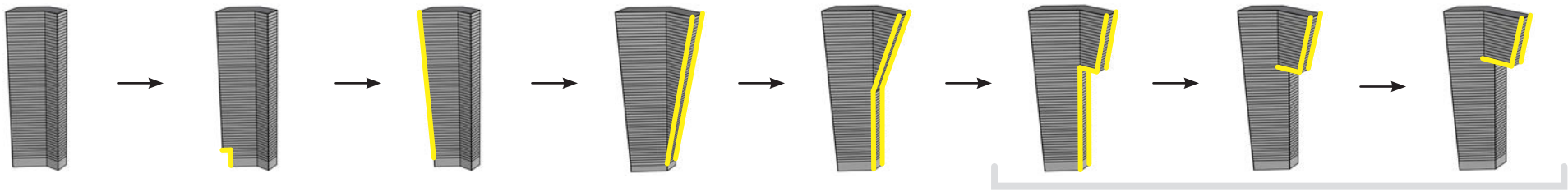


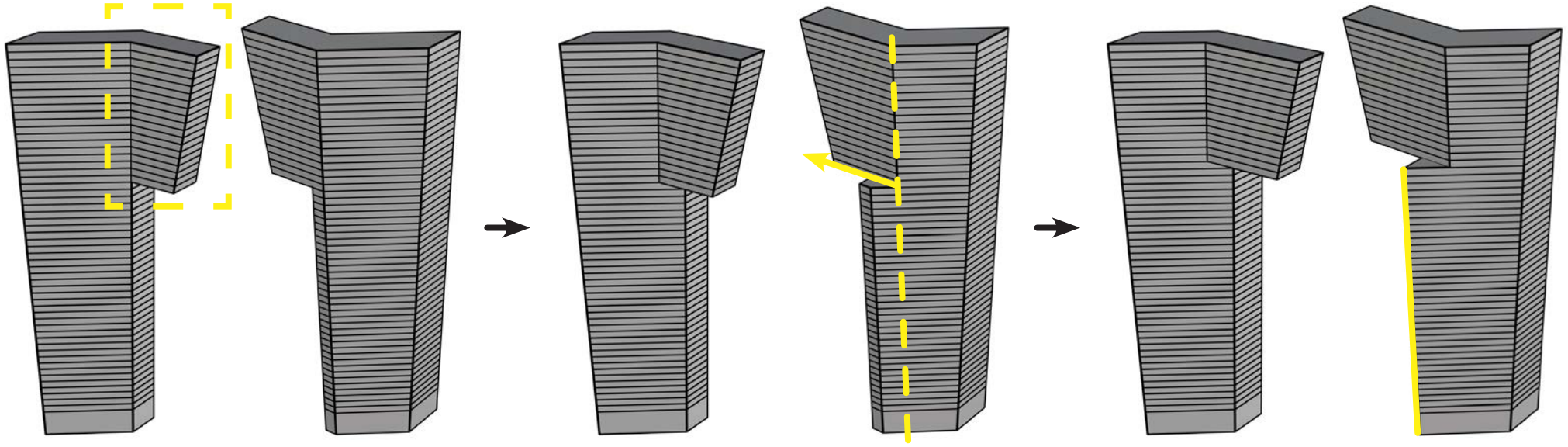
MASS OPTIMIZATION - Maximize Winter Insolation





MASS OPTIMIZATION - Streamline Mass



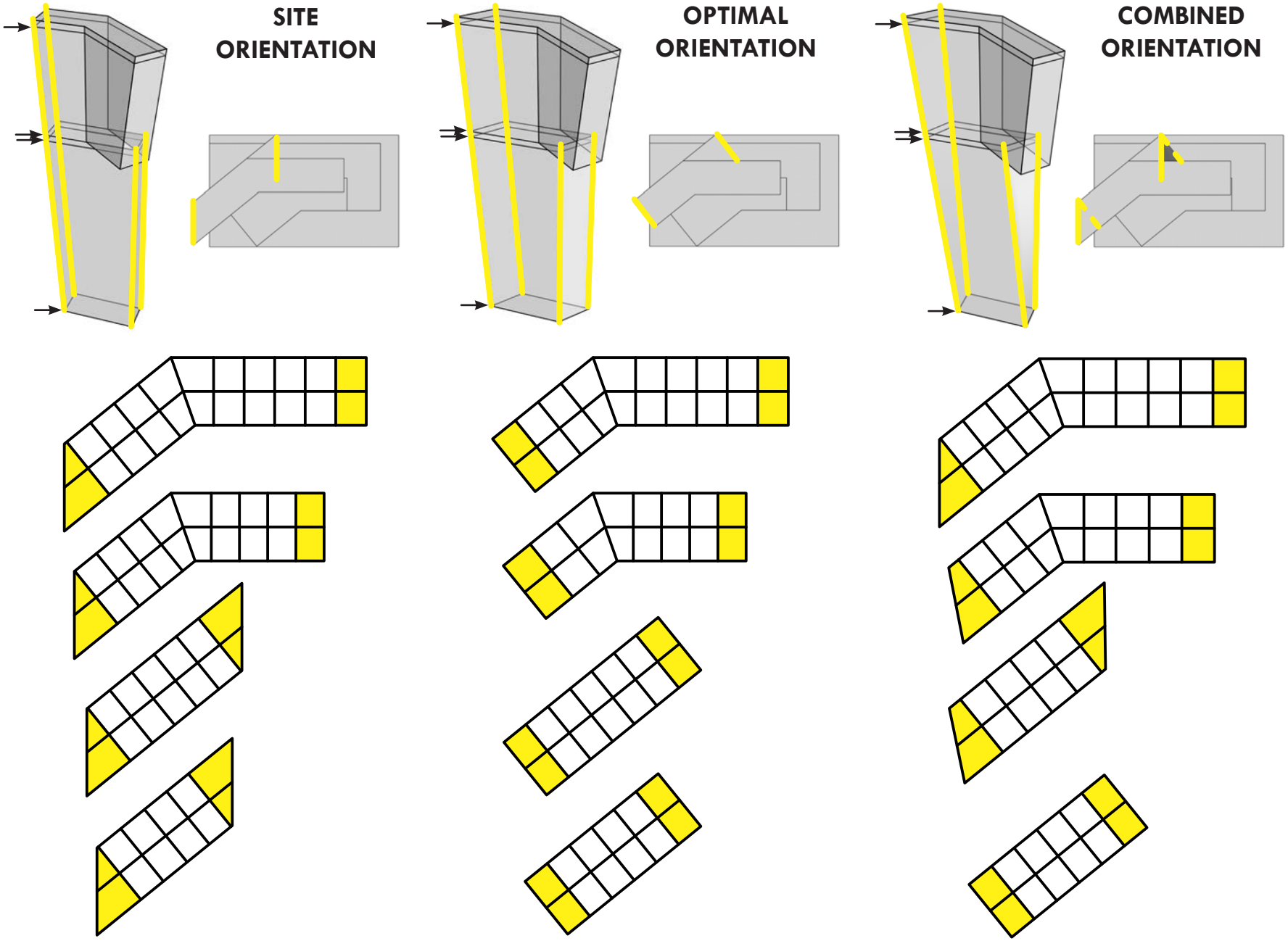


Maximized Winter Insolation

Maximize Optimal Orientation Surface Area; Streamline Aesthetics; Adjust Square Footage

Streamline Aesthetics; Adjust Square Footage

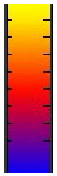
MASS OPTIMIZATION - Floor Plate Divisions



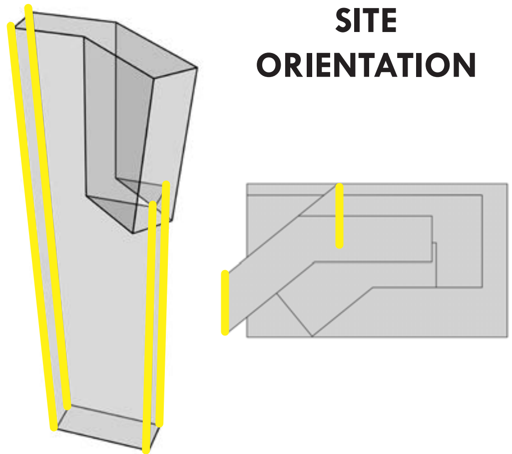
8

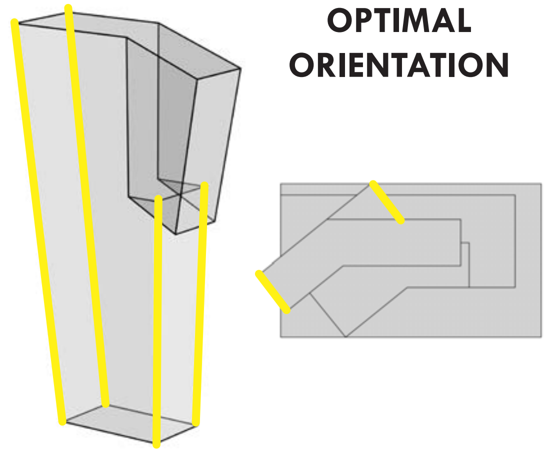
MASS OPTIMIZATION - East/West Facades

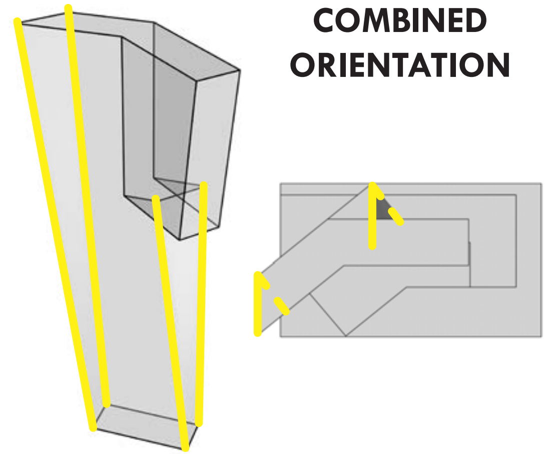
HIGHER RADIATION



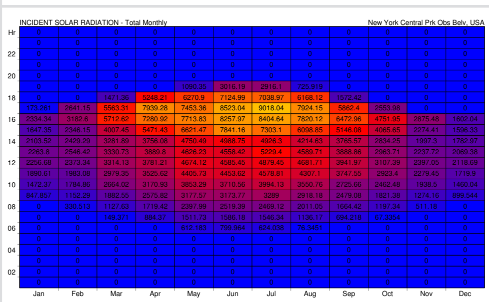
LOWER RADIATION

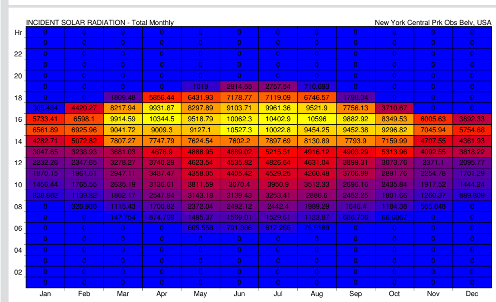


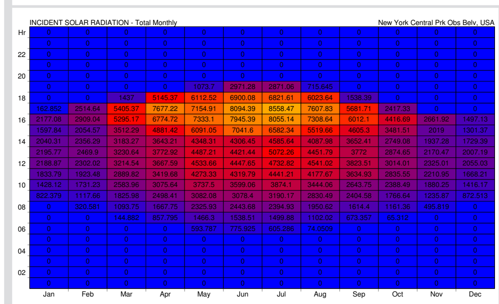




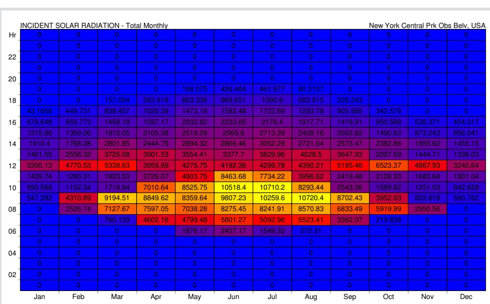
WEST FACADE

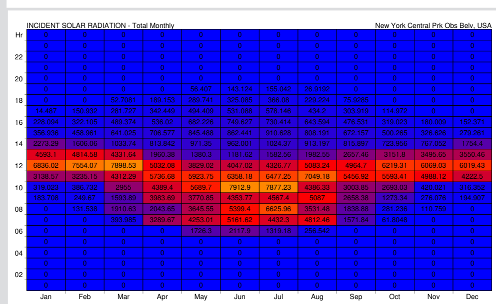


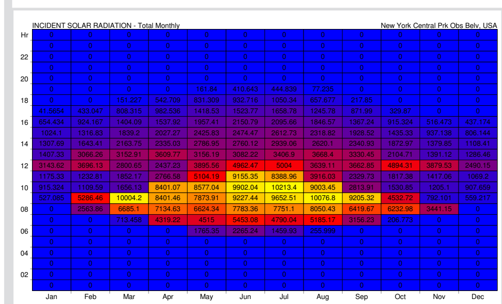




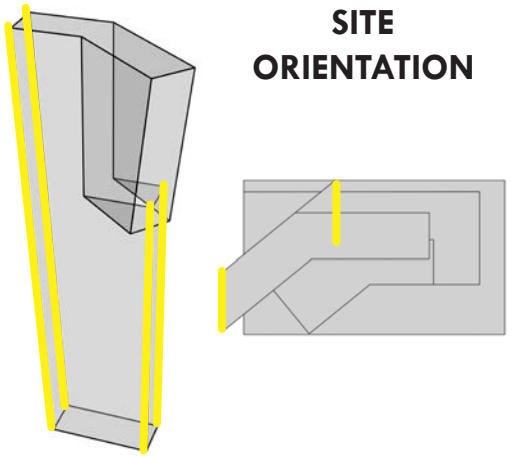
EAST FACADE

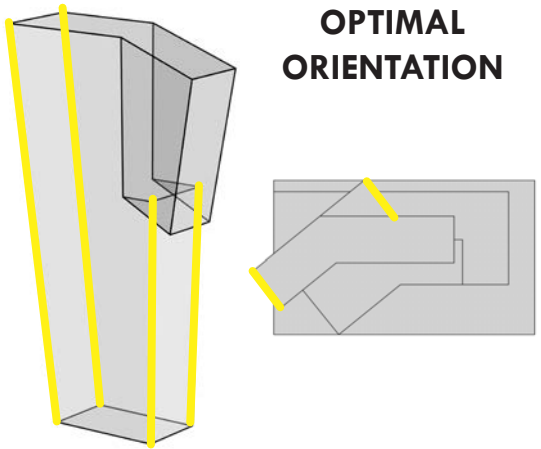


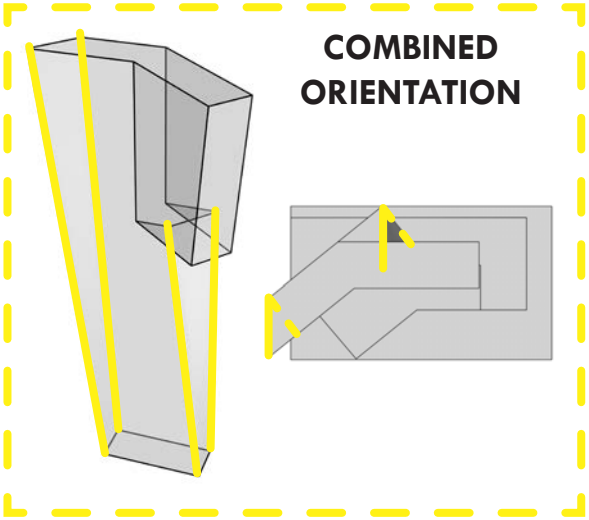


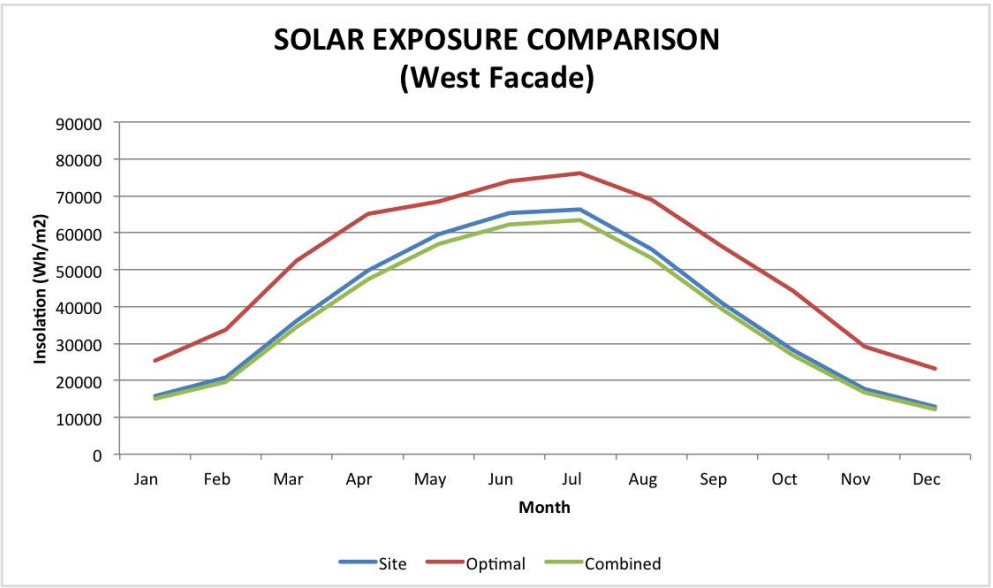


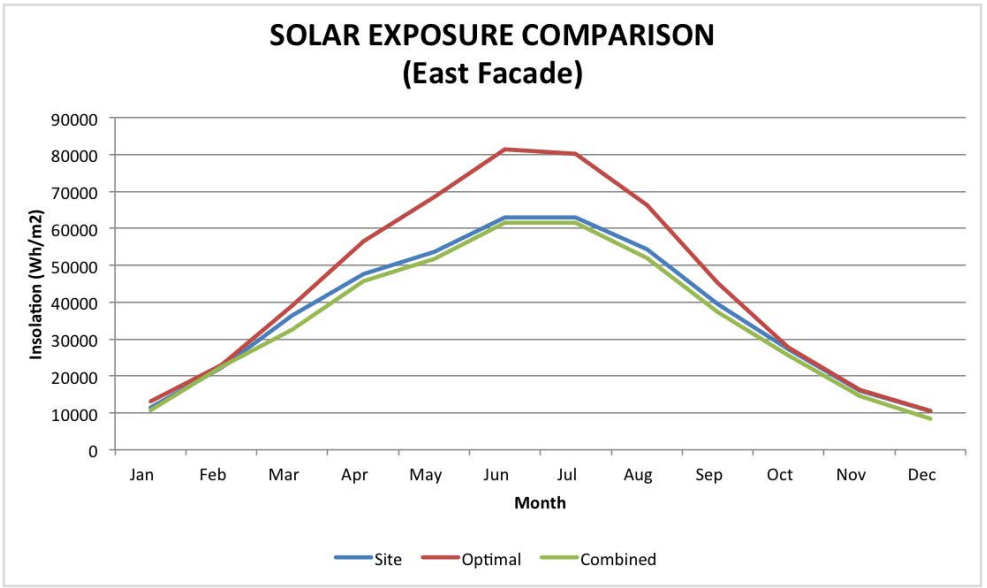
MASS OPTIMIZATION - East/West Facades











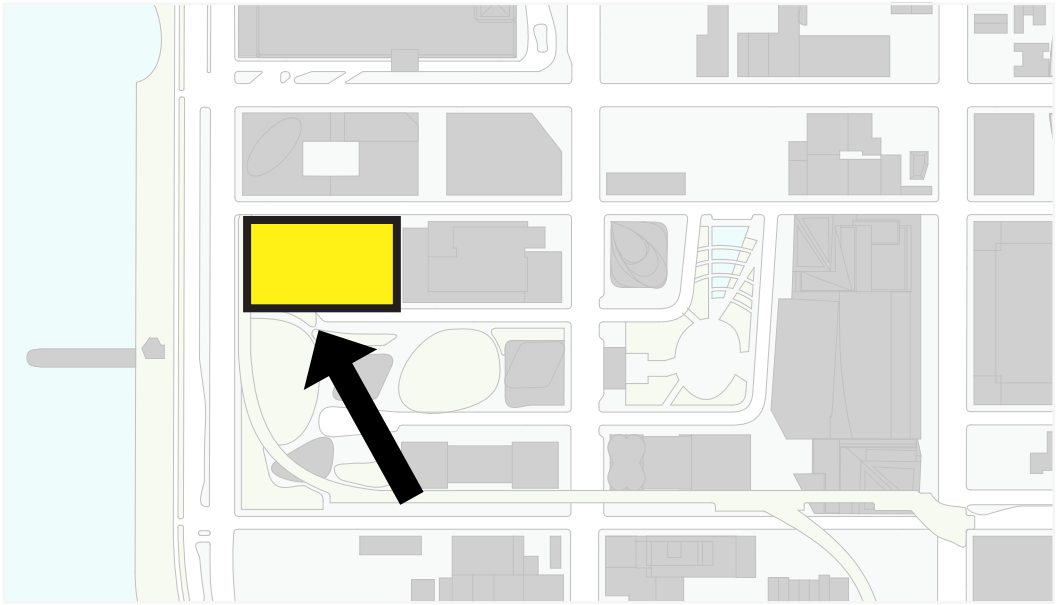
SITE **24% MORE EFFICIENT** THAN OPTIMAL

COMBINED **27% MORE EFFICIENT** THAN OPTIMAL

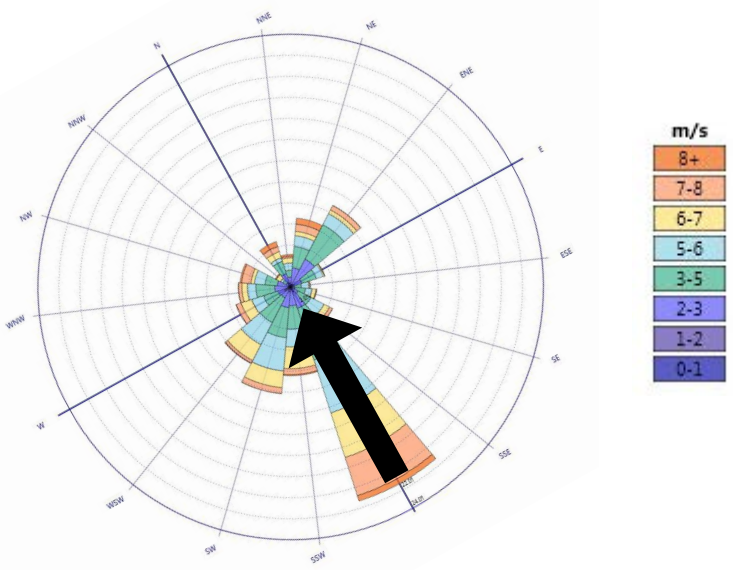
SITE **15% MORE EFFICIENT** THAN OPTIMAL

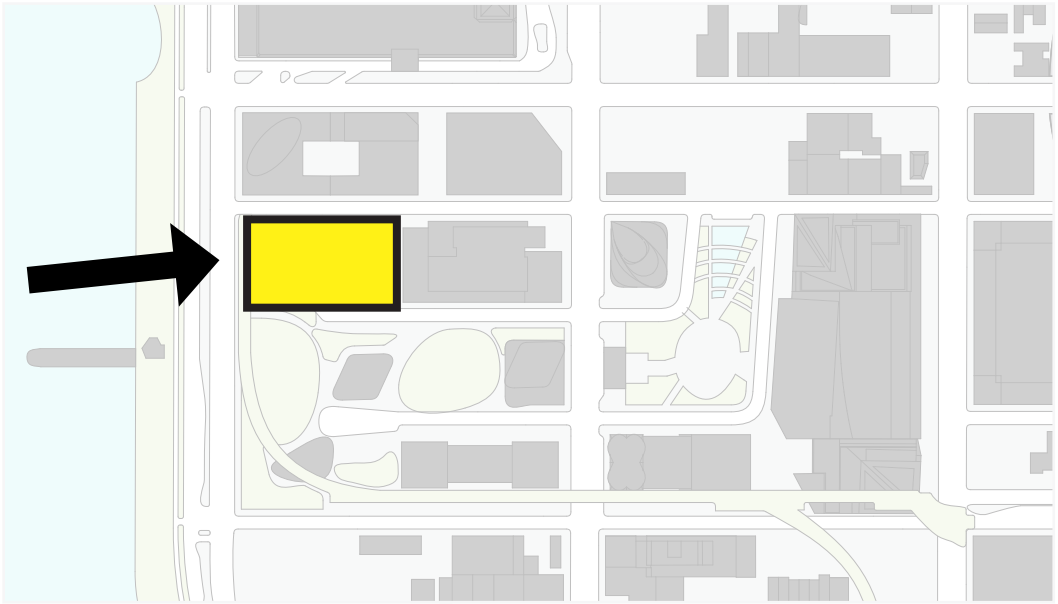
COMBINED **20% MORE EFFICIENT** THAN OPTIMAL

MASS OPTIMIZATION - Wind Flow Analysis

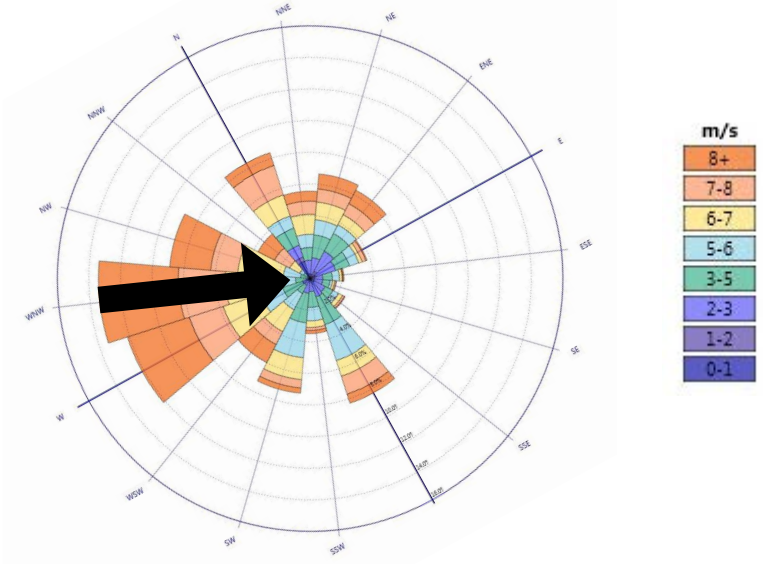


SUMMER WIND ROSE





WINTER WIND ROSE



MASS OPTIMIZATION - Summer Wind Flow Analysis

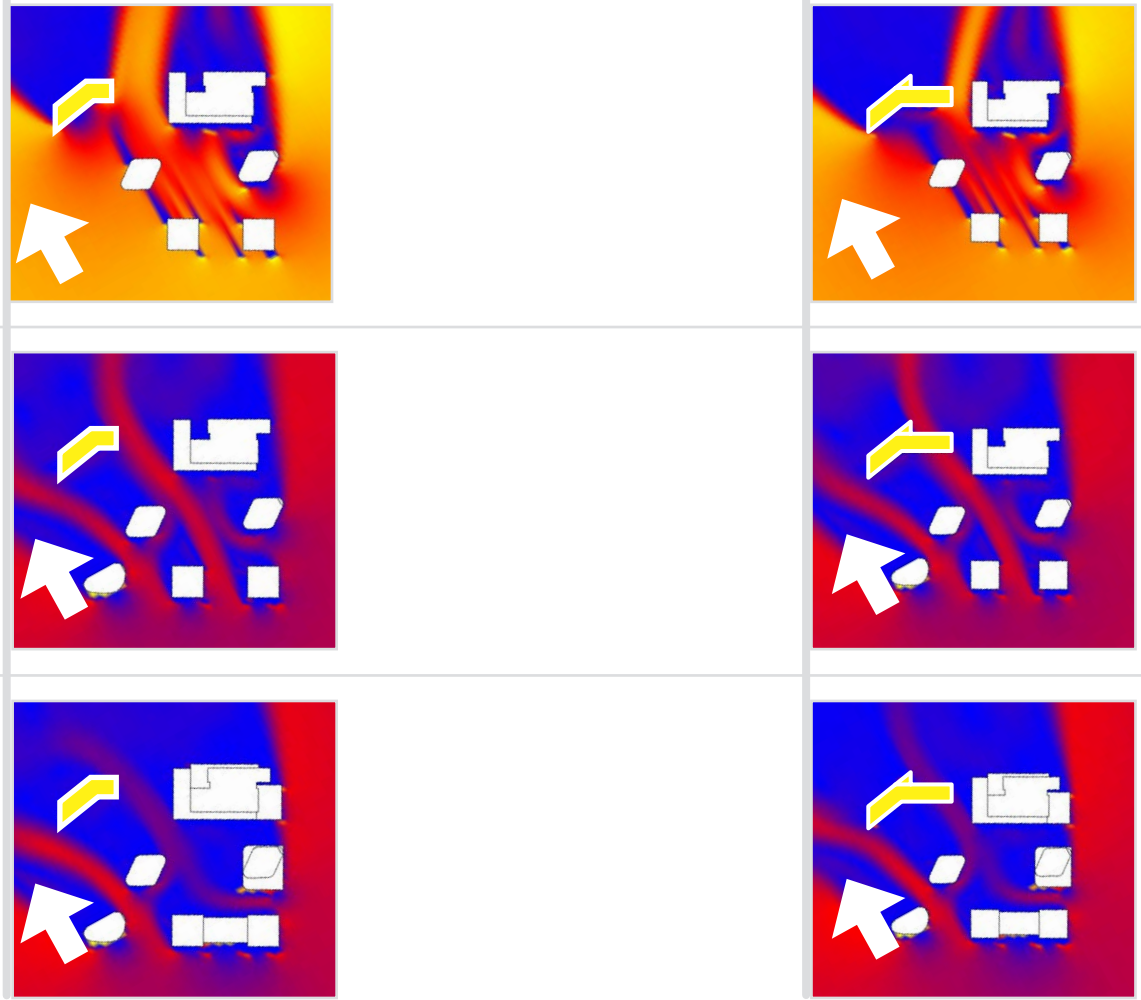
BASELINE

OPTIMIZED

600’ ELEVATION

300’ ELEVATION

100’ ELEVATION

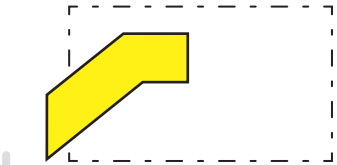


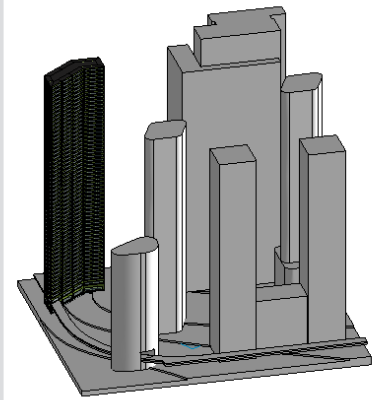
HIGHER VELOCITY

LOWER VELOCITY

MASS OPTIMIZATION - Conceptual Energy Analysis

BASELINE





EUI

Electricity:	15 kWh/sf/yr
Fuel:	44 kBtu/sf/yr
Total:	94 kBtu/sf/yr

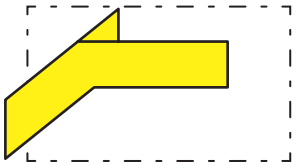
LIFE CYCLE

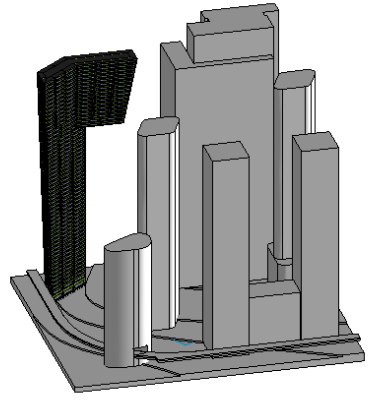
Electricity:	307,445,100 kWh
Fuel Use:	9,344,002 Therms
Energy Cost:	$24,061,258

HVAC LOADS

Cooling:	Window Solar
Heating:	Window Conductive

OPTIMIZED





EUI

Electricity:	15 kWh/sf/yr
Fuel:	45 kBtu/sf/yr
Total:	94 kBtu/sf/yr

LIFE CYCLE

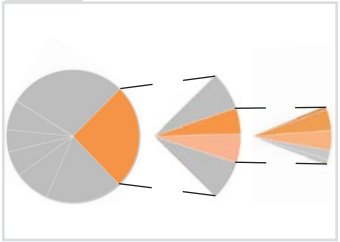
Electricity:	300,686,100 kWh
Fuel Use:	9,206,982 Therms
Energy Cost:	$23,560,665

HVAC LOADS

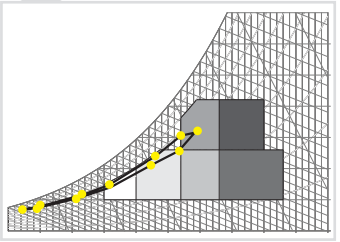
Cooling:	Window Solar
Heating:	Window Conductive

1 AREA OF INTEREST

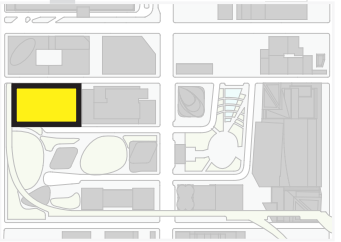
2 IDENTIFY PROBLEM



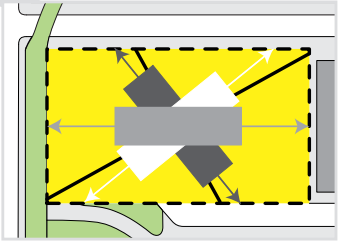
3 CLIMATE ANALYSIS



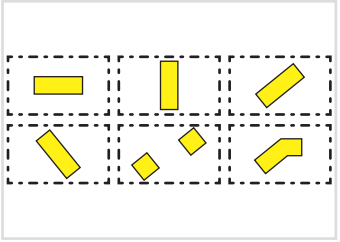
4 SITE SELECTION



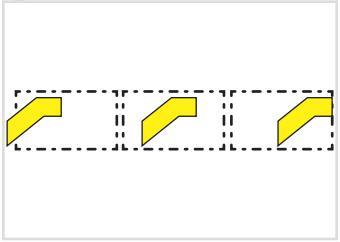
5 ORIENTATION ANALYSIS



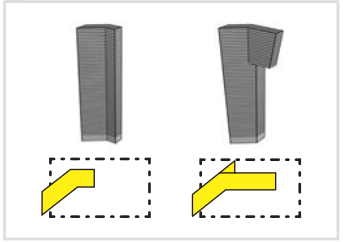
6 MASS COMPARISON



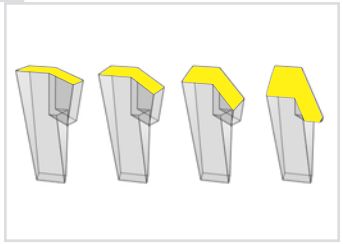
7 MASS LOCATION



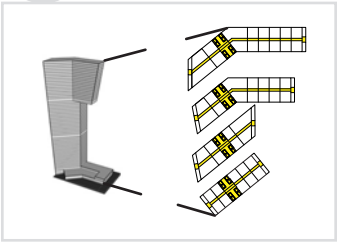
8 MASS OPTIMIZATION



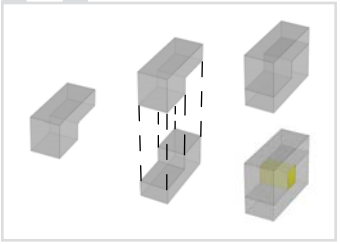
9 ROOF OPTIMIZATION



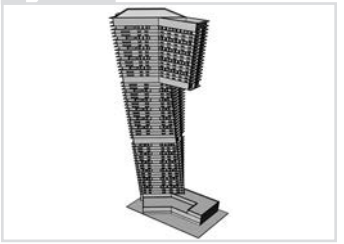
10 ARCHITECTURAL IMPLICATIONS



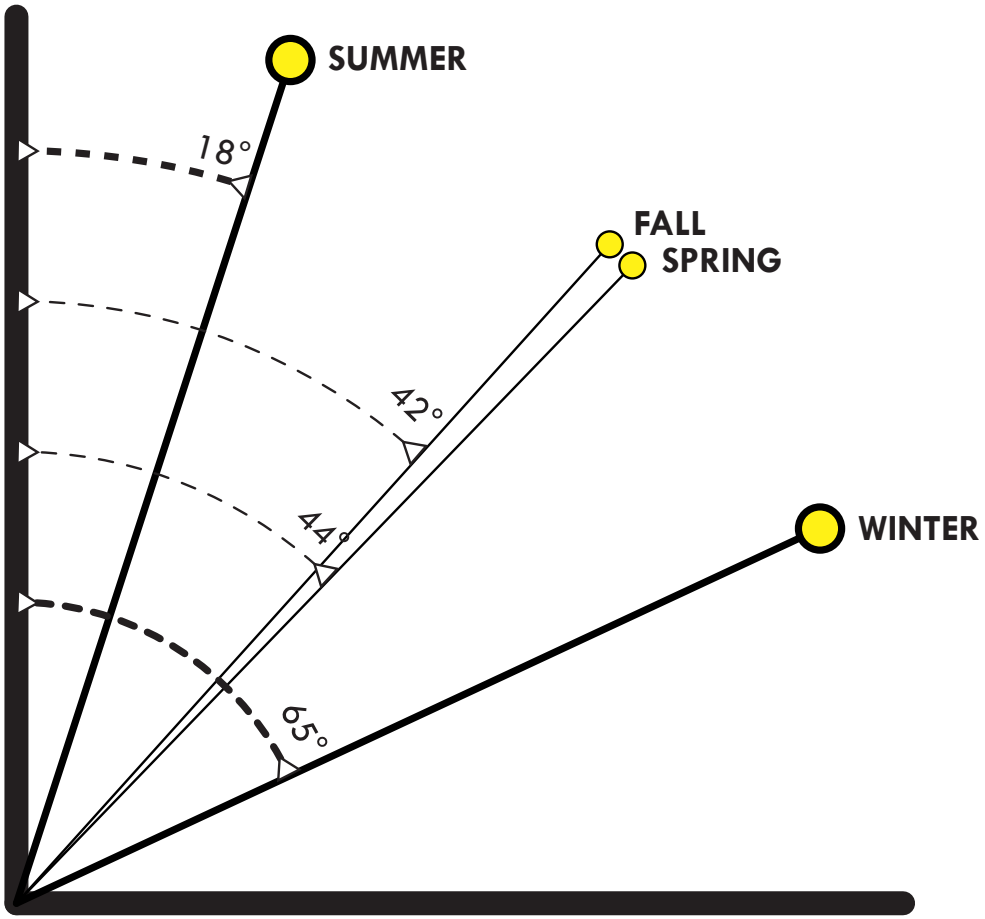
11 UNIT ANALYSIS

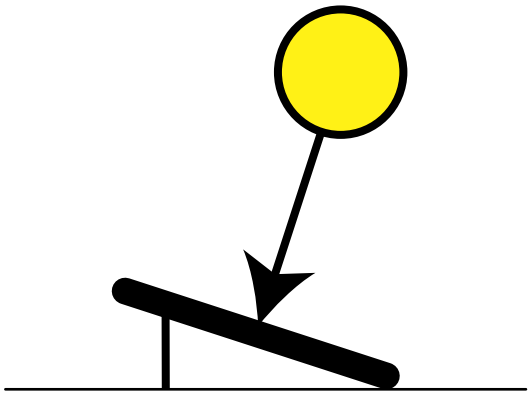


12 FINAL ANALYSIS



ROOF OPTIMIZATION - Seasonal Solar Angles

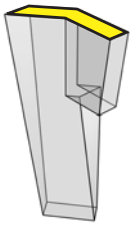




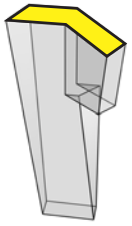
SOLAR PANEL PERPENDICULAR TO SOLAR ANGLE TO MAXIMIZE INSOLATION

ROOF OPTIMIZATION

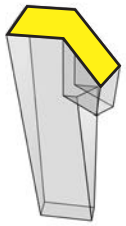
FLAT



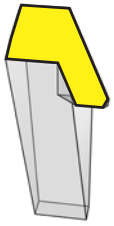
SUMMER



SPRING / FALL

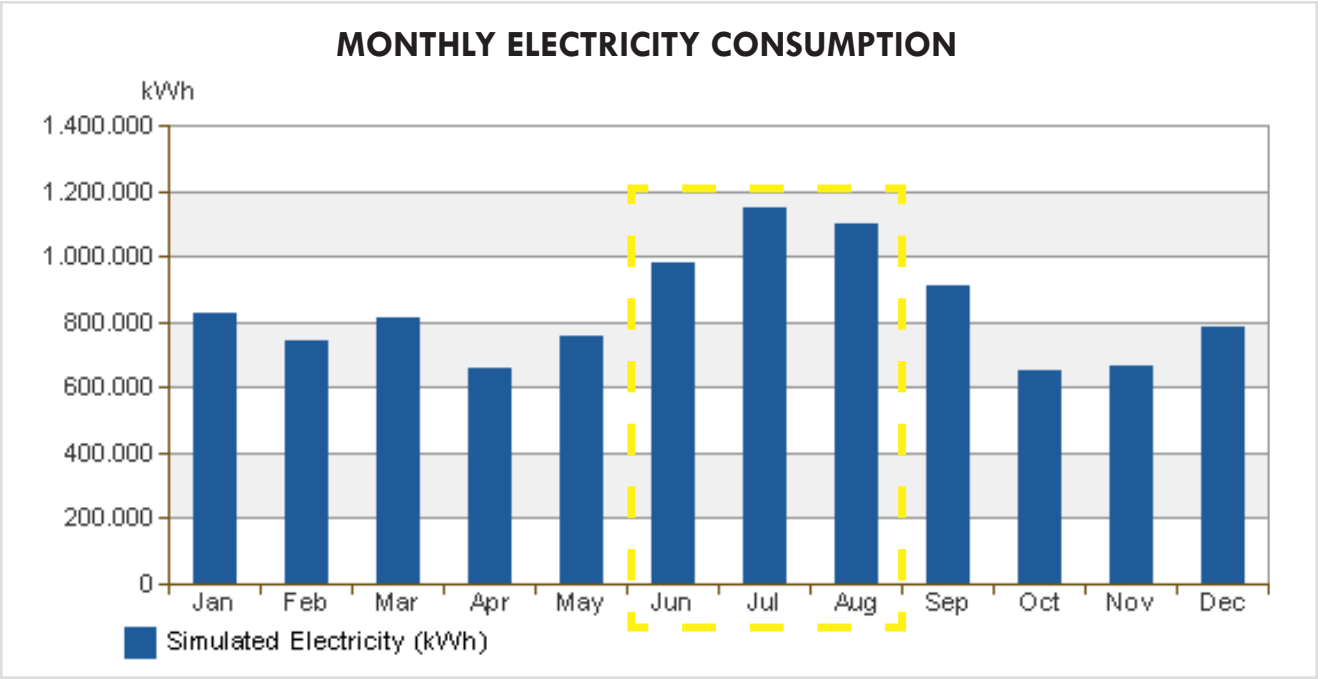


WINTER



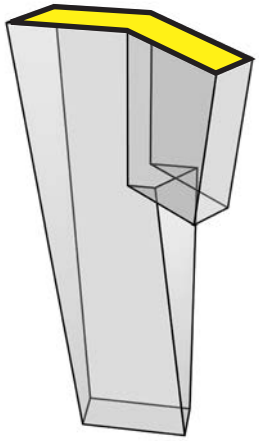
RADIATION ANALYSIS

ROOF OPTIMIZATION - Energy Demand

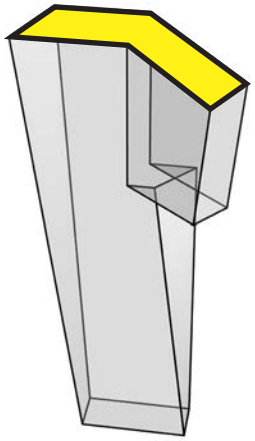


ROOF OPTIMIZATION - Radiation Analysis

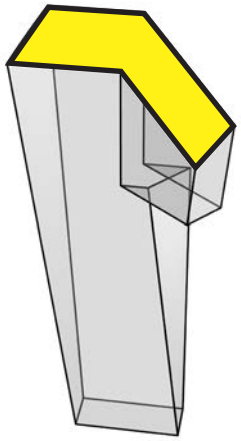
FLAT



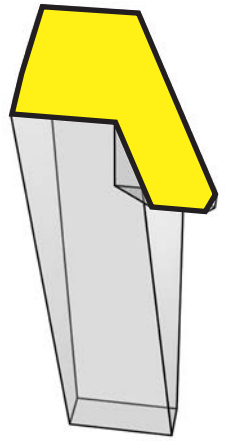
SUMMER

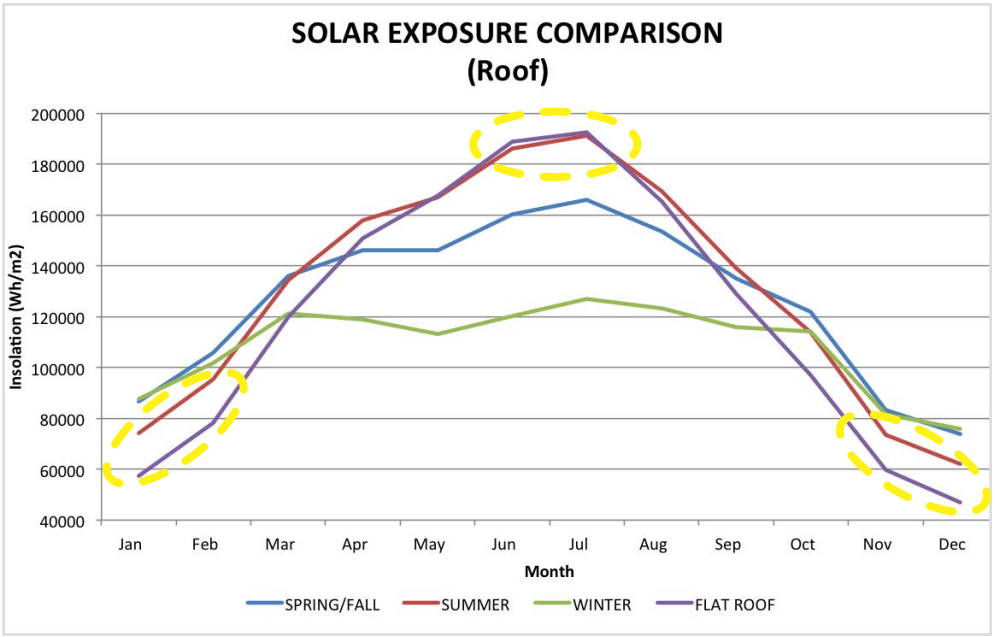


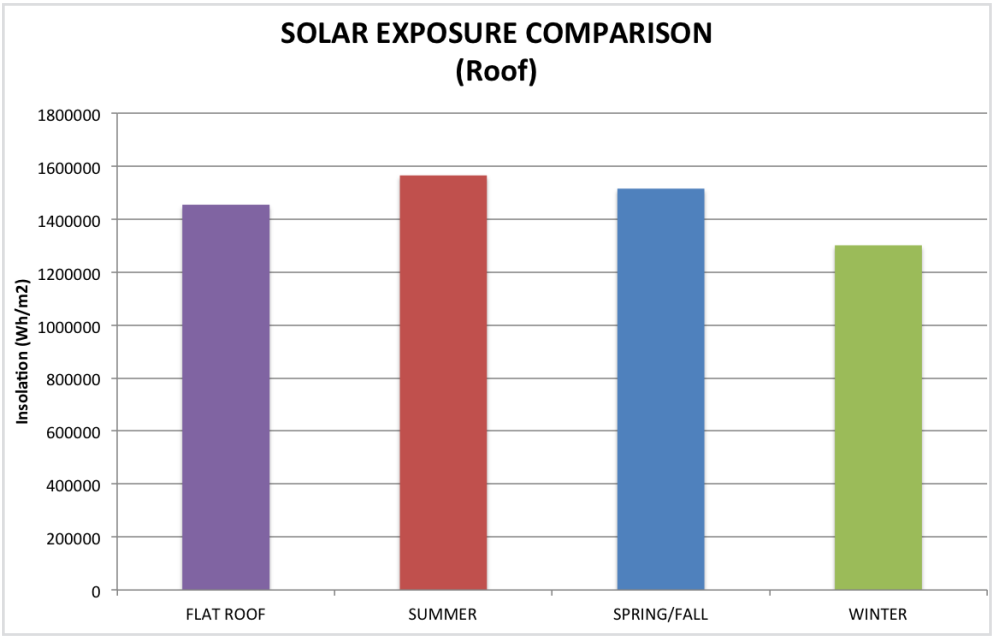
SPRING / FALL



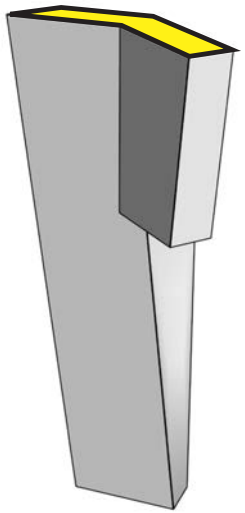
WINTER



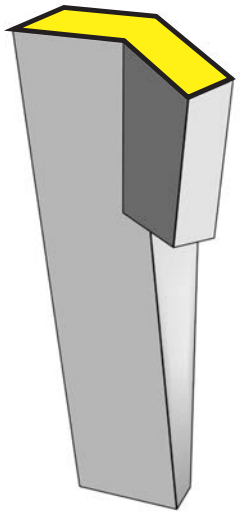




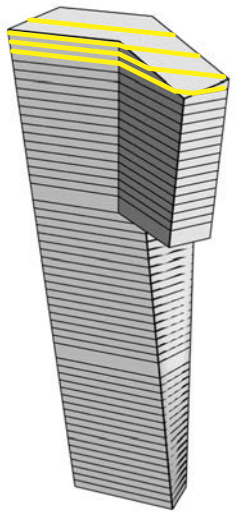
9 ROOF OPTIMIZATION - Mechanical & Renewable Spaces



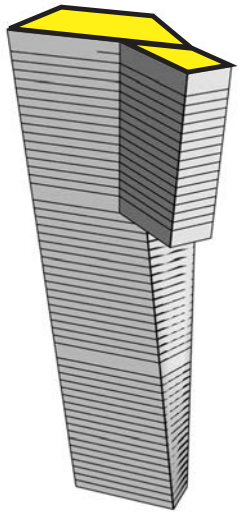
FLAT ROOF



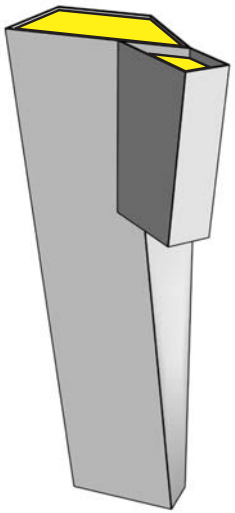
SUMMER ANGLE



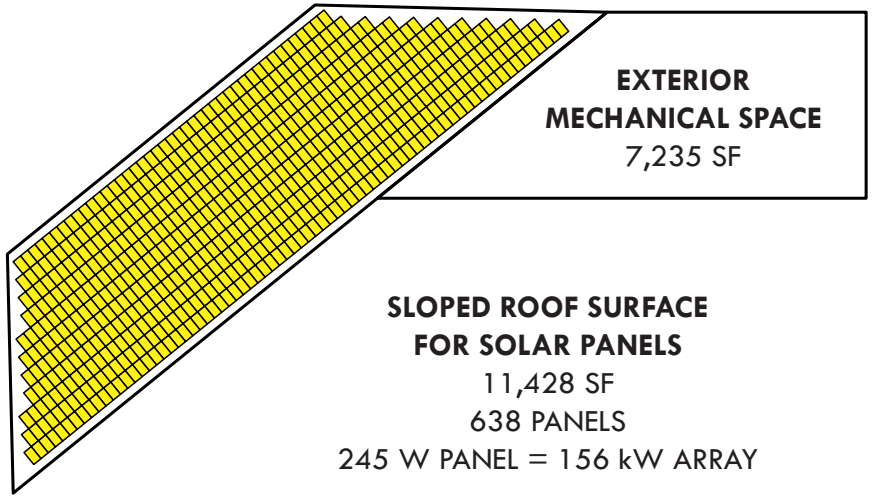
MASS FLOORS



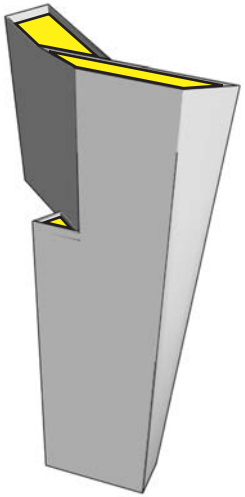
MAXIMIZE SPACE UTILIZATION
CREATE EXTERIOR MECHANICAL SPACE



MAXIMIZE SPACE UTILIZATION
CREATE EXTERIOR MECHANICAL SPACE



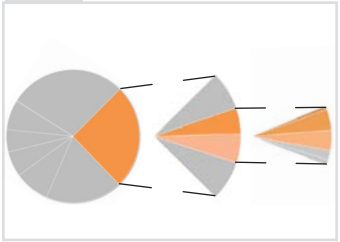
SLOPED ROOF SURFACE
FOR SOLAR PANELS
11,428 SF
638 PANELS
245 W PANEL = 156 kW ARRAY



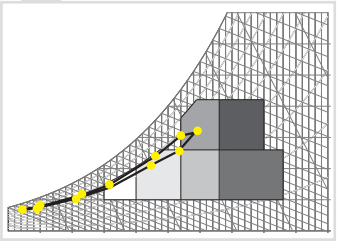
CREATE EXTERIOR MECHANICAL SPACE
ON MID-LEVEL MECHANICAL FLOOR

1 AREA OF INTEREST

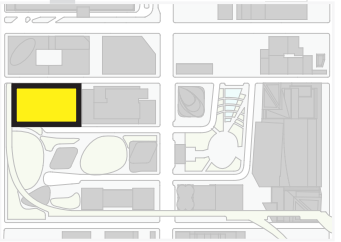
2 IDENTIFY PROBLEM



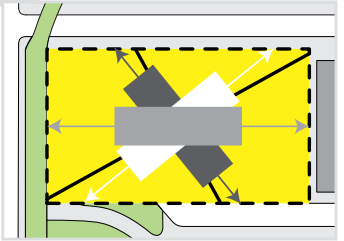
3 CLIMATE ANALYSIS



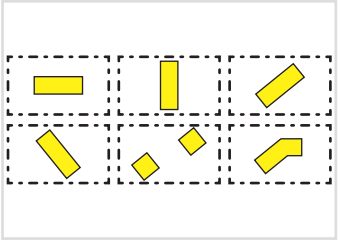
4 SITE SELECTION



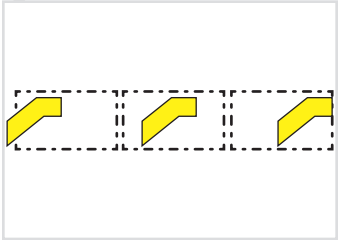
5 ORIENTATION ANALYSIS



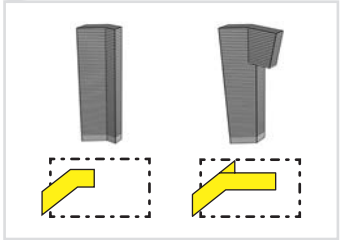
6 MASS COMPARISON



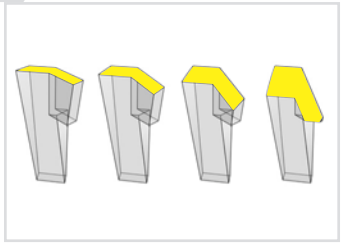
7 MASS LOCATION



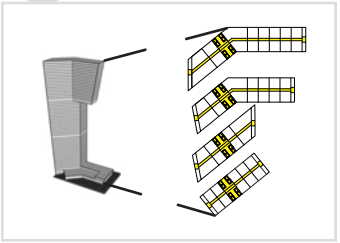
8 MASS OPTIMIZATION



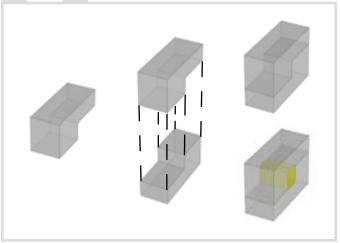
9 ROOF OPTIMIZATION



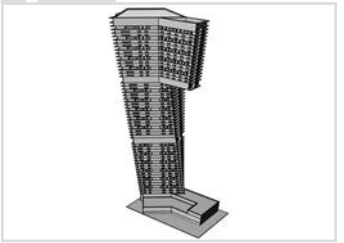
10 ARCHITECTURAL IMPLICATIONS



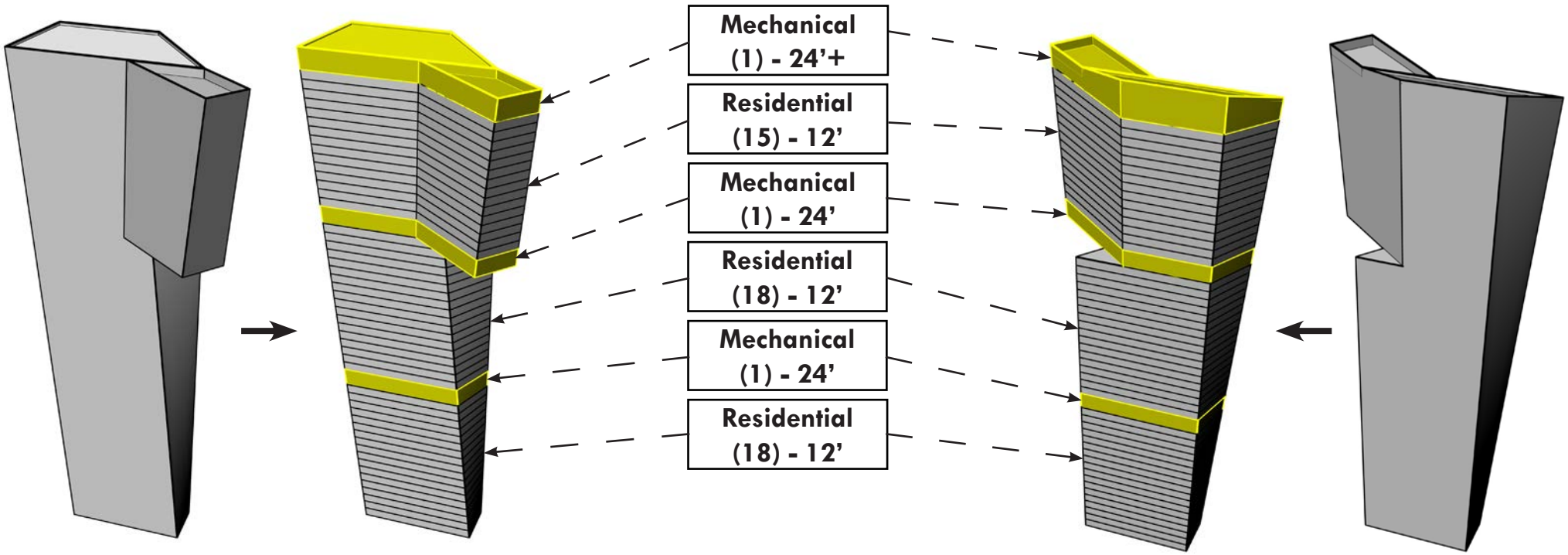
11 UNIT ANALYSIS



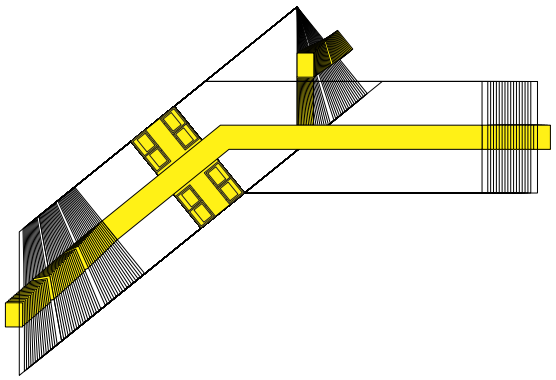
12 FINAL ANALYSIS

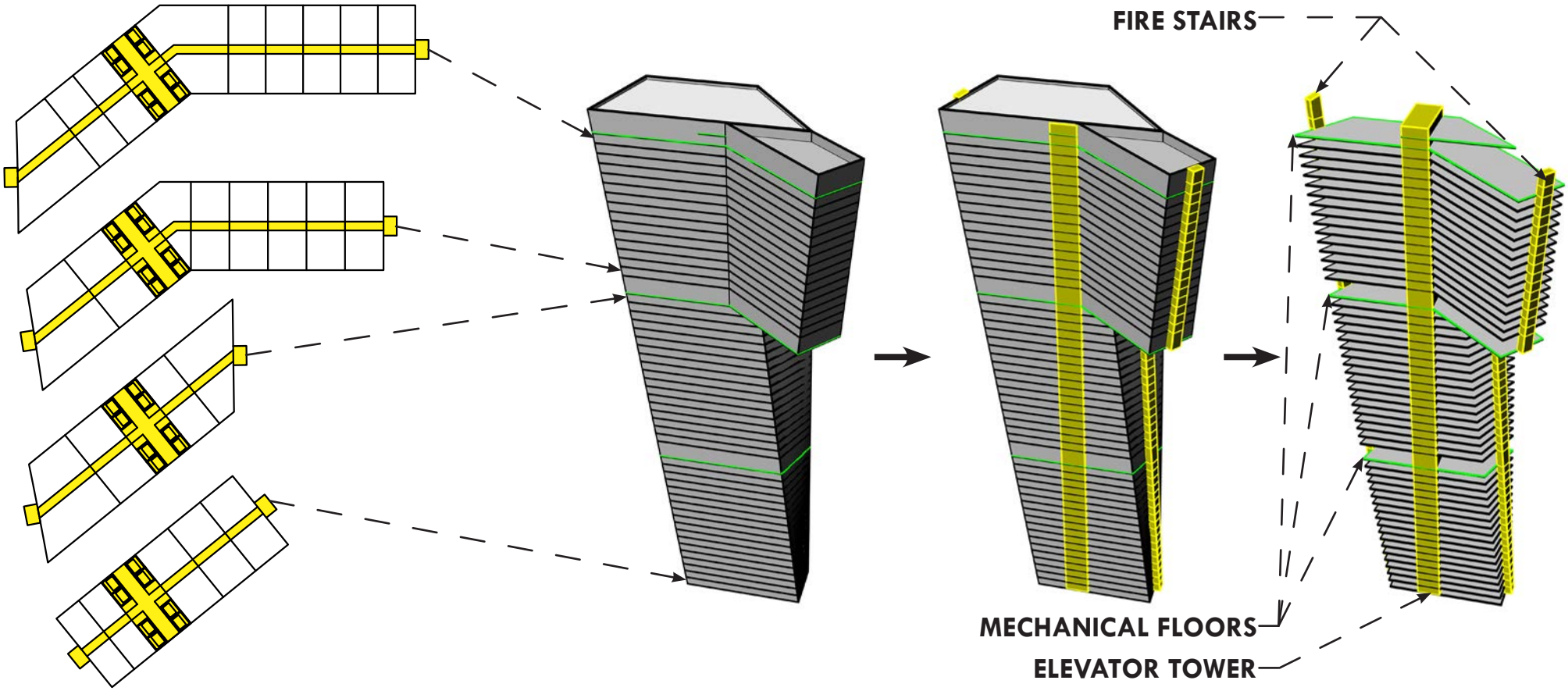


ARCHITECTURAL IMPLICATIONS - Mass Division Into Floor Plates

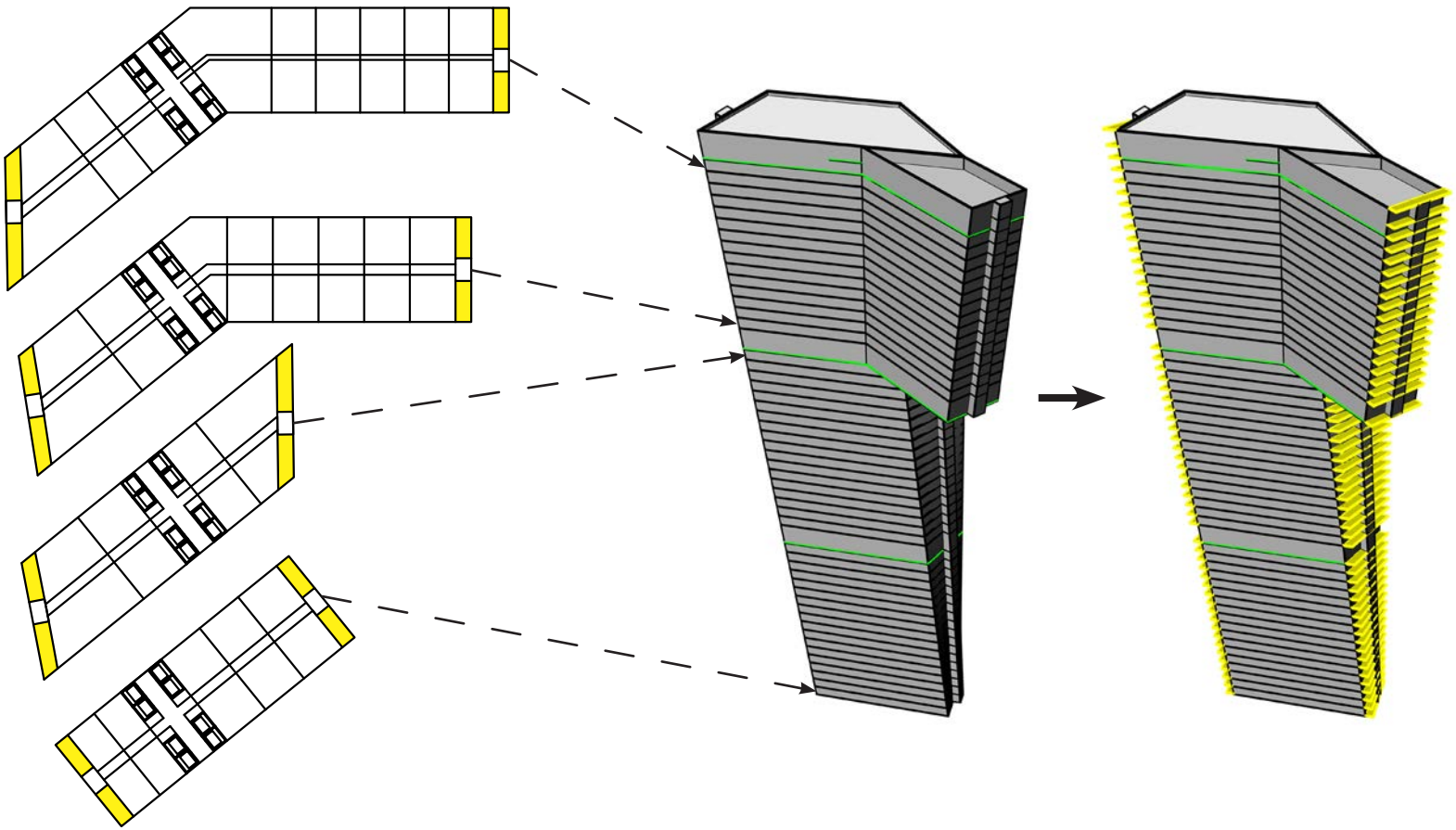


ARCHITECTURAL IMPLICATIONS - Circulation Integration



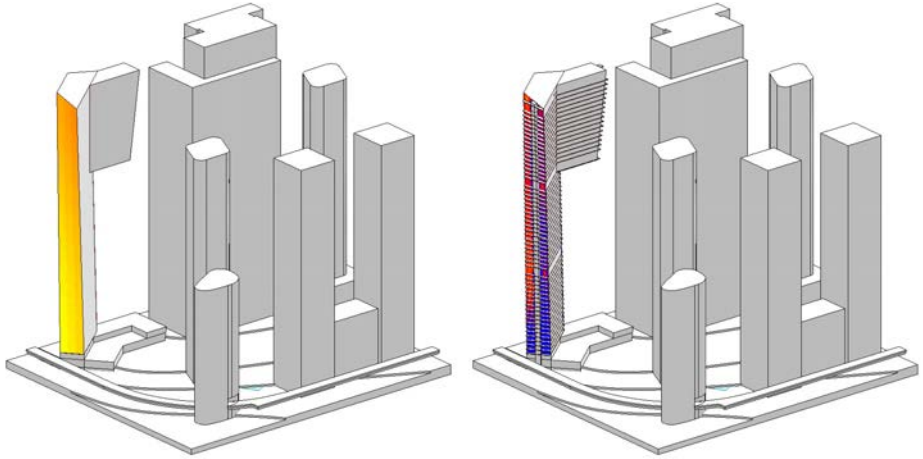


ARCHITECTURAL IMPLICATIONS - Balcony Integration

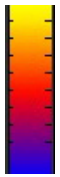


ARCHITECTURAL IMPLICATIONS - Balcony Summer Shading

WEST FACADE - SUMMER INSOLATION

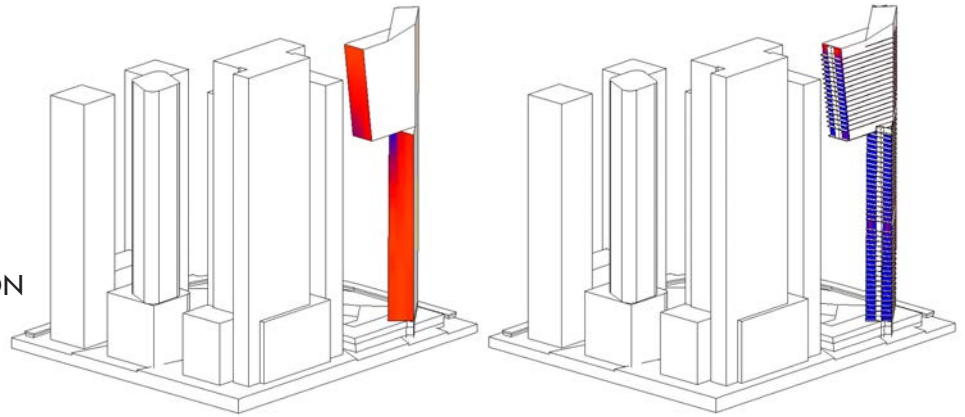


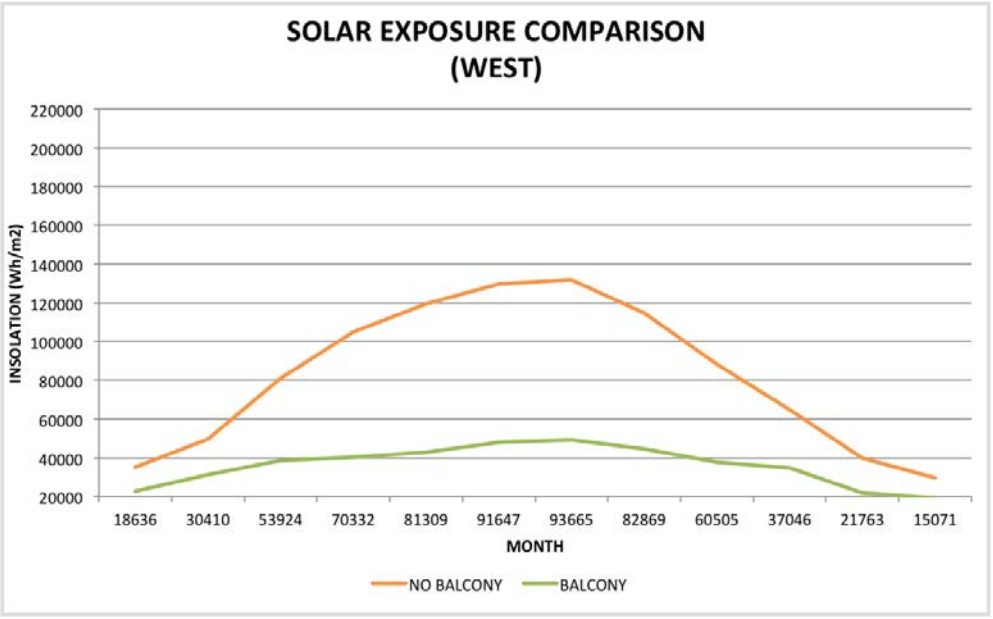
HIGHER RADIATION



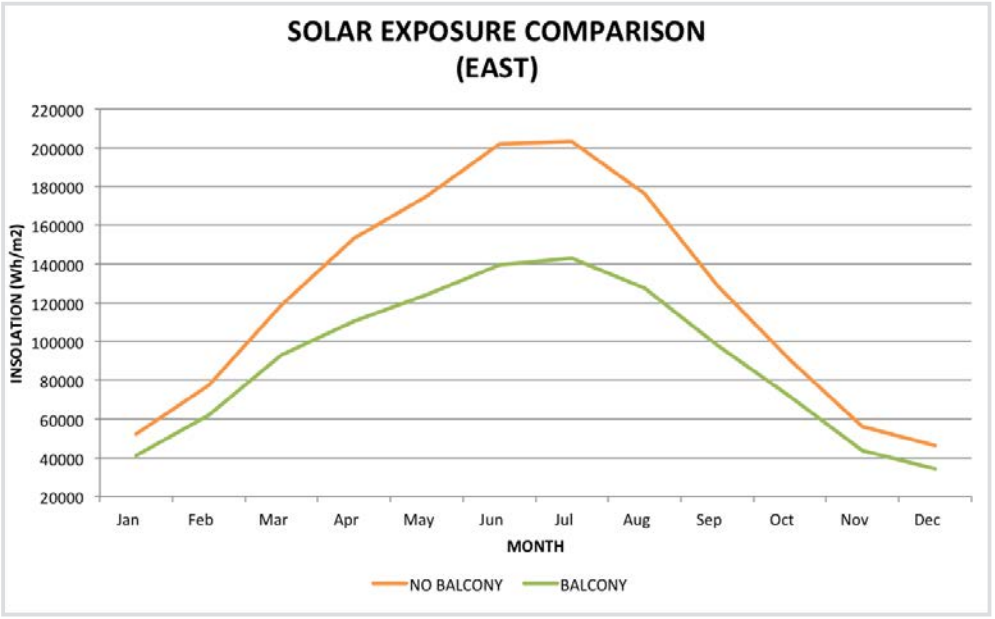
LOWER RADIATION

EAST FACADE - SUMMER INSOLATION



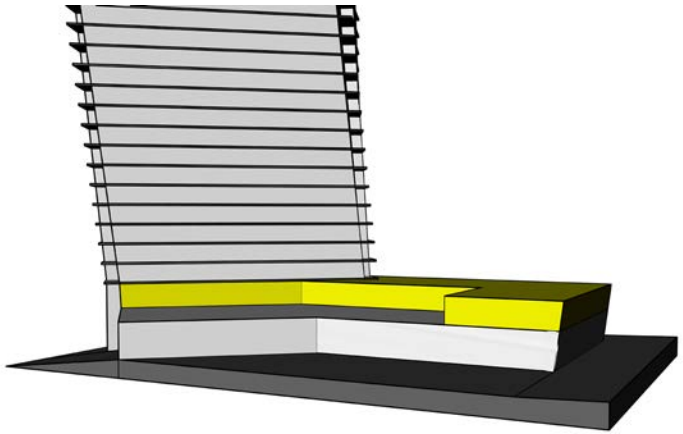


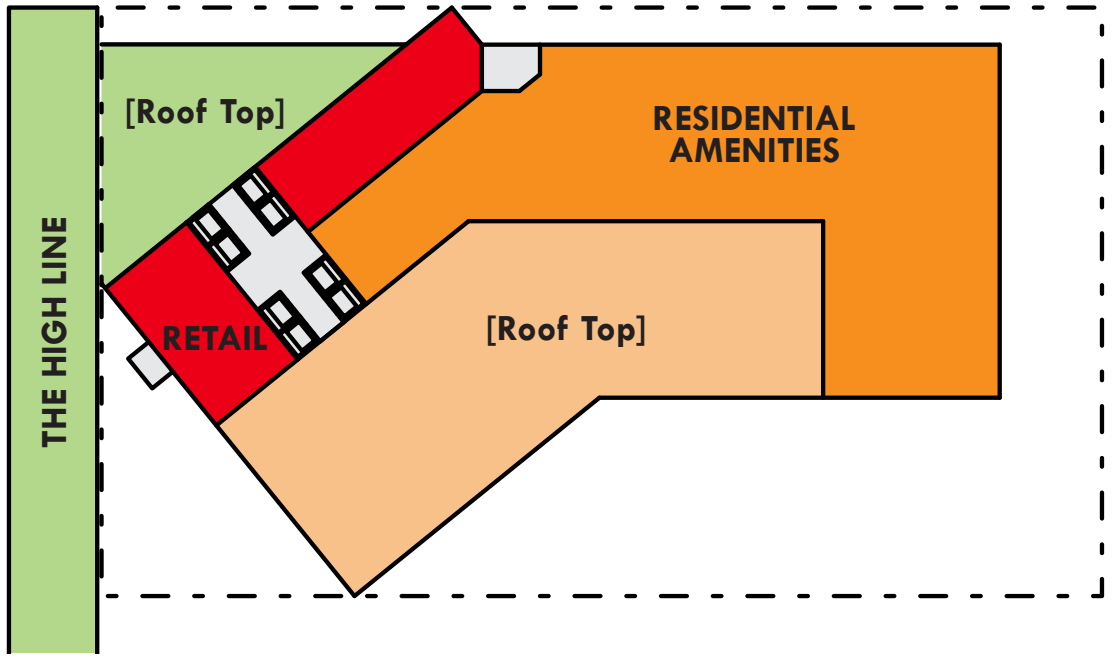
55% IMPROVEMENT

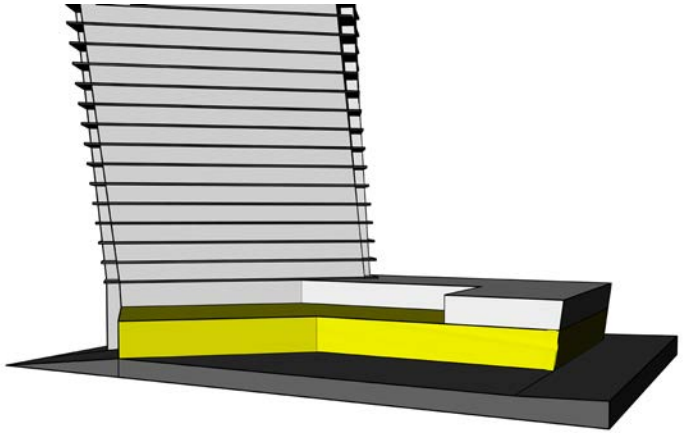


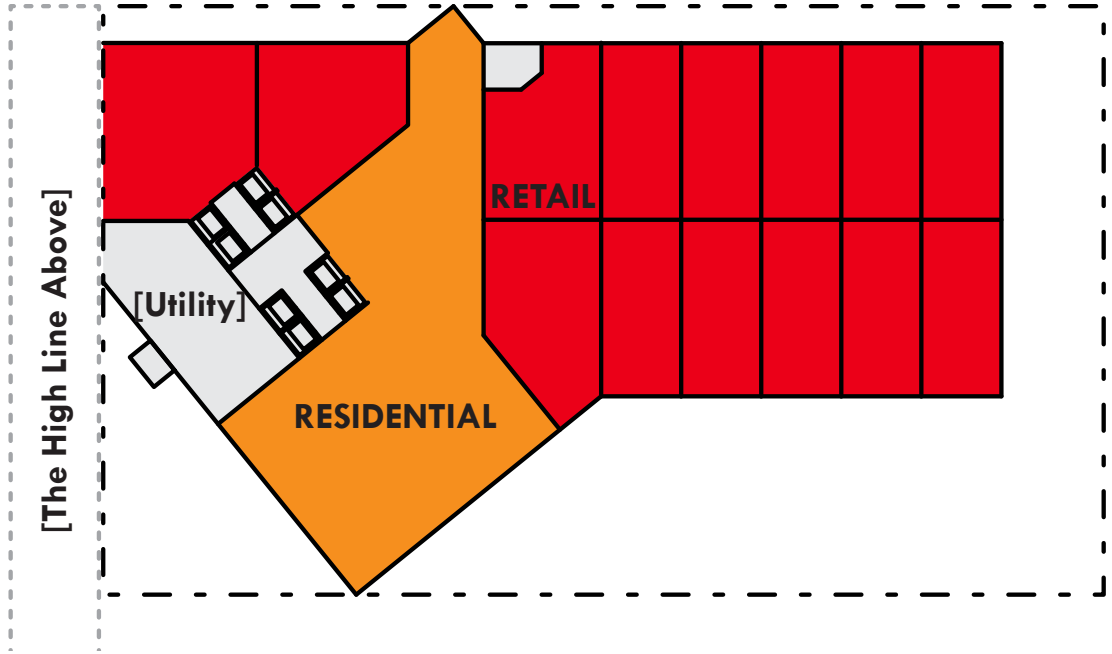
26% IMPROVEMENT

ARCHITECTURAL IMPLICATIONS - Plinth Space Planning

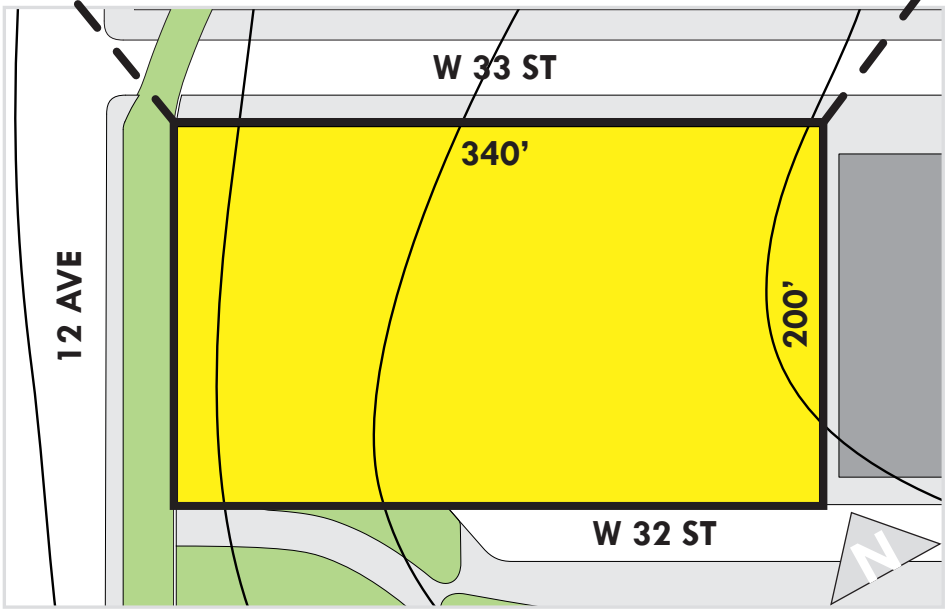




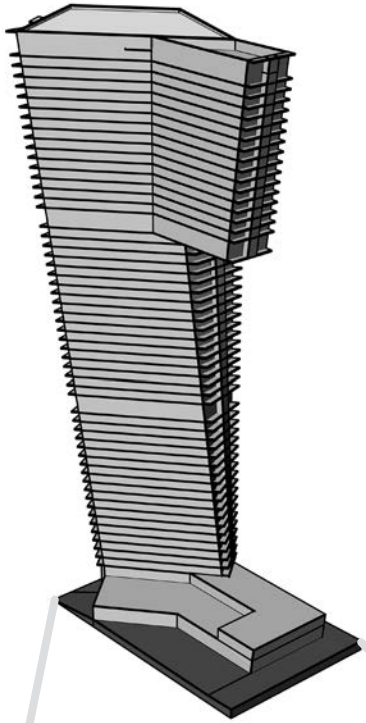


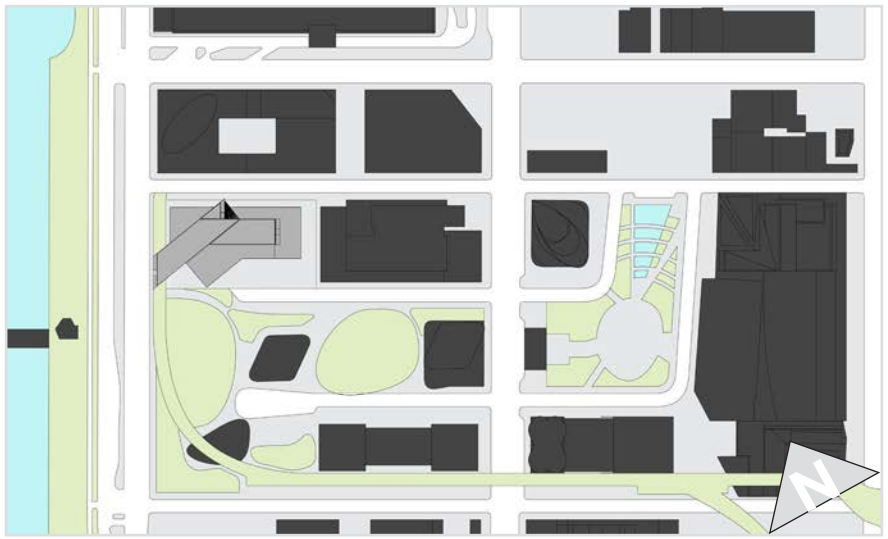


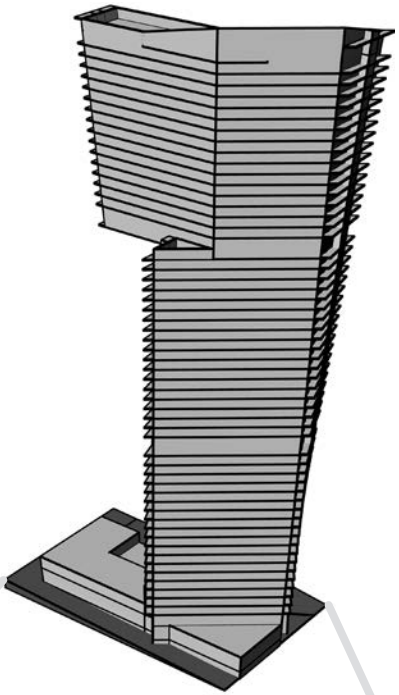
ARCHITECTURAL IMPLICATIONS - Grade Change

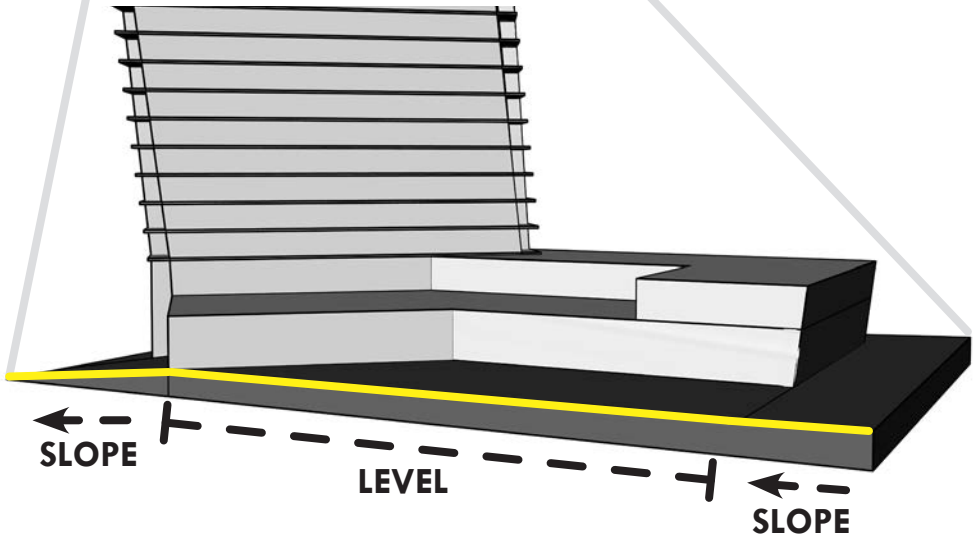


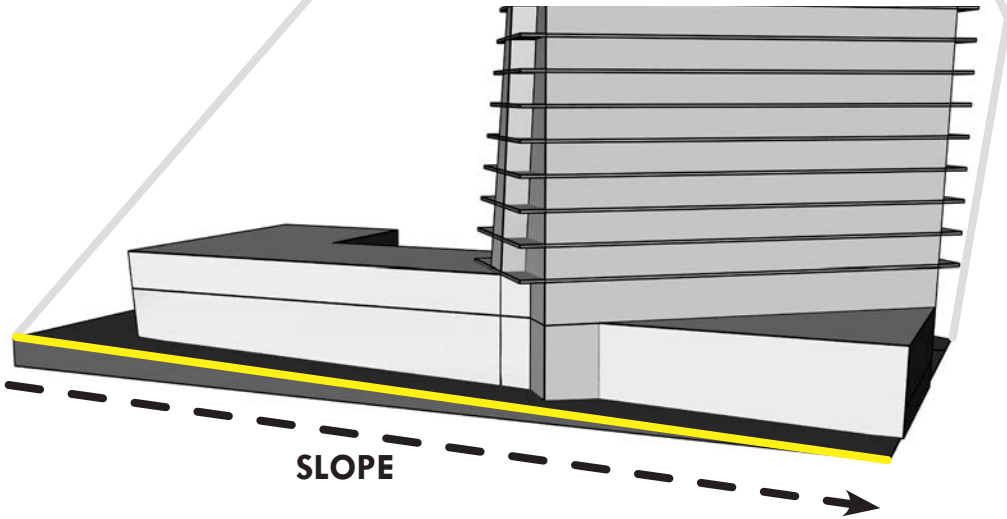
ARCHITECTURAL IMPLICATIONS - Grade Change Interaction





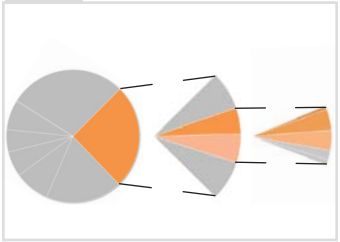




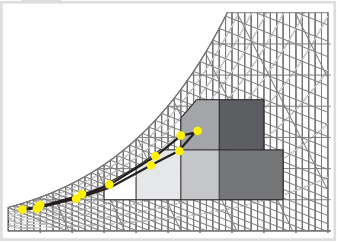


1 AREA OF INTEREST

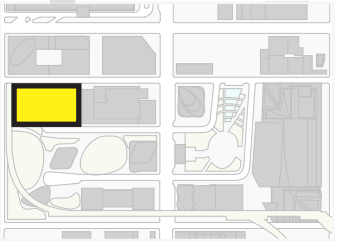
2 IDENTIFY PROBLEM



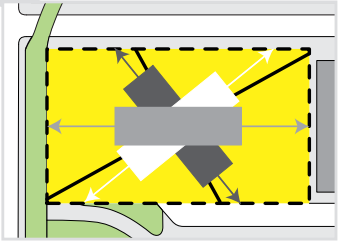
3 CLIMATE ANALYSIS



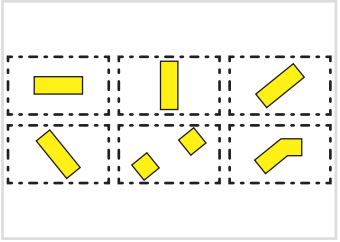
4 SITE SELECTION



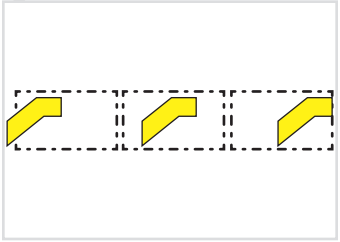
5 ORIENTATION ANALYSIS



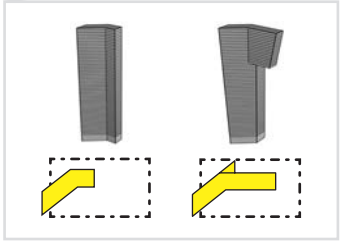
6 MASS COMPARISON



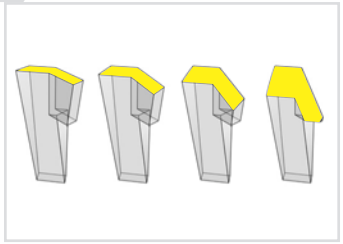
7 MASS LOCATION



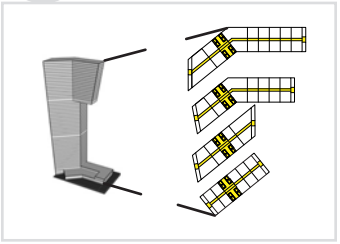
8 MASS OPTIMIZATION



9 ROOF OPTIMIZATION

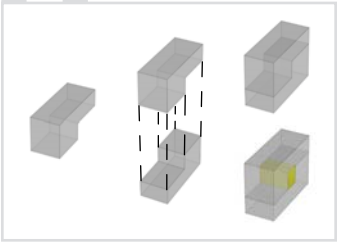


10 ARCHITECTURAL IMPLICATIONS

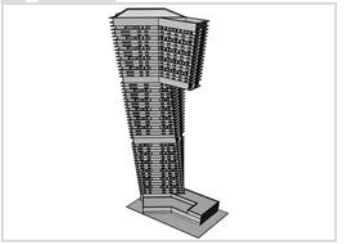


IN PROGRESS

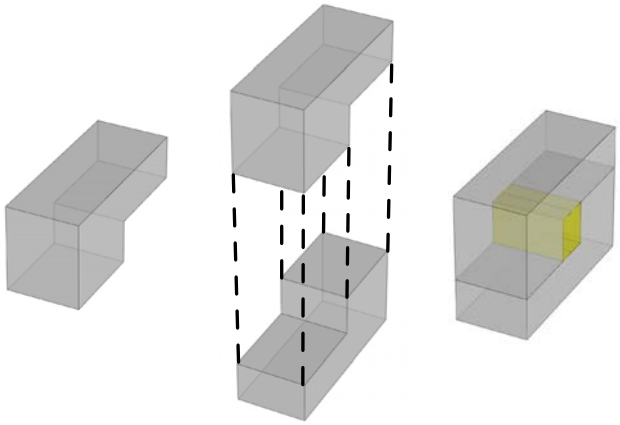
11 UNIT ANALYSIS

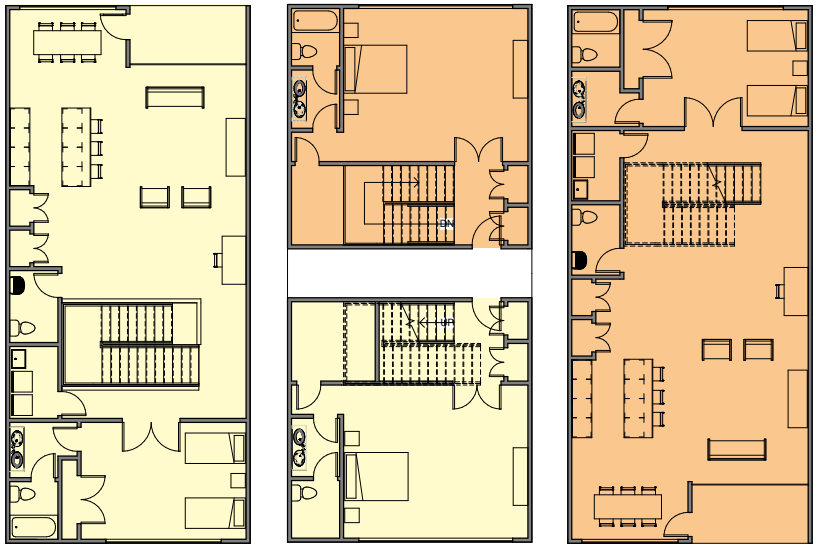


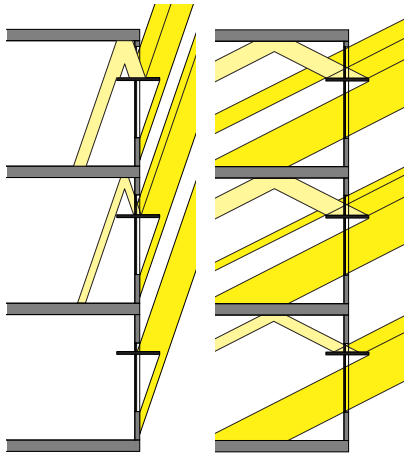
12 FINAL ANALYSIS

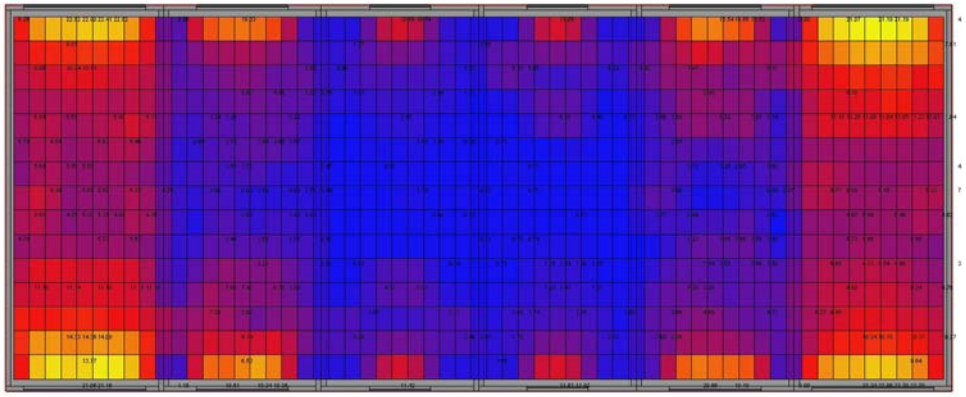


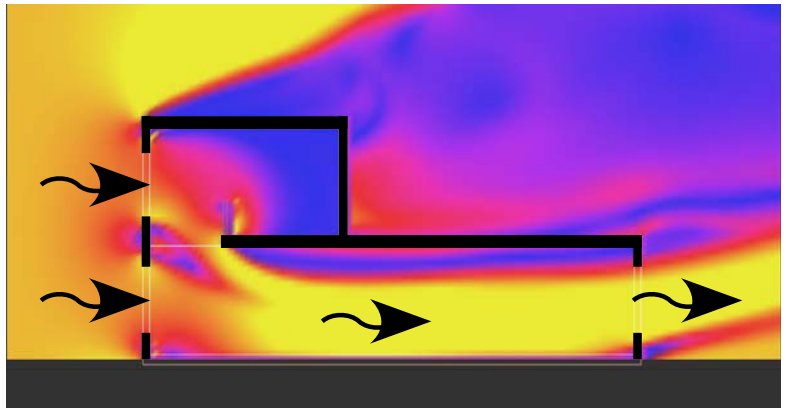
UNIT ANALYSIS - In Progress



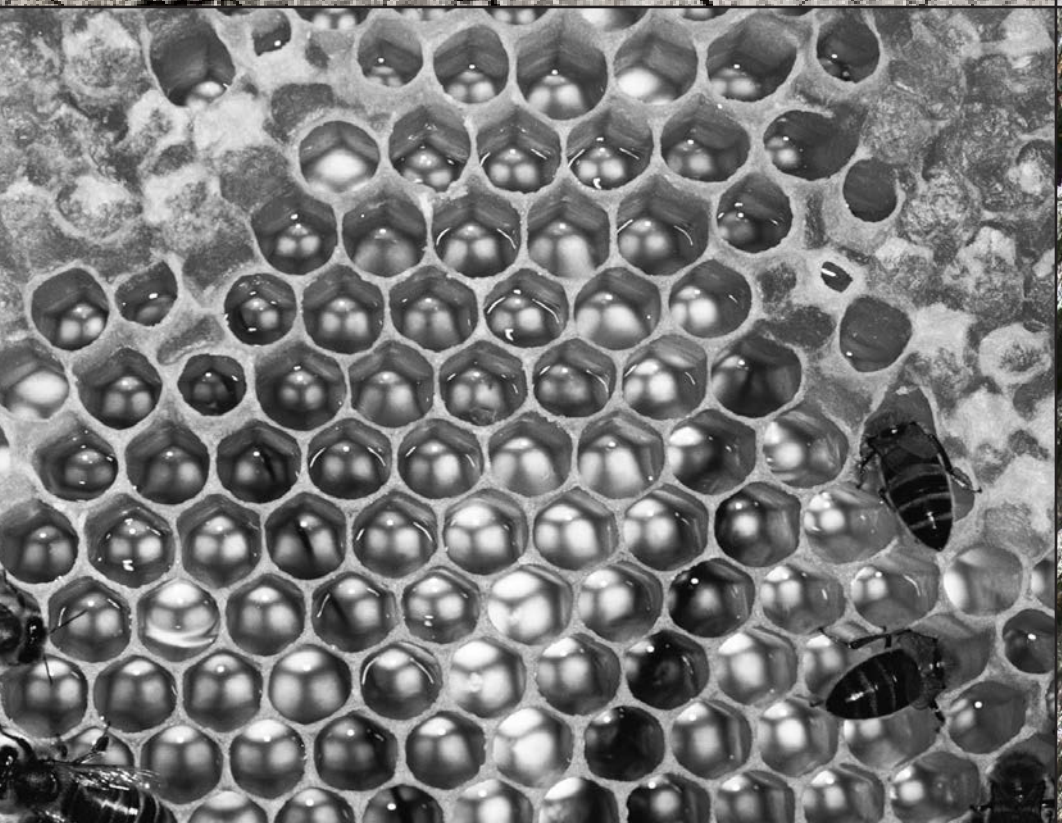




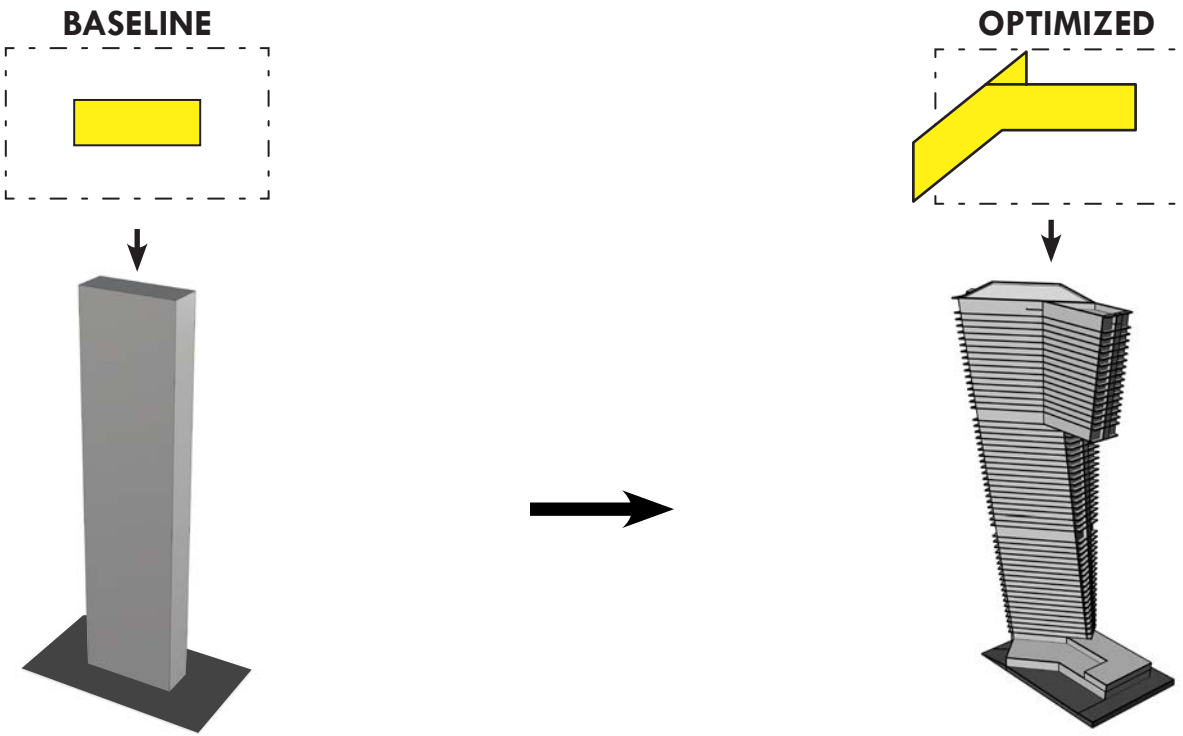


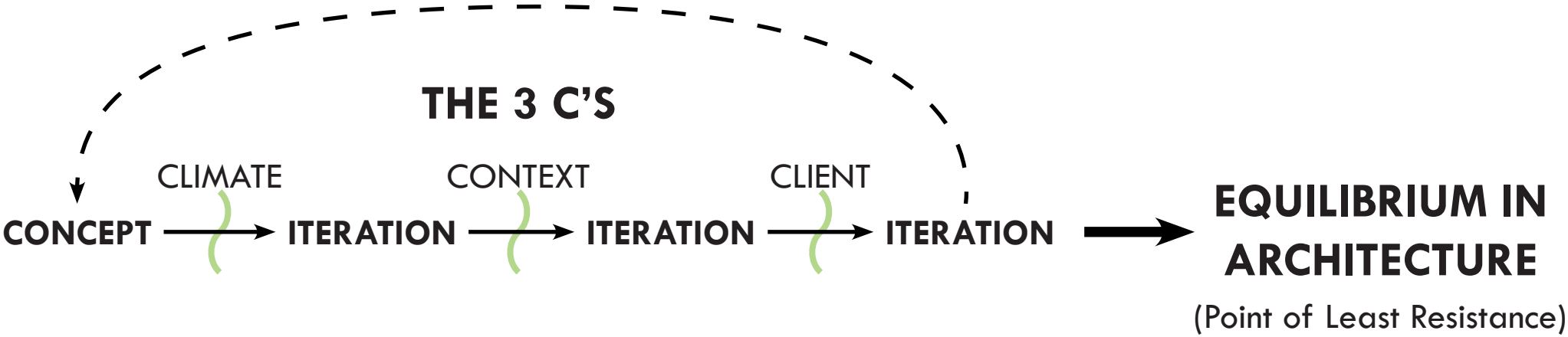



SOAPY WATER 2004



AN ARCHITECTURE OF LEAST RESISTANCE





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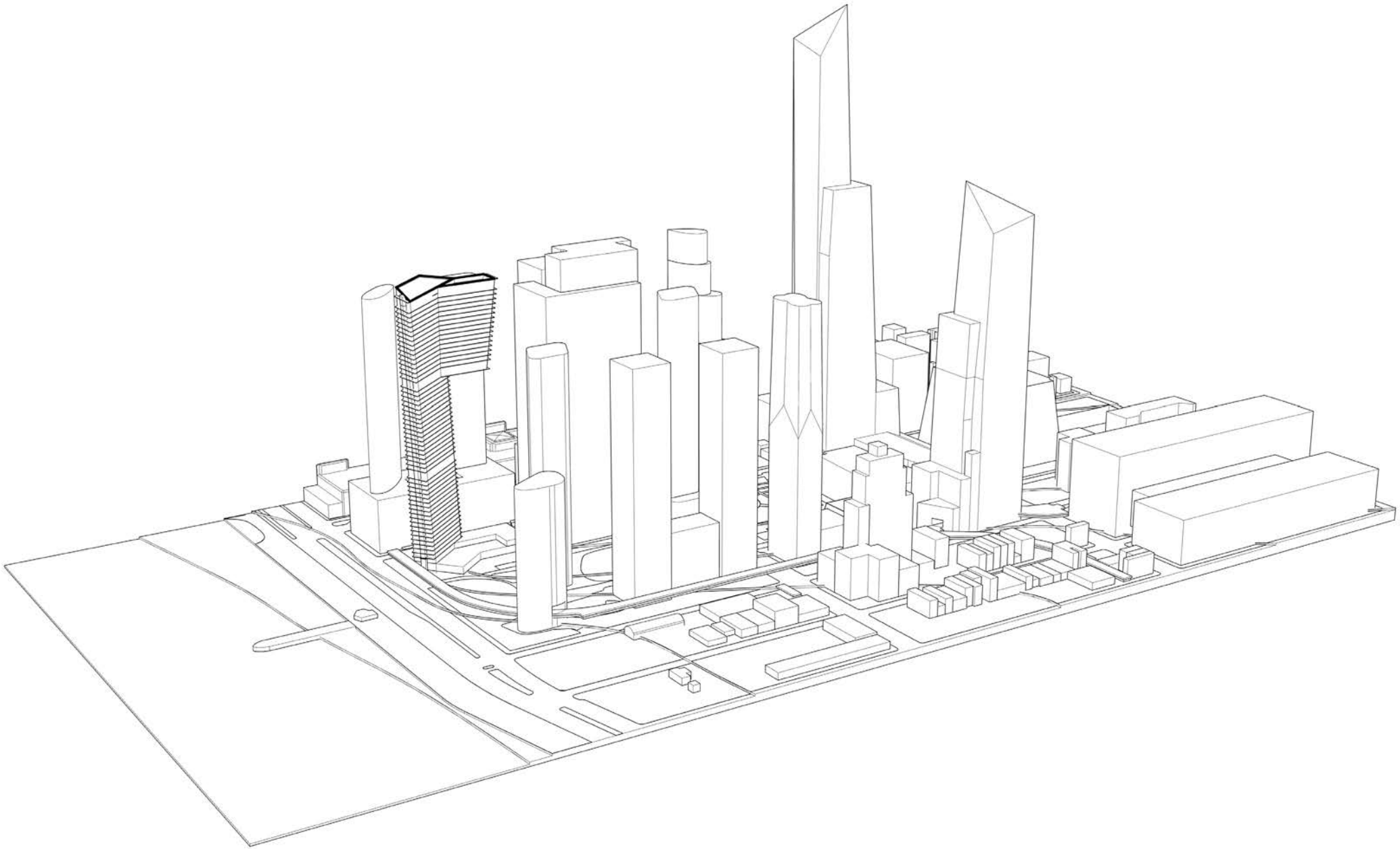

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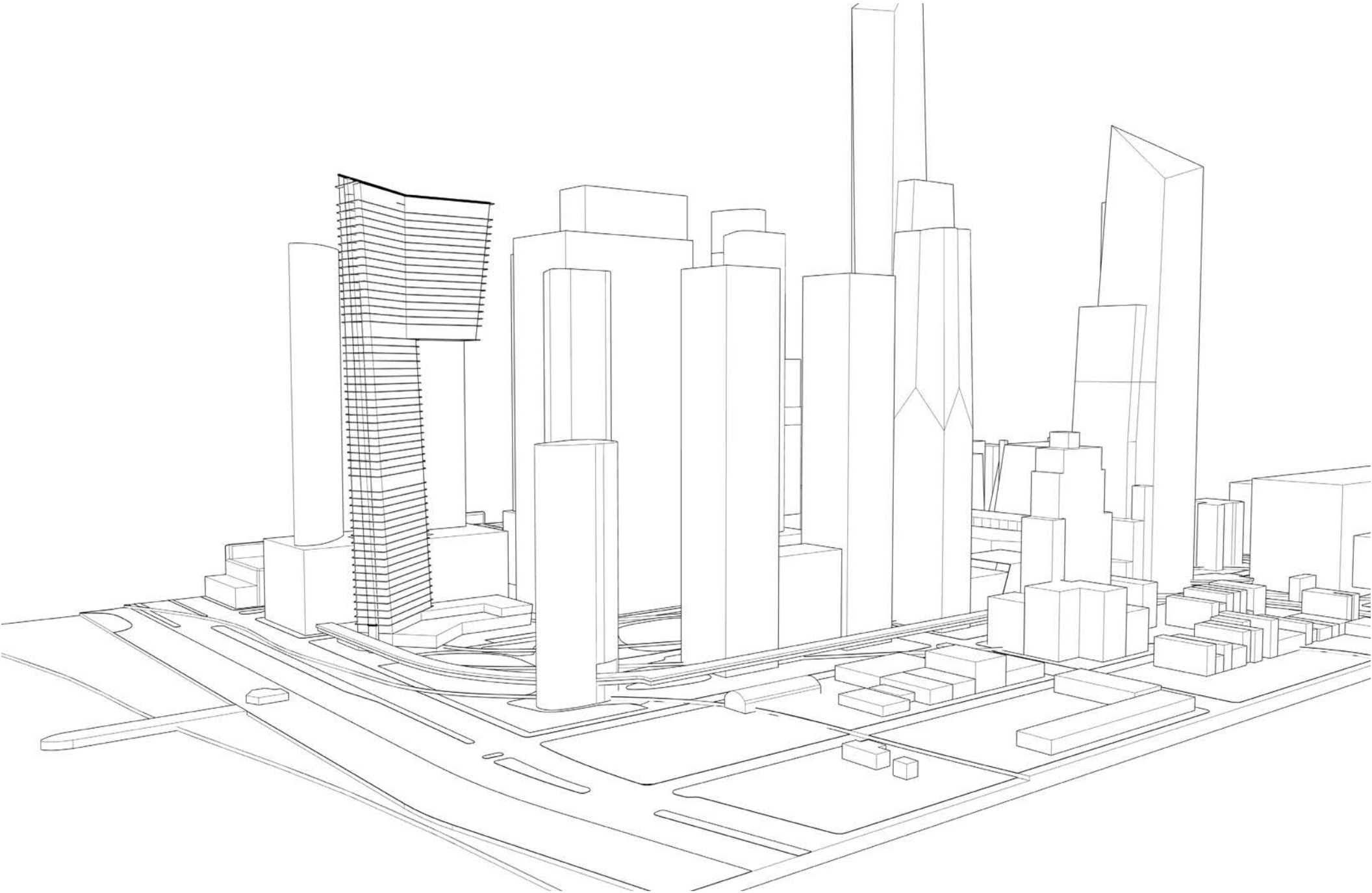

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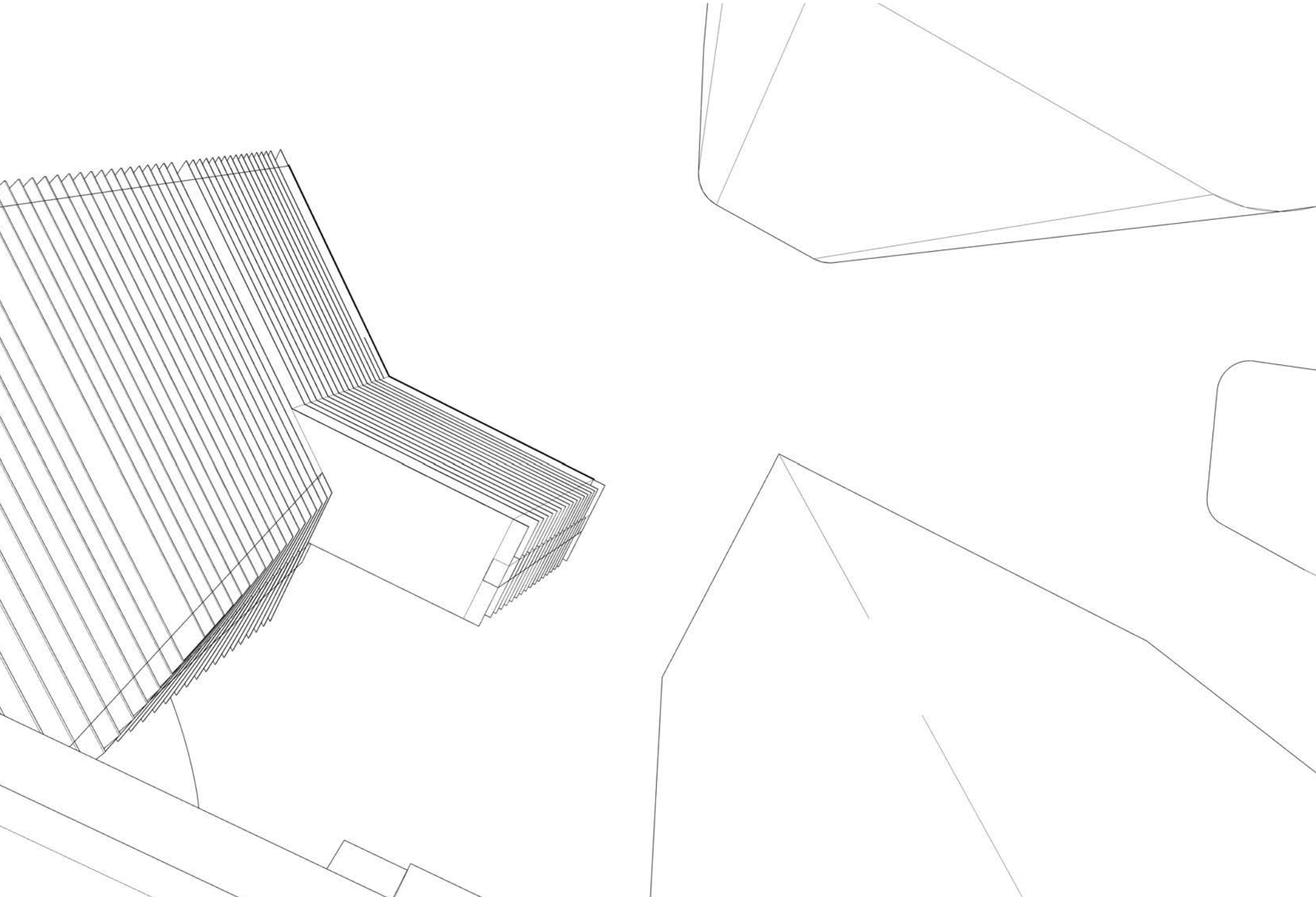

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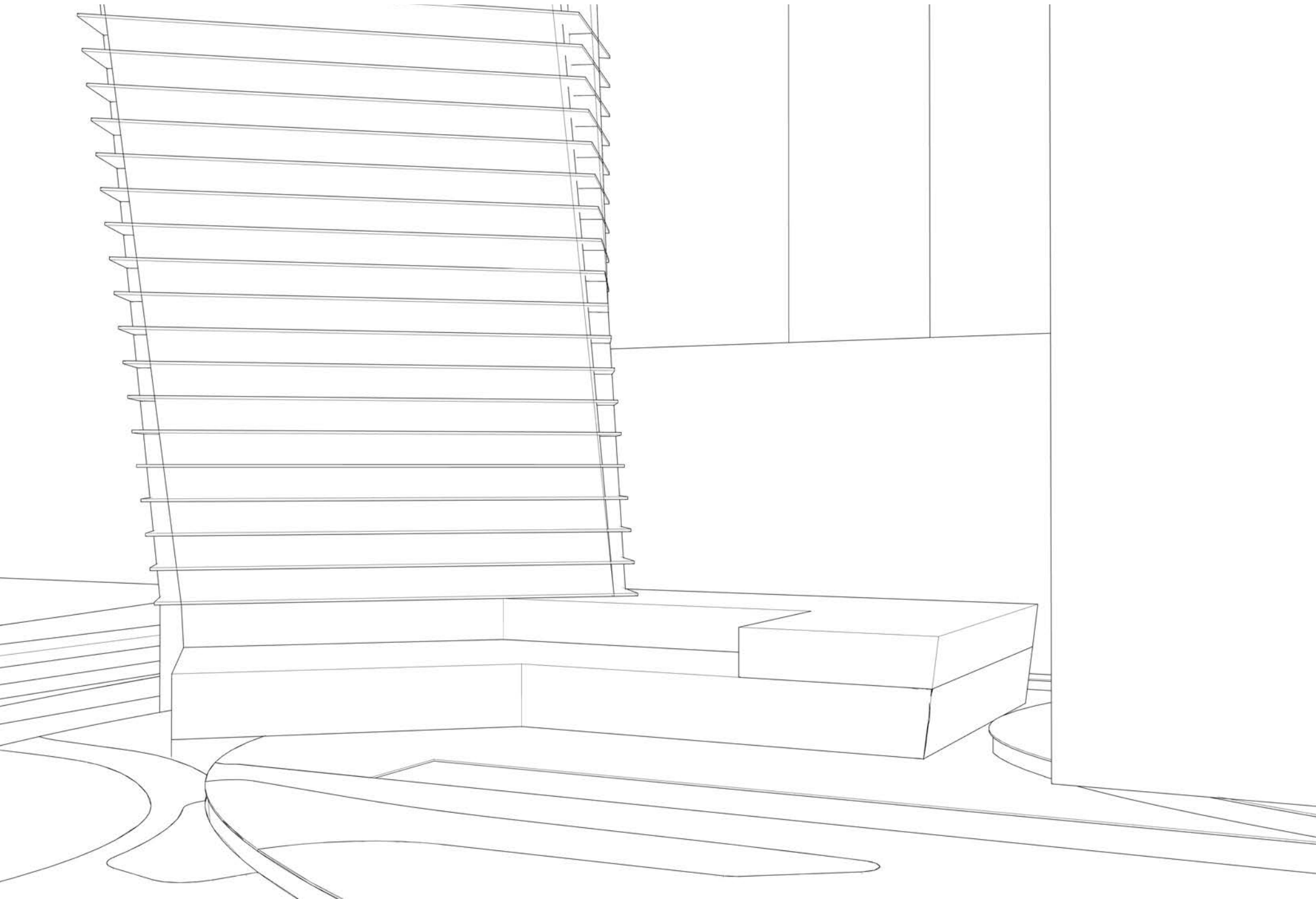

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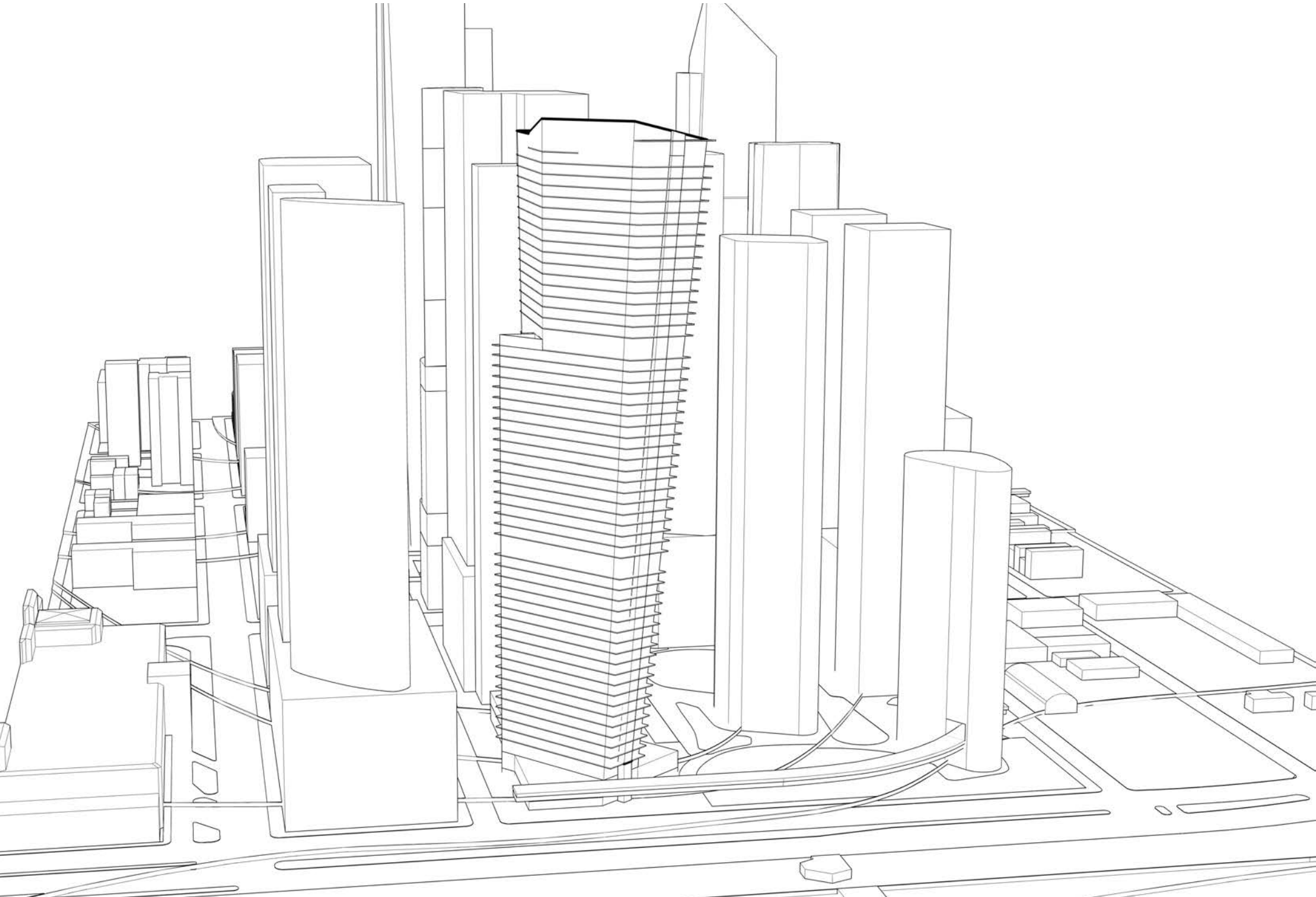

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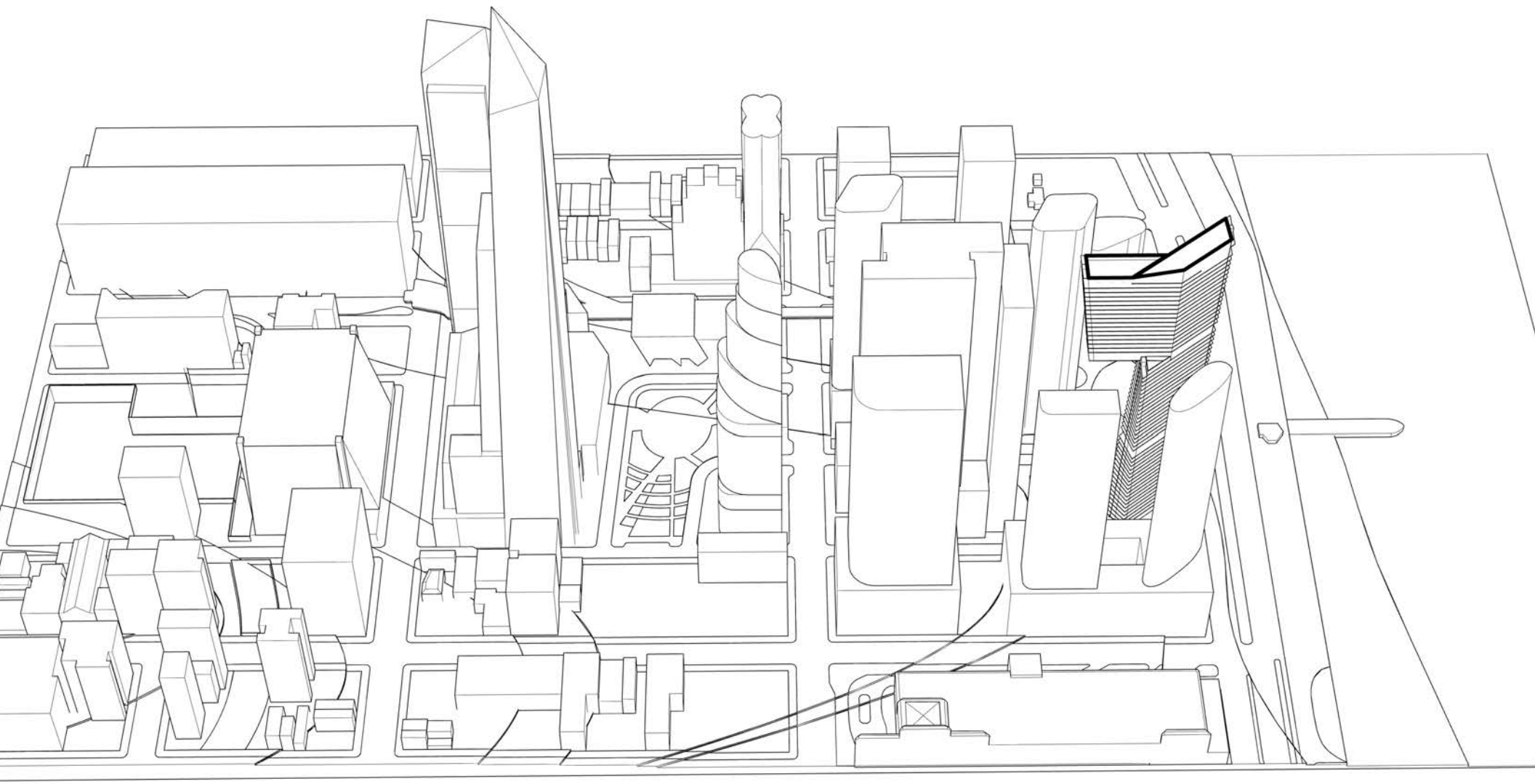

CITATIONS

IMAGE OF MUDCRACKS:
By Magdalena Yaramova
http://us.123rf.com/400wm/400/400/maggee/maggee1005/maggee100500002/6987931-cracked-mud-representingdrought-or-implying-global-warming.jpg

IMAGE OF SOAP BUBBLES:
http://2.bp.blogspot.com/-Q69eNj4csgE/UPBCg23o5TI/AAAAAAAAAio/tclhpsEyvos/s1600/bubbles.jpg

IMAGE OF HONEY COMB:
http://www.androidguys.com/wp-content/uploads/2010/08/Honeycomb.jpg

IMAGE OF TREE BARK:
Gibson, Arthur C. "Bark Features." General Botany. UCLA, http://www.botgard.ucla.edu/html/botanytextbooks/generalbotany/index.html.

IMAGE OF RASPBERRY:
http://www.freegreatpicture.com/fruits-and-vegetables/hdraspberry-picture-25182

IMAGE OF FREI OTTO - OPTIMIZED PATH EXPERIMENT:
Frei Otto and Bodo Rasch. Finding Form (1995): 69.

CHART OF GLOBAL PRIMARY ENERGY CONSUMPTION:
"International Energy Statistics." Independent Statistics & Analysis U.S. Energy Information Administration. U.S. Department of Energy, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=regions&syid=1980&eyid=2011&unit=QBTU.

CHART OF MOST POPULOUS COUNTRIES:
"The World Factbook." Central Intelligence Agency. Central Intelligence Agency, https://www.cia.gov/library/publications/the-world-factbook/geos/us.html.

CHART OF ENERGY CONSUMPTION OF MOST POPULOUS COUNTRIES:
"International Energy Statistics." Independent Statistics & Analysis U.S. Energy Information Administration. U.S. Department of Energy, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=regions&syid=1980&eyid=2011&unit=QBTU.

CHARTS OF U.S. ENERGY CONSUMPTION ANALYSIS:
Buildings Energy Data Book. U.S. Department of Energy, http://buildingsdatabook.eren.doe.gov/default.aspx.

CHART OF U.S. BUILDING SITE ENERGY CONSUMPTION BY END USE:
Buildings Energy Data Book. U.S. Department of Energy, http://buildingsdatabook.eren.doe.gov/default.aspx.

CHART OF MOST POPULOUS GLOBAL CITIES AND CLIMATE CONDITIONS:
"The World Factbook." Central Intelligence Agency. Central Intelligence Agency, https://www.cia.gov/library/publications/the-world-factbook/geos/us.html.

IMAGE OF GLOBAL CLIMATE ZONES:
Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger Climate Classification Updated. Meteorol. Z., 15, 259-263. DOI: 10.1127/0941-2948/2006/0130.

IMAGE OF NATIONAL CLIMATE ZONES:
Pacific Northwest National Laboratory and Oak Ridge National Laboratory. 2010. Guide to Determining Climate Regions by County: U.S. Department of Energy. 2.

IMAGE OF WINTER IN NEW YORK CITY:
http://www.desktopdress.com/desktopwallpapers/other/central-park-in-winter_new-york-city_new-york.jpg

IMAGE OF SPRING IN NEW YORK CITY:
http://inhabitat.com/nyc/wp-content/blogs.dir/2/files/2011/06/high-line-section-2-20th-street-01.jpg

IMAGE OF SUMMER IN NEW YORK CITY:
http://dc93.4shared.com/img/5QJcHxi_/s7/140beca6d40/summer_in_manhattan_new_york.jpg

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http://www.wallsave.com/wallpapers/2560x1440/central-park/650845/central-park-in-nyc-im-herbst-computer-hd-650845.jpg

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http://www.hudsonyardsnewyork.com/Template/GetSlideShowImages/4

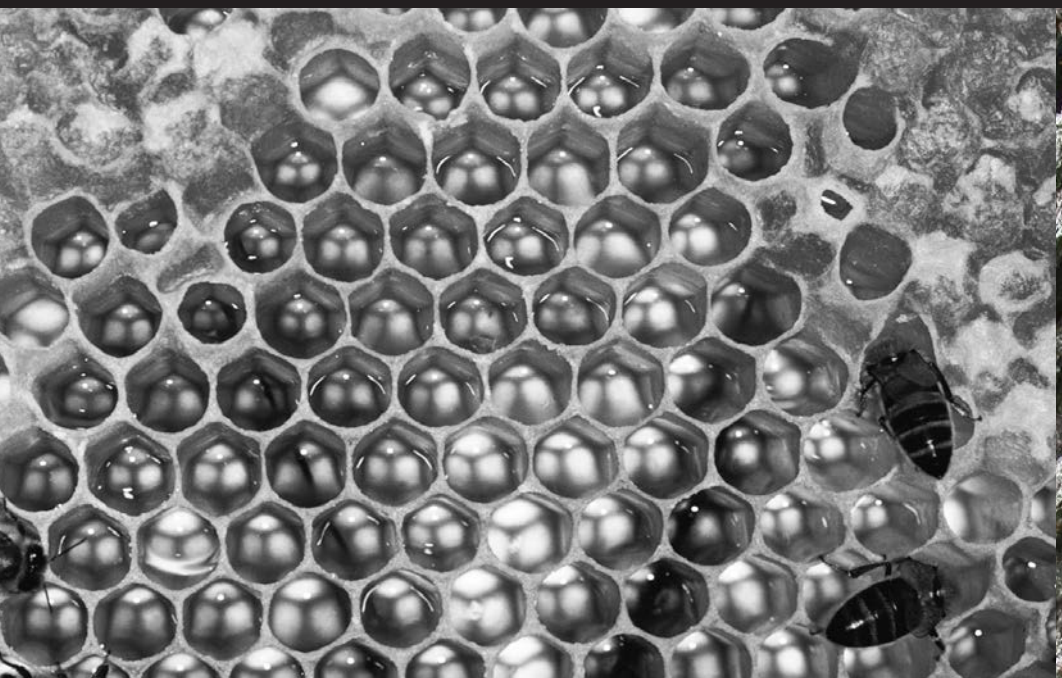
IMAGES OF SITE SELECTION - EXISTING HUDSON YARDS:
Google Earth Images

IMAGES OF MASS COMPARISON - EXISTING VIEW CORRIDORS:
Google Earth Images

SOFTWARE USED TO PRODUCE IMAGES/CHARTS:
Rhino, Grasshopper, Revit, Vasari, Ecotect, Photoshop, Illustrator, InDesign, Excel


AN ARCHITECTURE OF LEAST RESISTANCE:
Building Performance Analytics in High Performance Building Design

Amanda R. Stacy
Master of Architecture / Master of Science in Sustainable Design / The Catholic University of America




APRIL 8-14

-Adjust Floor Plans
-Show Experiential Vignette of Spaces

APRIL 15-21

-Shading Devices on Unit
-Daylighting with Unit
-Wind within Unit

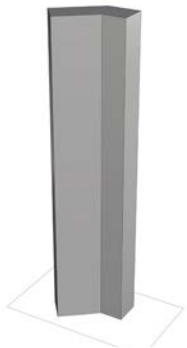
APRIL 22-28

-Evolution of Models
-Overall Baseline Differences (Insolation, Energy)
-Structure
-Final Model and Renderings

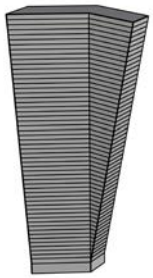
APRIL 29-5

-Complete Presentation
-Complete Models
-Complete Renderings
PROPOSE MAY 25TH MEETING

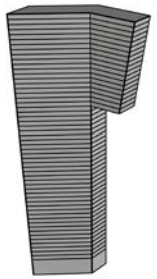
baseline



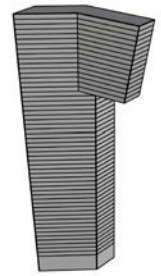
mixed



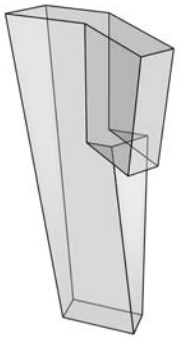
highline interaction



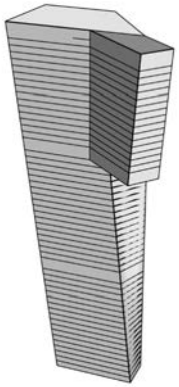
maximize insolation



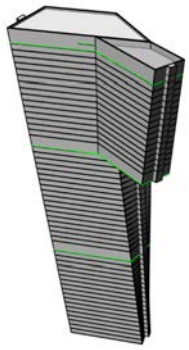
streamline mass



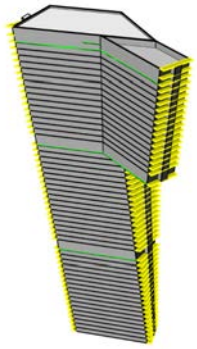
optimize east/west



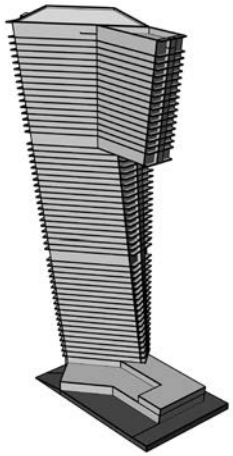
optimize roof



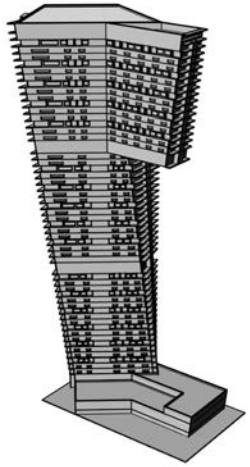
integrate circulation



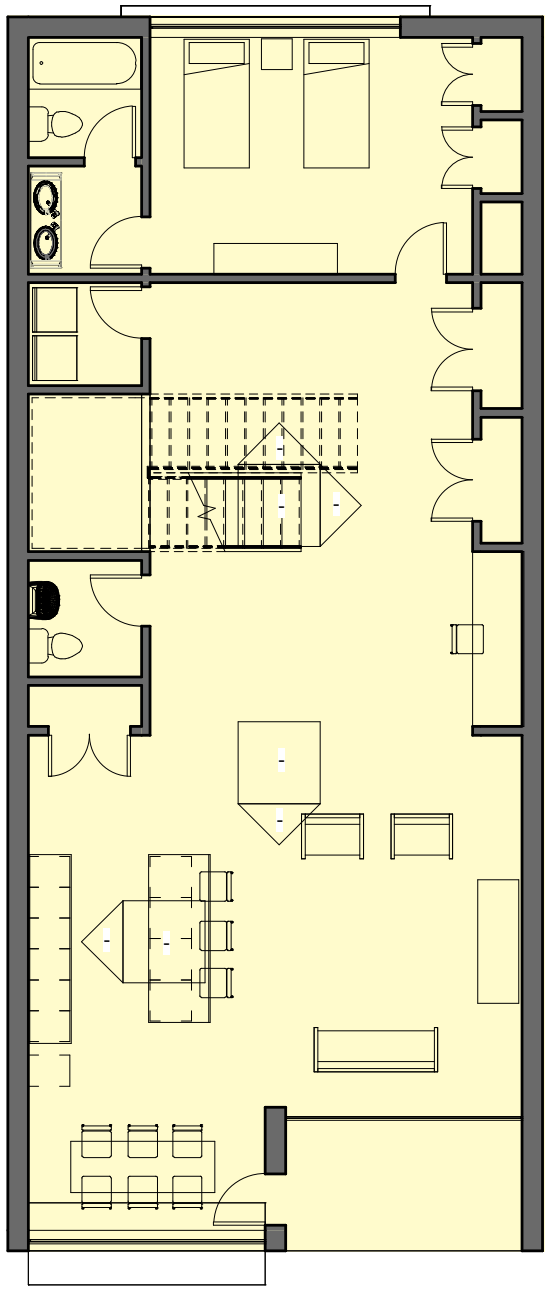
integrate balcony



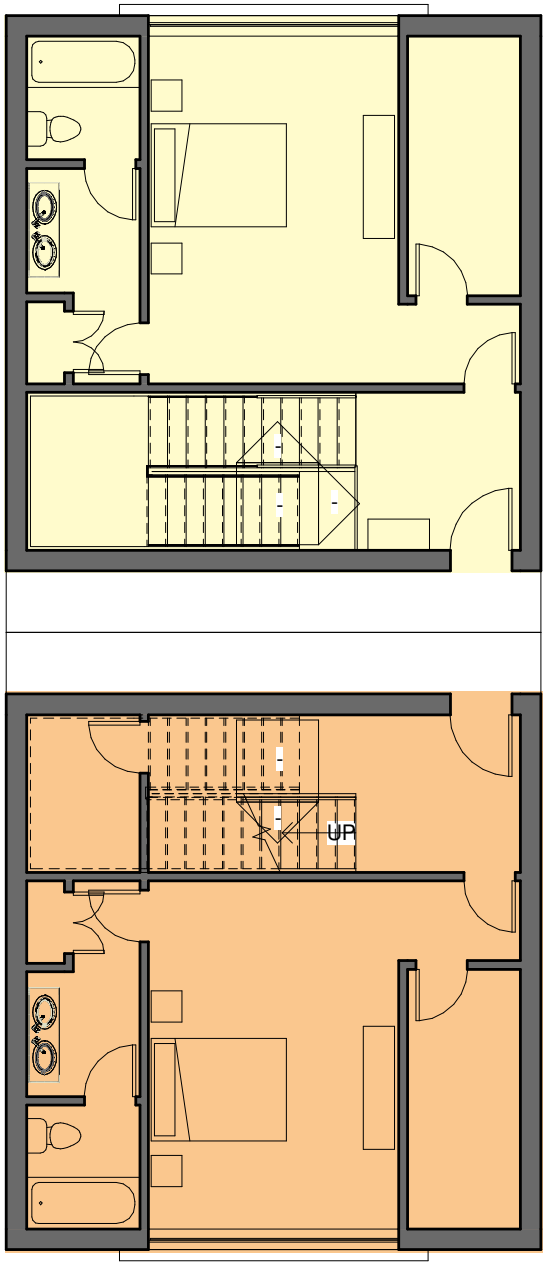
plinth design



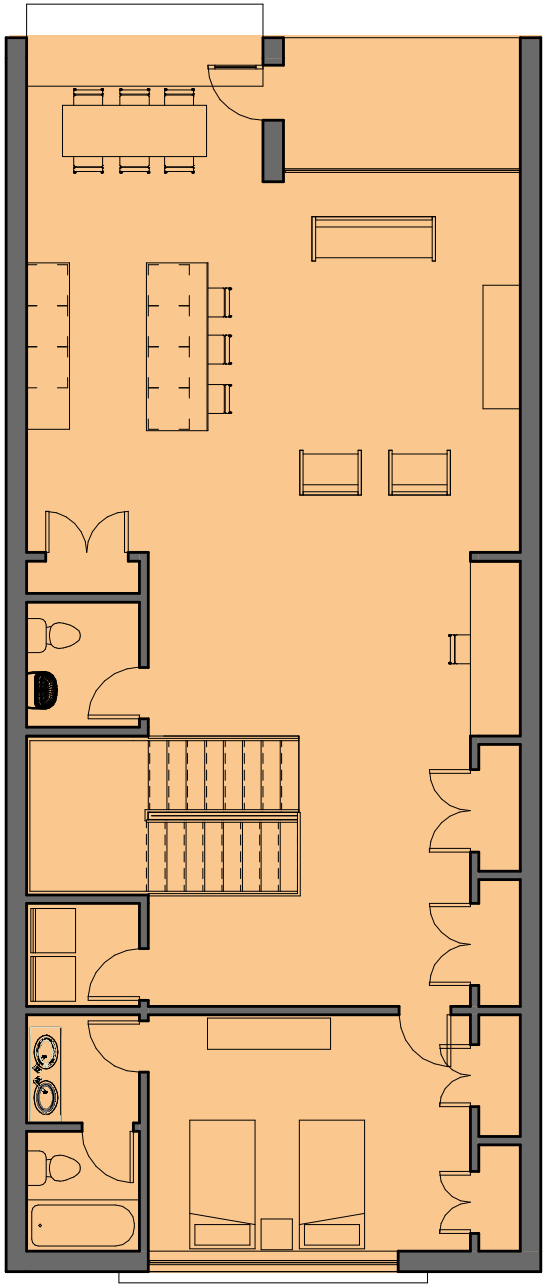
final



LEVEL 01



LEVEL 03



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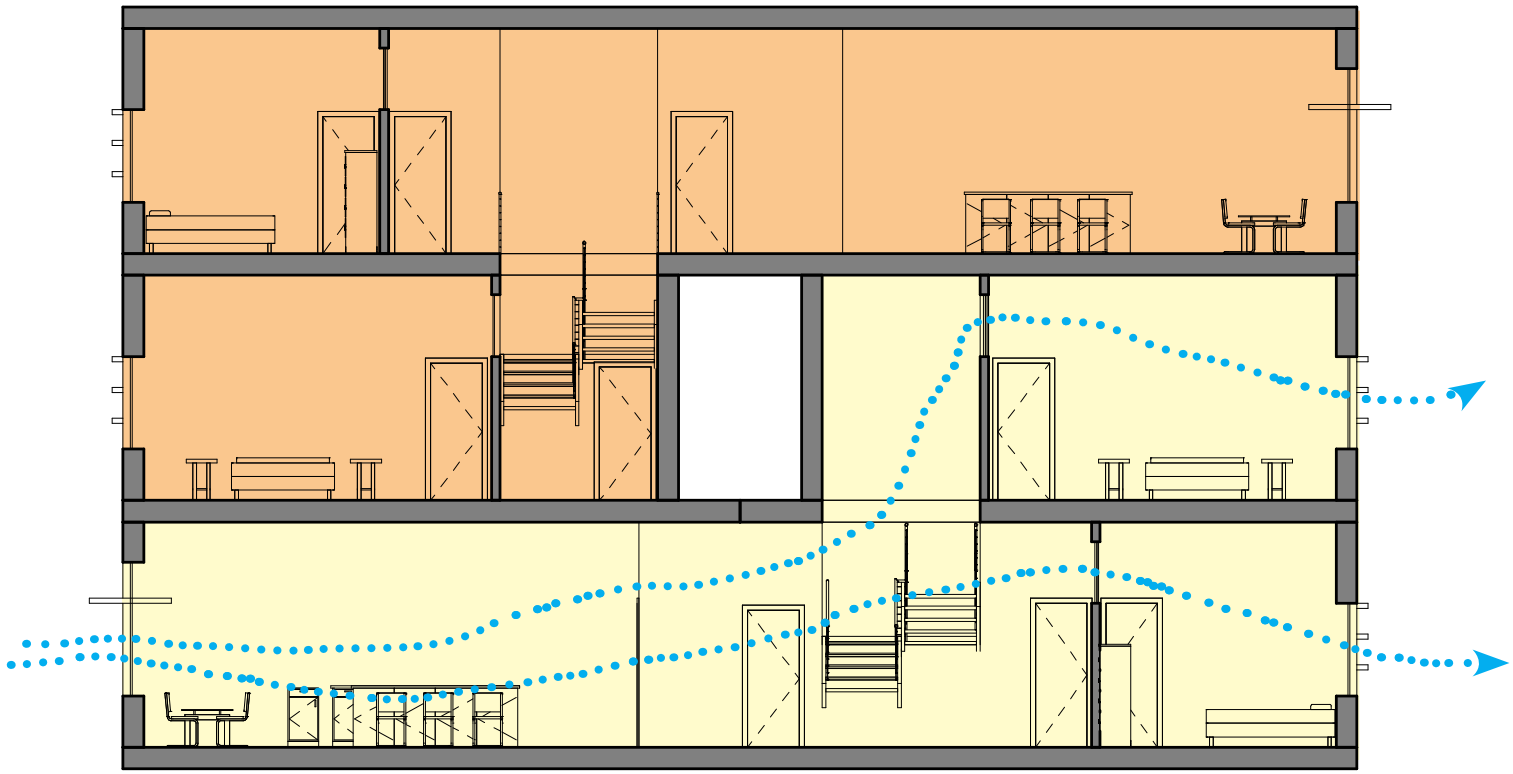

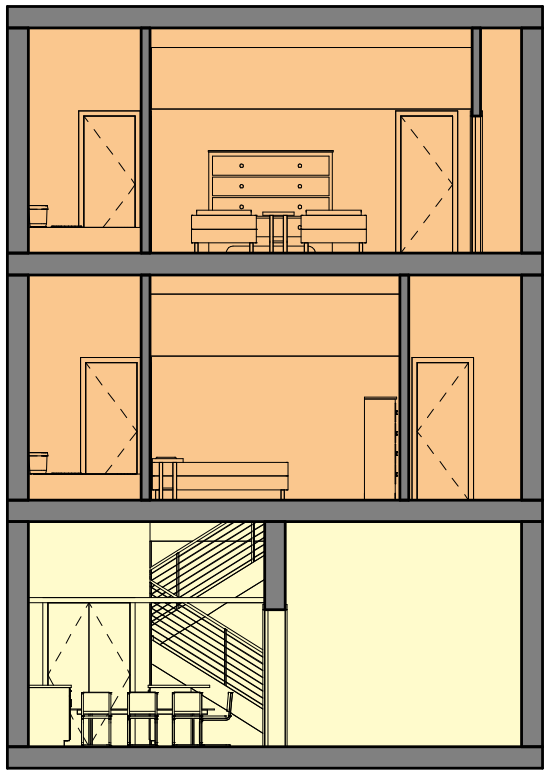

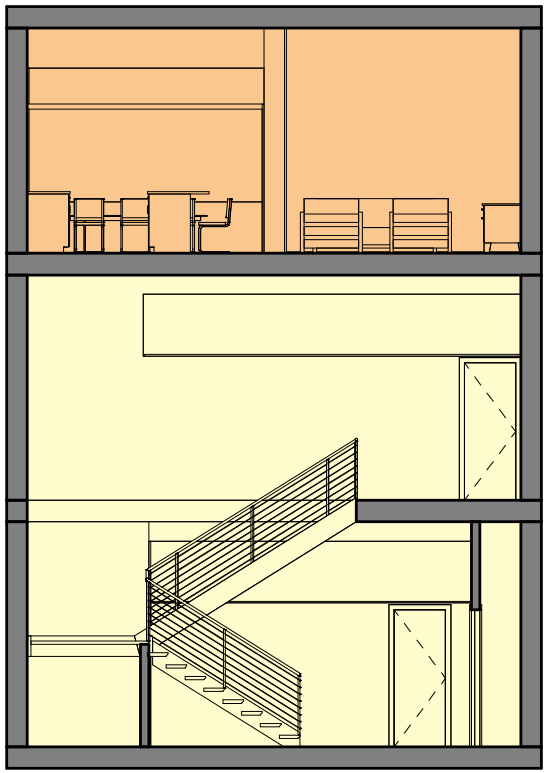

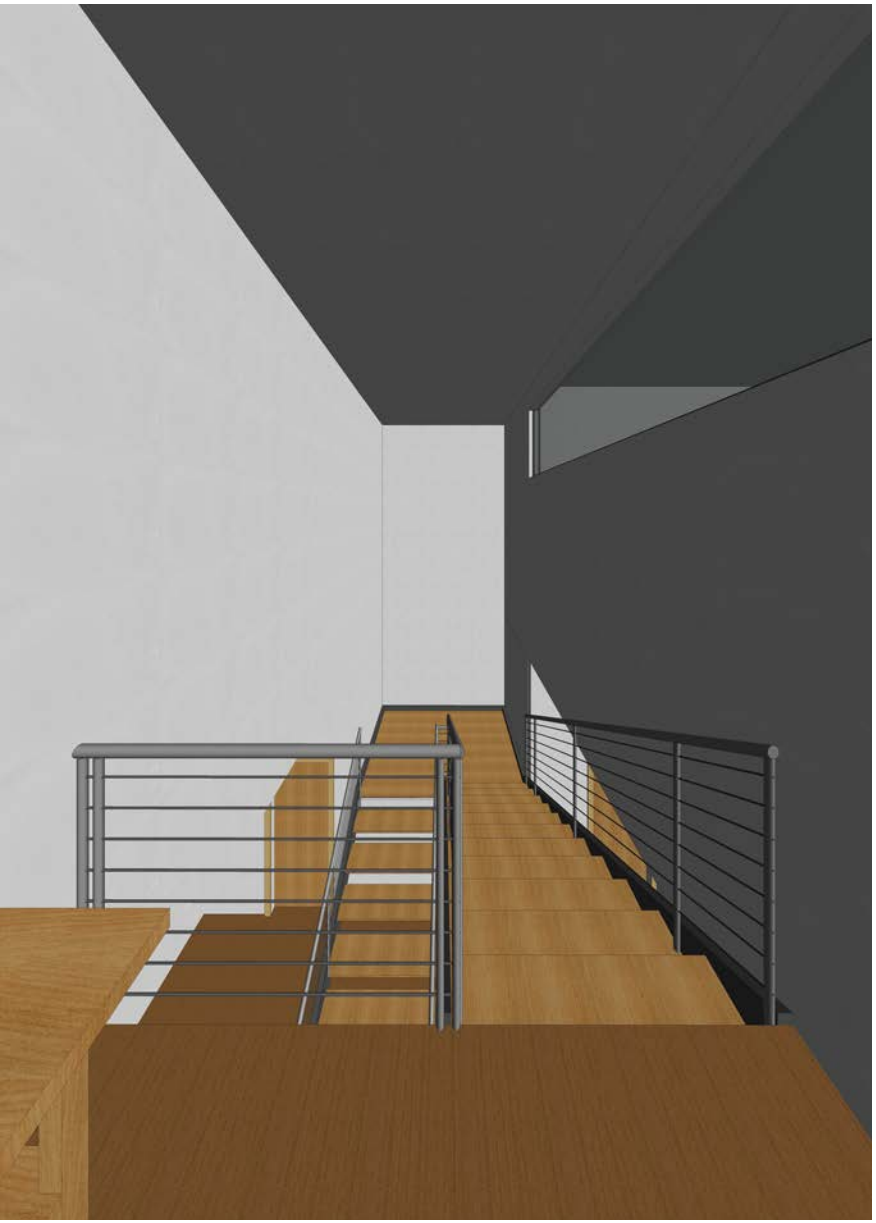

LEVEL 01 & 02

LEVEL 02 & 03

LEVEL 03

LEVEL 01