Agenda

- to create a vertical community bound together by two key issues/requirements in Korean society: urban agriculture and mental health care

- to create a ‘vertical façade farm’ capable of producing 156 tons of vegetables (predominantly lettuce, tomatoes, peppers, and strawberries) and 200 tons of fish per year

- to create a mental health sanctuary (or sanatorium) that provides short term (days), midterm (months) and long term (years) residence and care for people with mental health issues that may require physical operations and/or psychological care.

- to actively engage the mental health residents in aspects of the agricultural production to draw on research showing that engagement with plants/nature assists in mental healing.

- to create a large multi-purpose space at the ground floor of the building which will largely serve as a farmer’s market for sale of the agricultural produce and engagement between the community residents and the public

- to create a series of gardens/green spaces at height within the complex, as well as vertical green walls, for healing (residents and urban issues)

- to use the double-skin ‘façade farm’ for assisting in passive natural ventilation of internal spaces

Research

Climate Studies

Design Development

Design Solution

Structural System

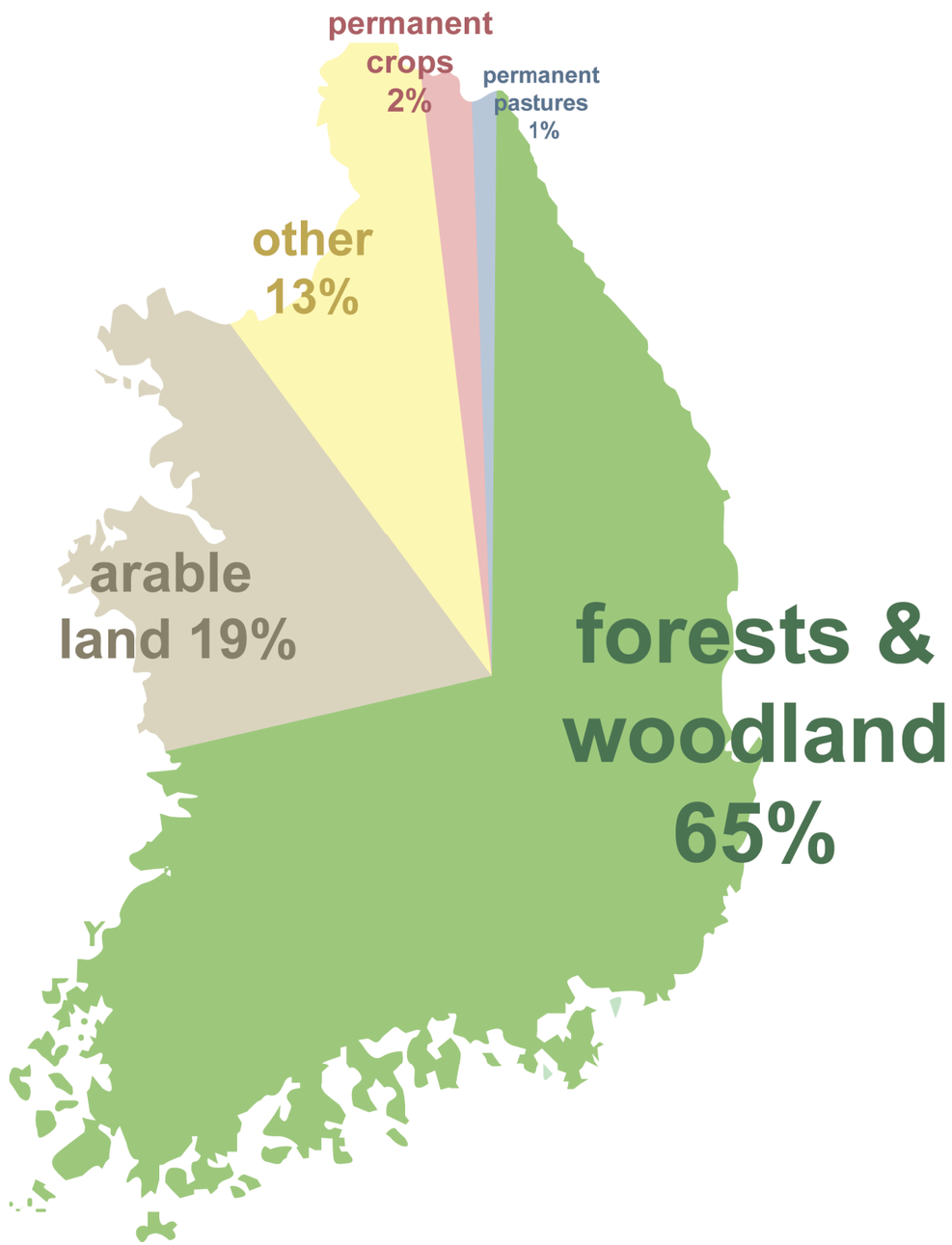
Water & Ventilation System

Aeroponic & Aquaponic System

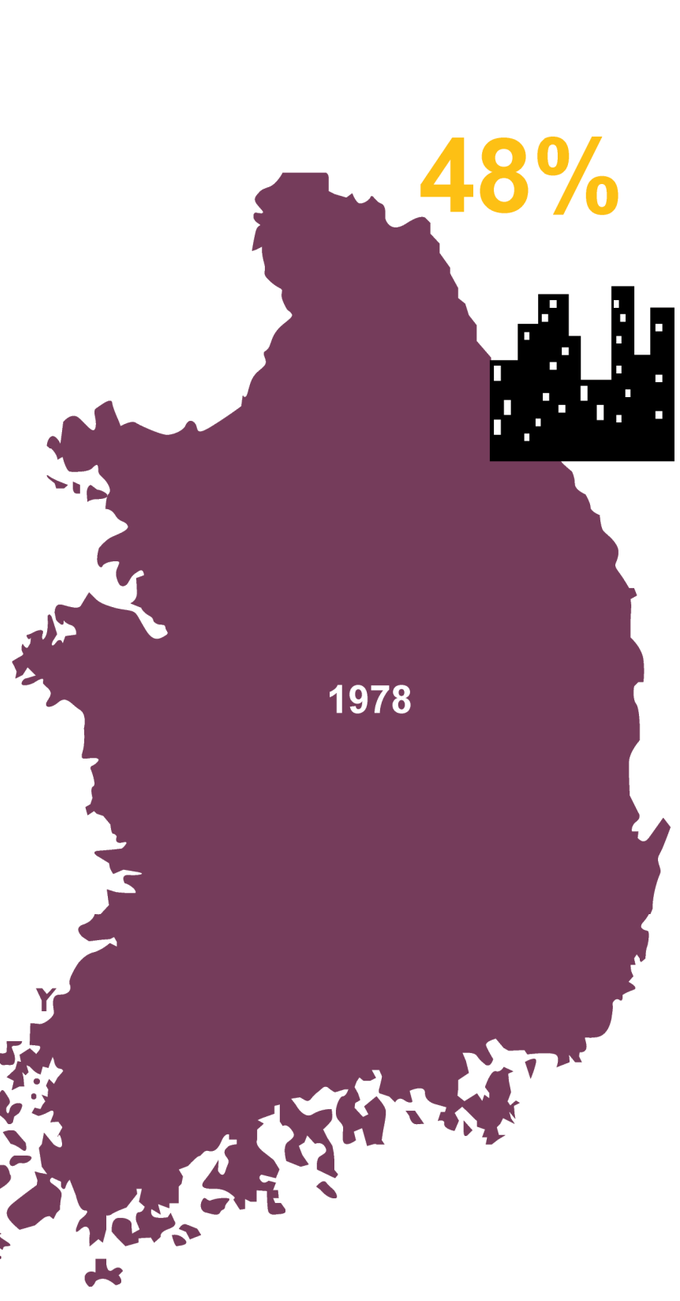
Research

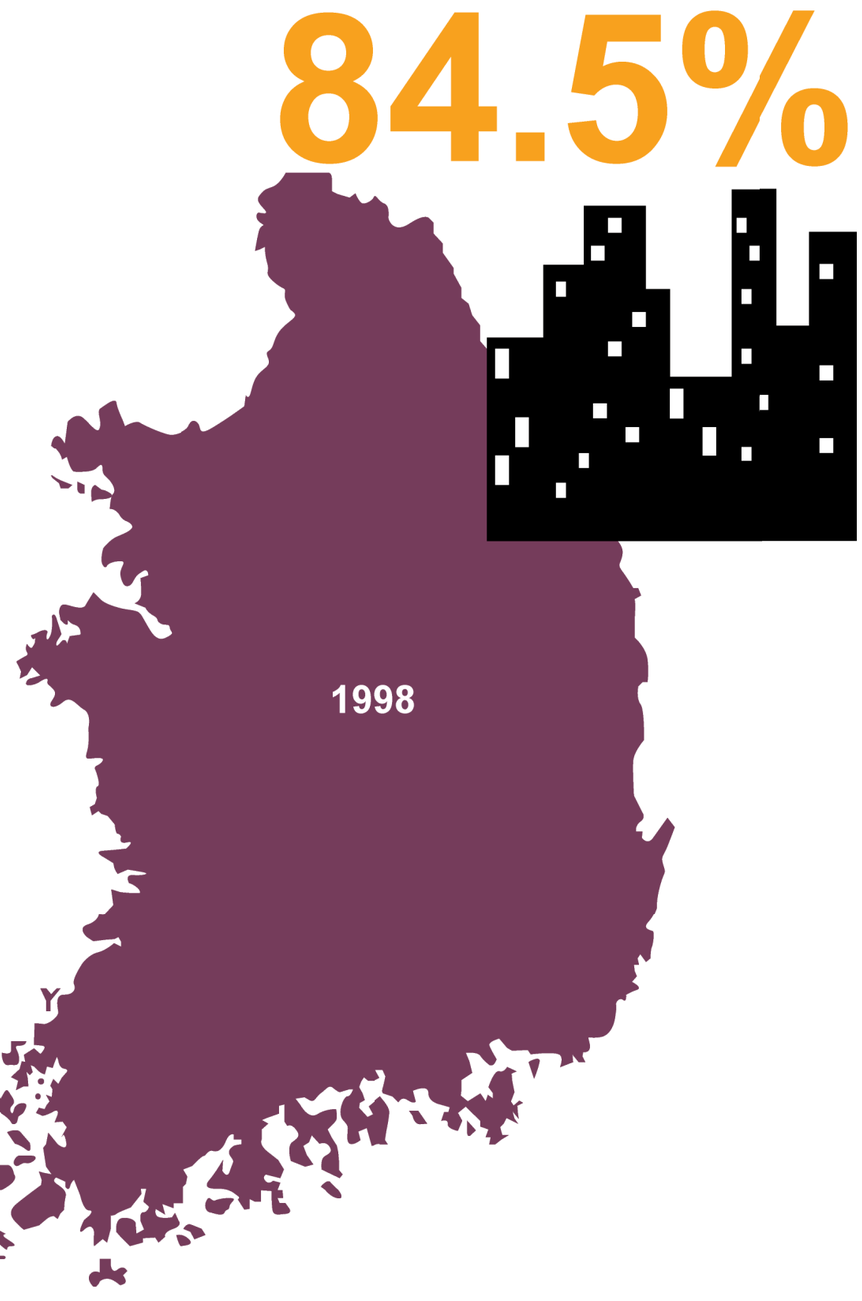
South Korea Land Use

South Korea is a mountainous country that consists of only 19% of arable farmland. Rapid growth in urban areas is contiguously expediting the reduction of farmable land.



Growing Urban Population

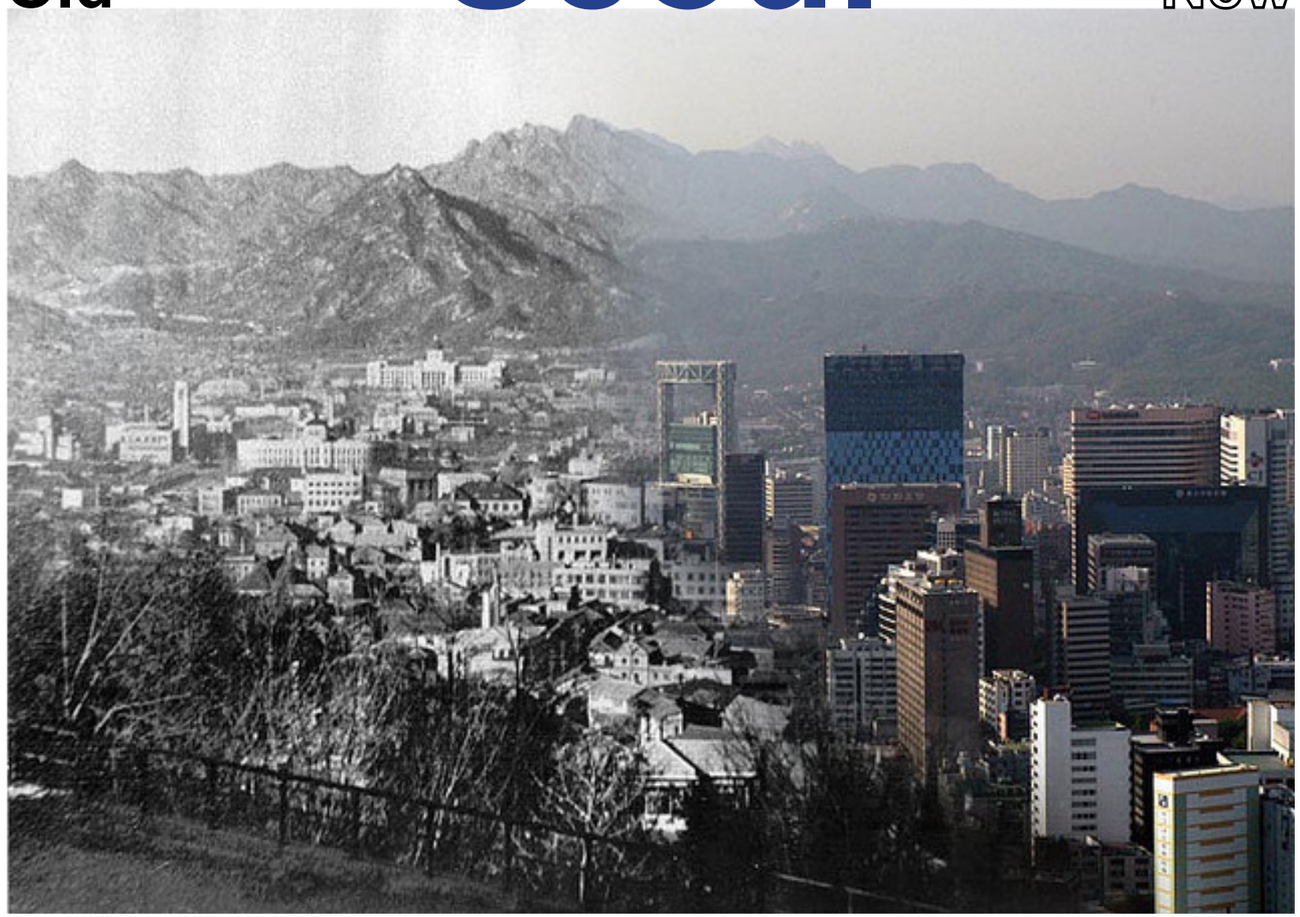




Old

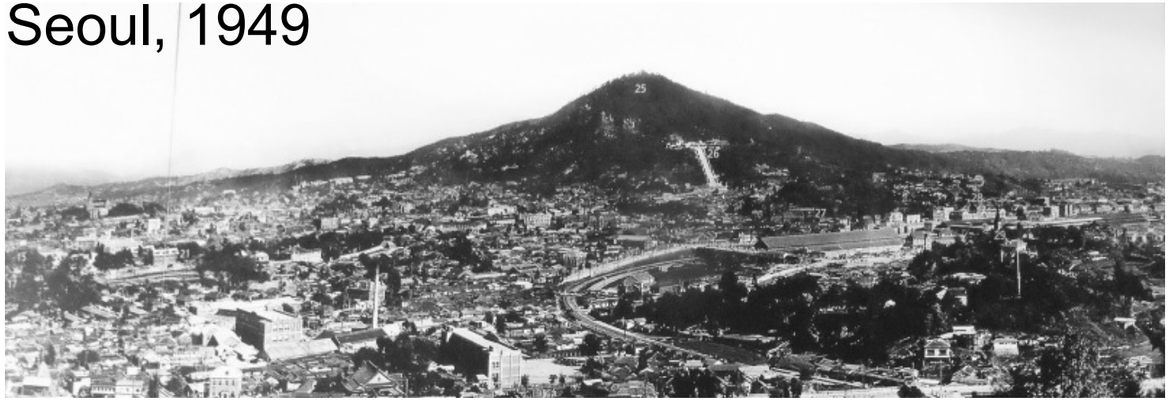
Seoul

New



Results of Urban Sprawl

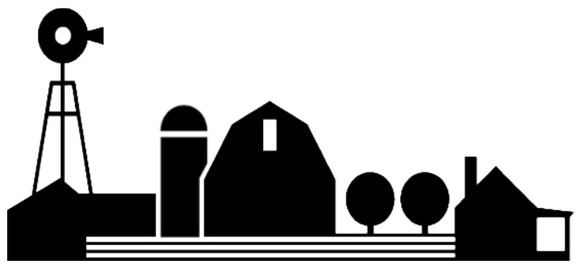
Seoul, 1949



Seoul, 2007

Reduction of Farm Land

1970



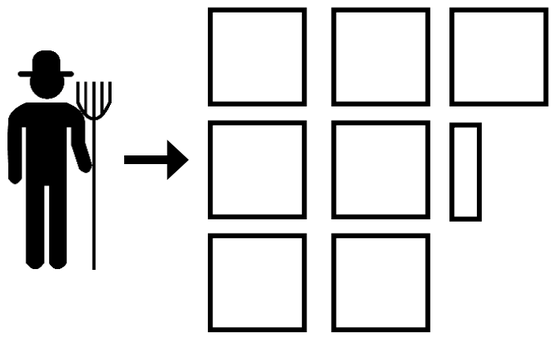
2.298 Million Hectares

2009

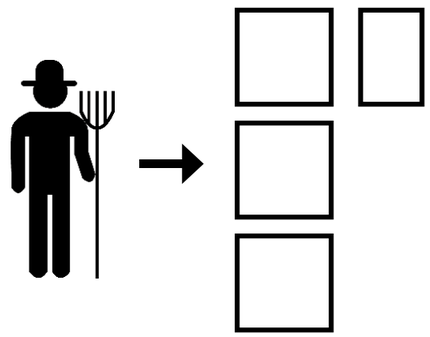
1.759 Million Hectares

Results of Urban Sprawl

1970



2009



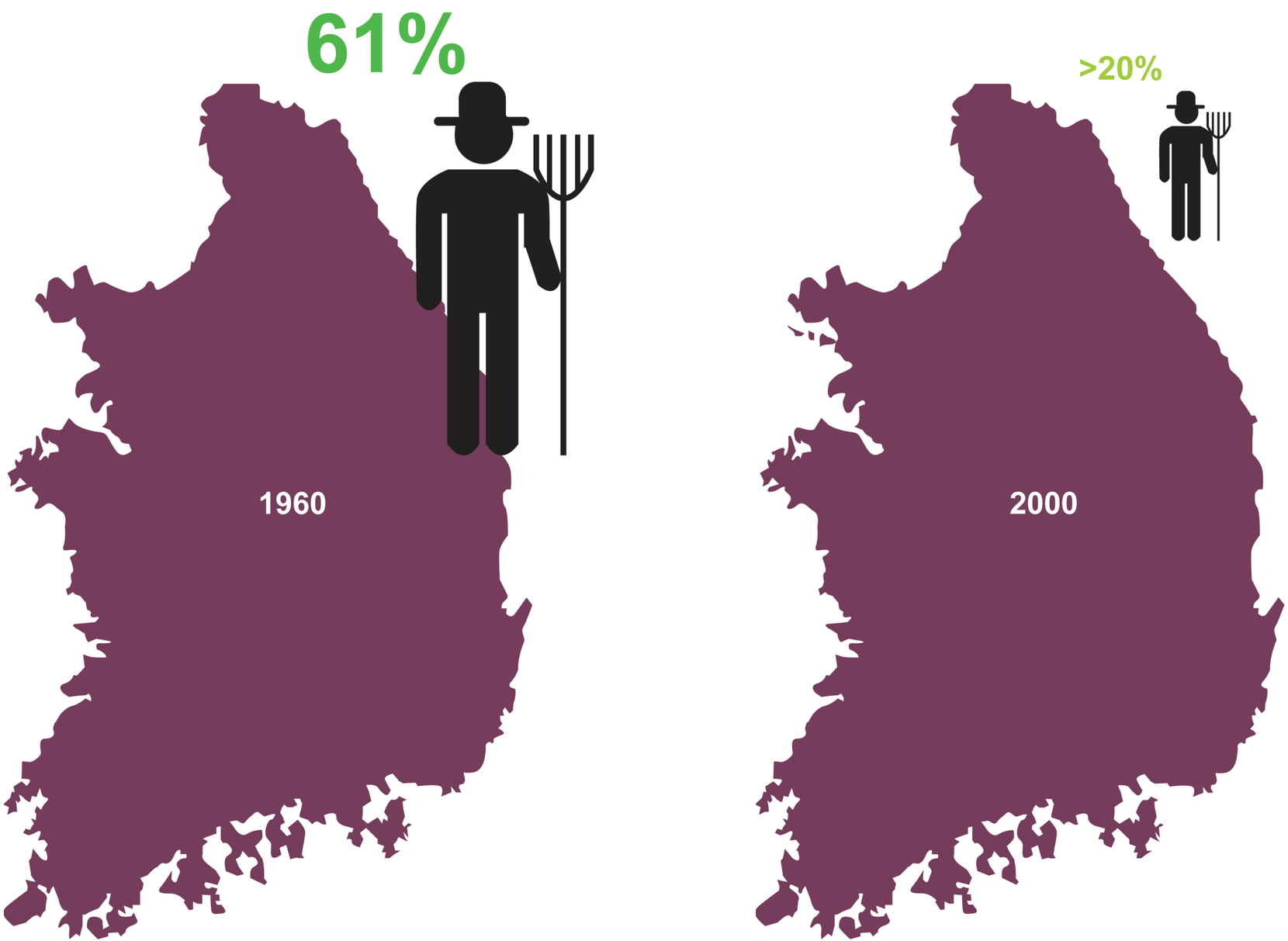
= 1 Acre of Farmland

South Korean Migration

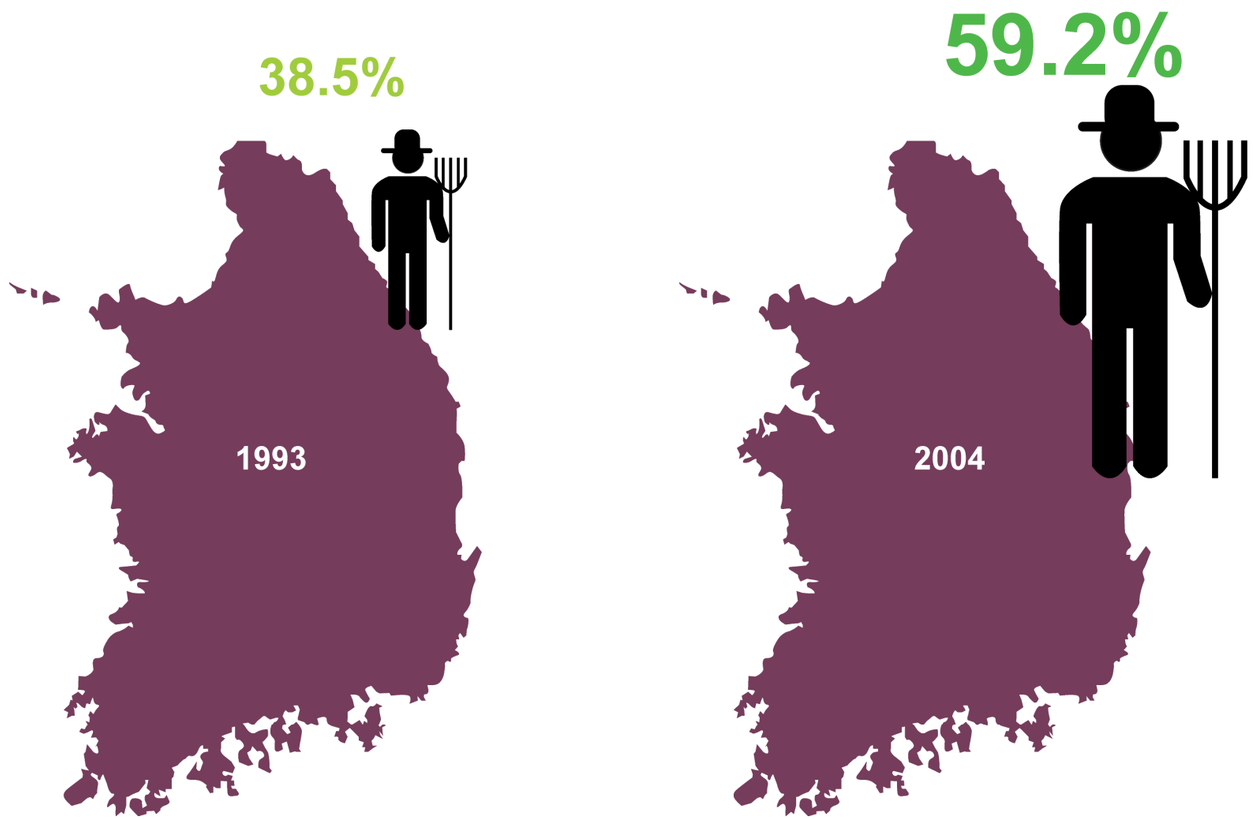
The rural population continues to dwindle as farming families send their children to urban areas for better education, young farmers move to the cities to find wives, and families relocate for better job opportunities & medical services.

As a result, farms are left for old farmers and women to tend. When these farmers pass on, there will be no one to take over, as the younger generation have other job interests and lives in the cities.

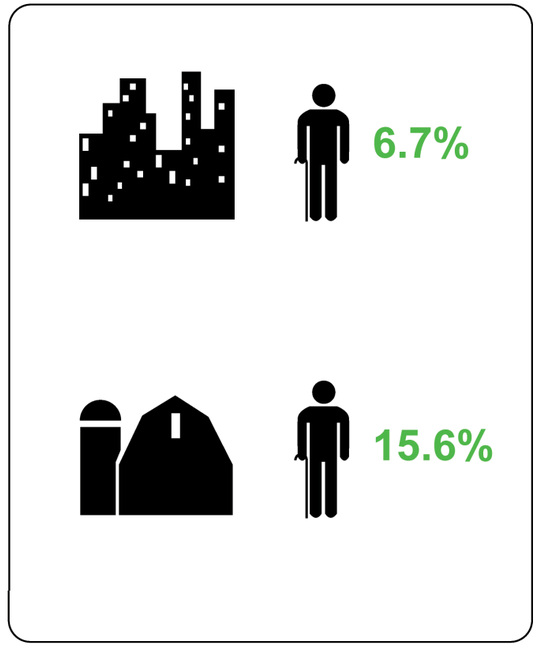
Decreasing Farm Workers



Aging Rural Population

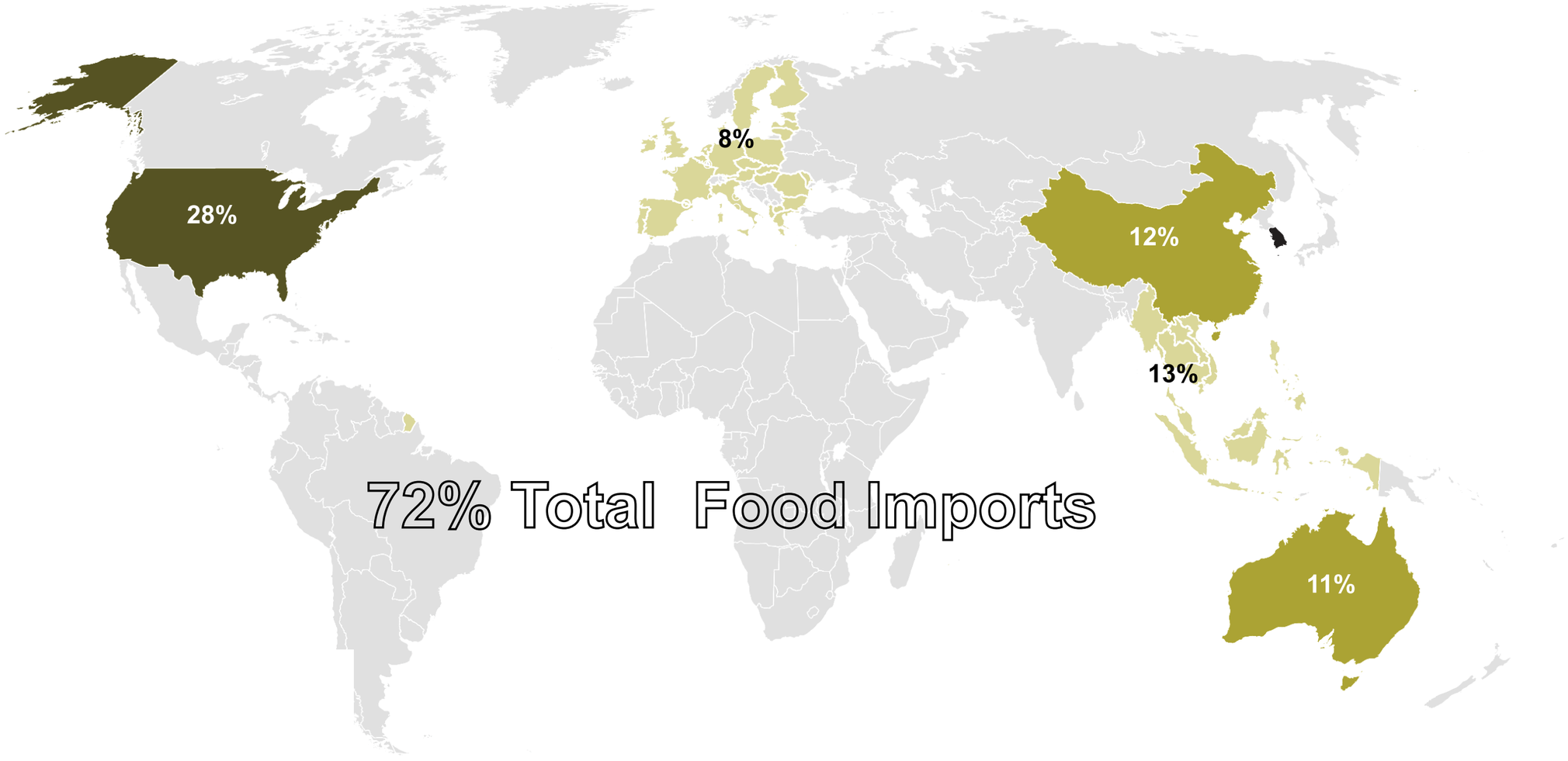


Farm Owner's Age Over 60



Urban & Rural Population Over Age 65

Foreign Food Imports



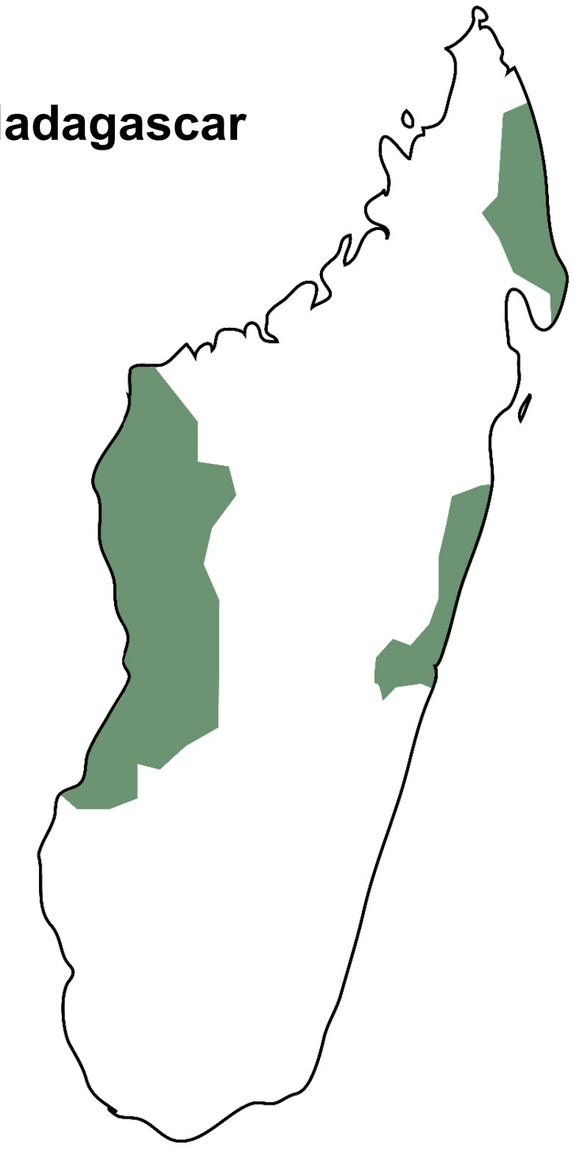
Source: USDA, Economic Research Service using Korean Trade Data

Leasing Farmland

Agricultural property increased significantly as farmland became a rarity. This resulted in higher cost production for locally grown foods, while imports became more affordable. A solution to this issue was to rent farm land overseas because of it's abundance and profitability.

South Korea

Madagascar



Total Arable Land (Hectares)

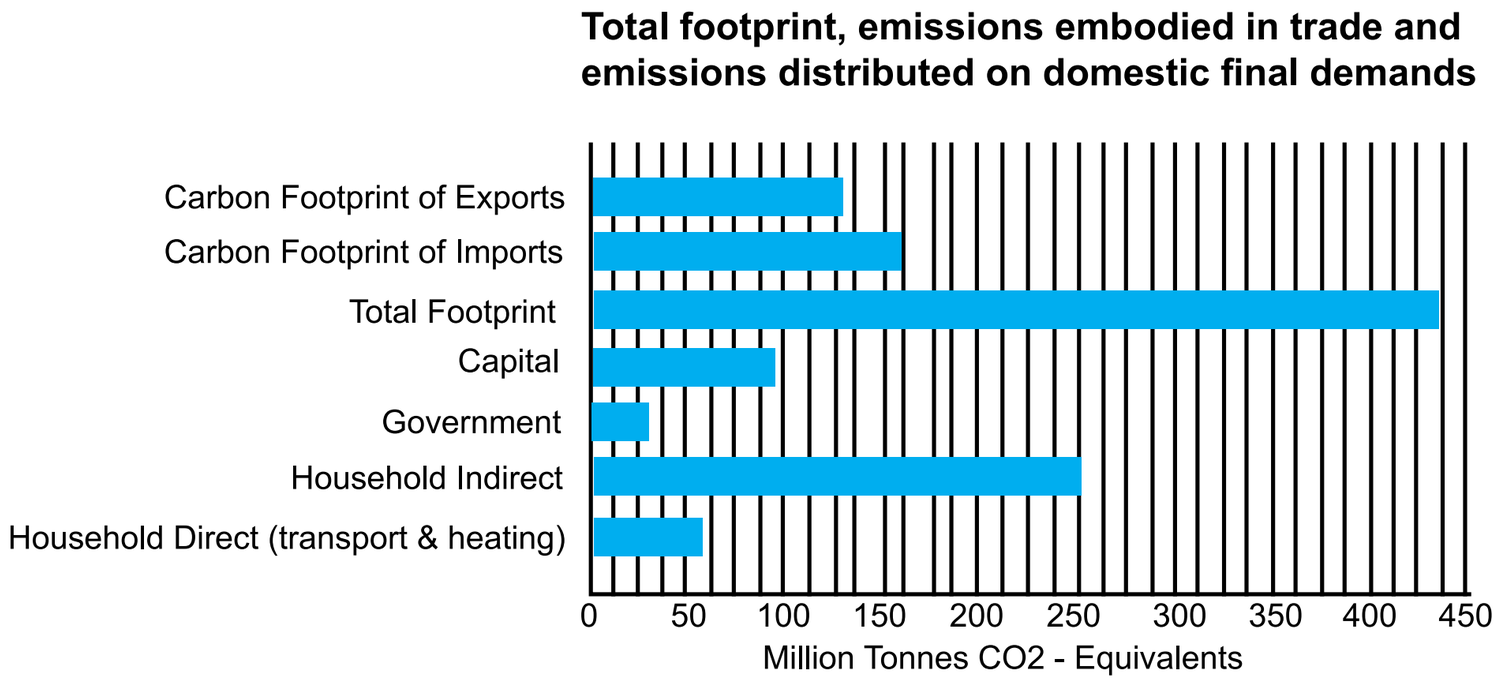
2.5 million

Land Acquired By South Korea

1.3 million

Source: "The Breadbasket of South Korea: Madagascar - TIME."

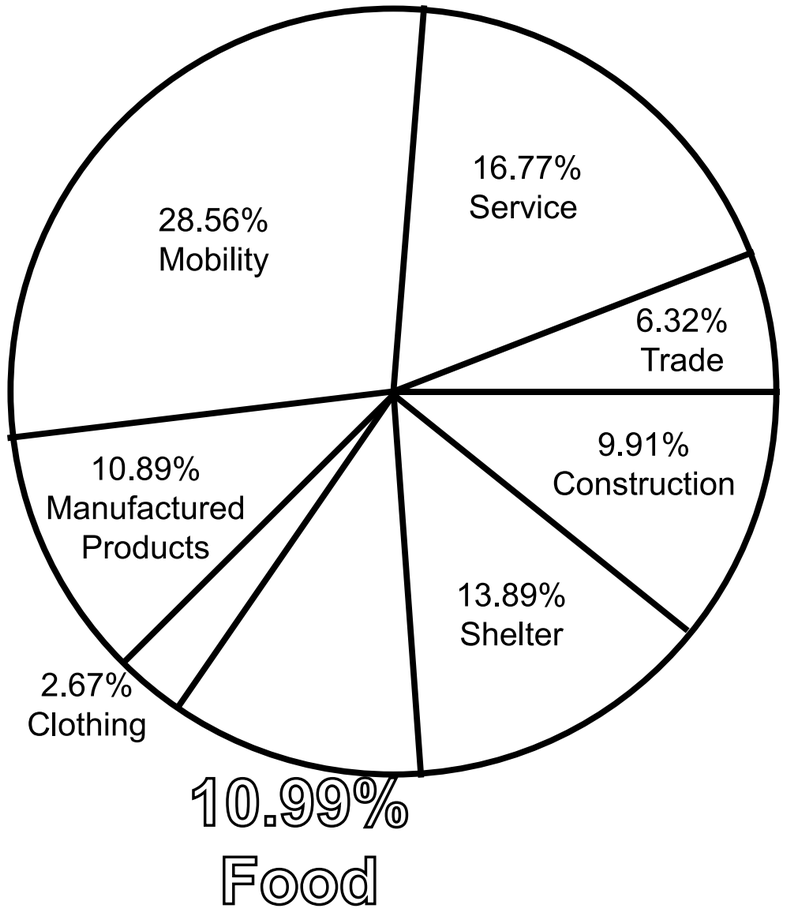
National Carbon Footprint & Trade Balance



150 Million Tonnes of CO2 Emissions

Source: Norwegian University of Science and Technology | Carbon Footprint for Nations Calculator

National Carbon Footprint Distributed On Goods

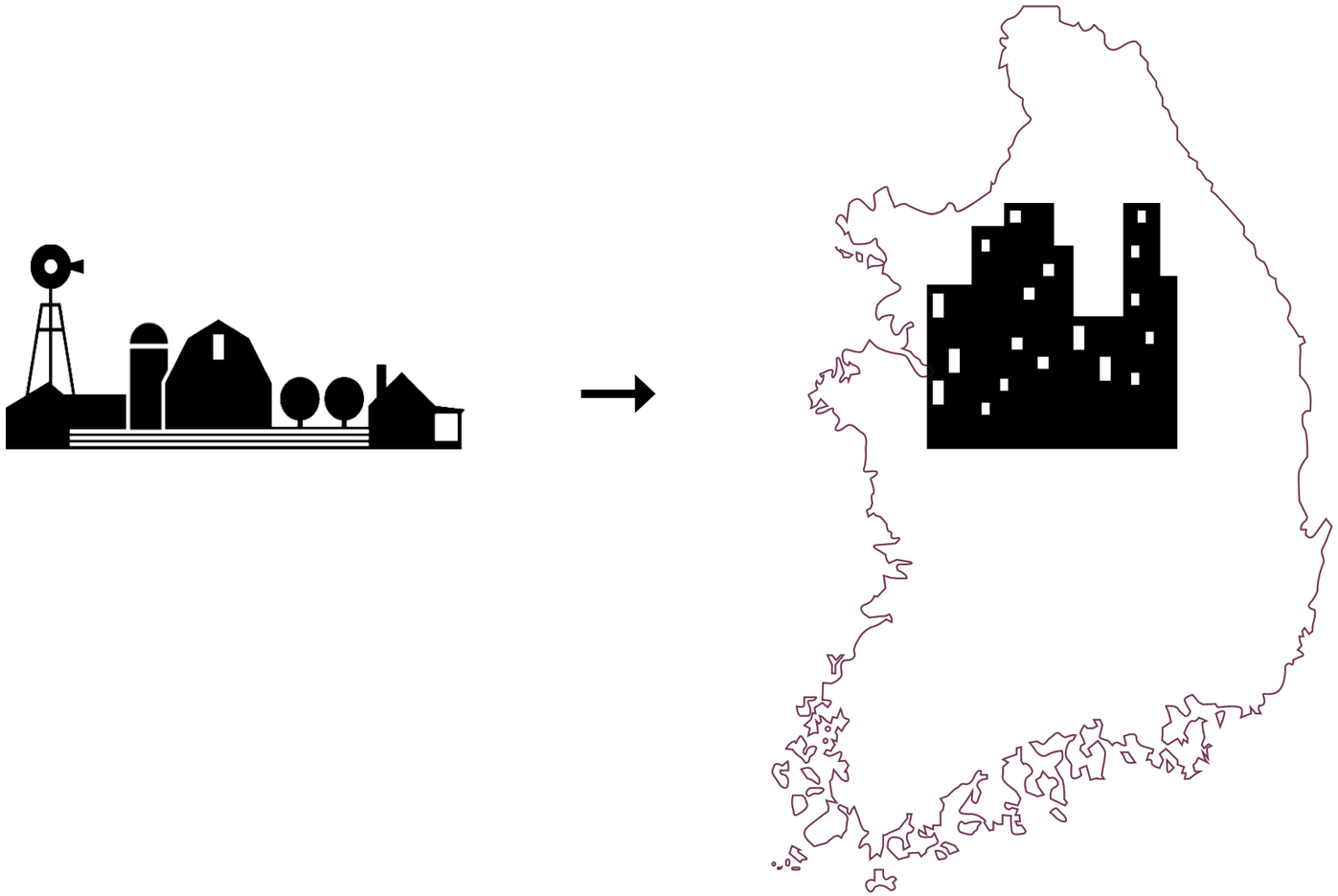


Carbon Footprint Per Capita
[Tonnes CO2 - Equivalents]

The green & yellow boundaries represent sustainable and world average levels respectively

Source: Norwegian University of Science and Technology | Carbon Footprint for Nations Calculator
http://www.carbonfootprintofnations.com/content/calculator_of_carbon_footprint_for_nations/

Bringing the Farm to the Urban Environment

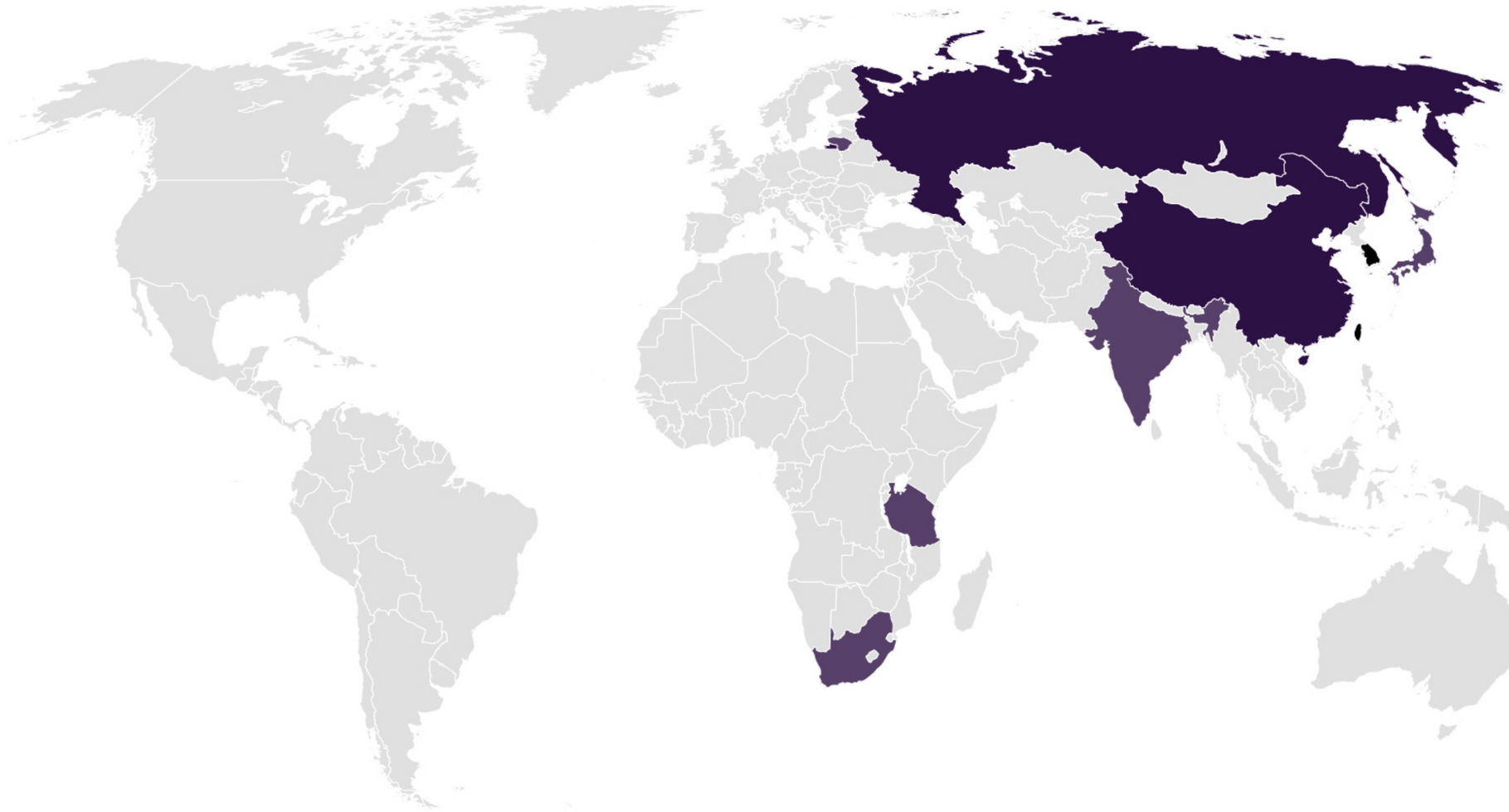


Life in Seoul

Chiyuui Jeon-won [Agricultural Rehabilitation] Tower

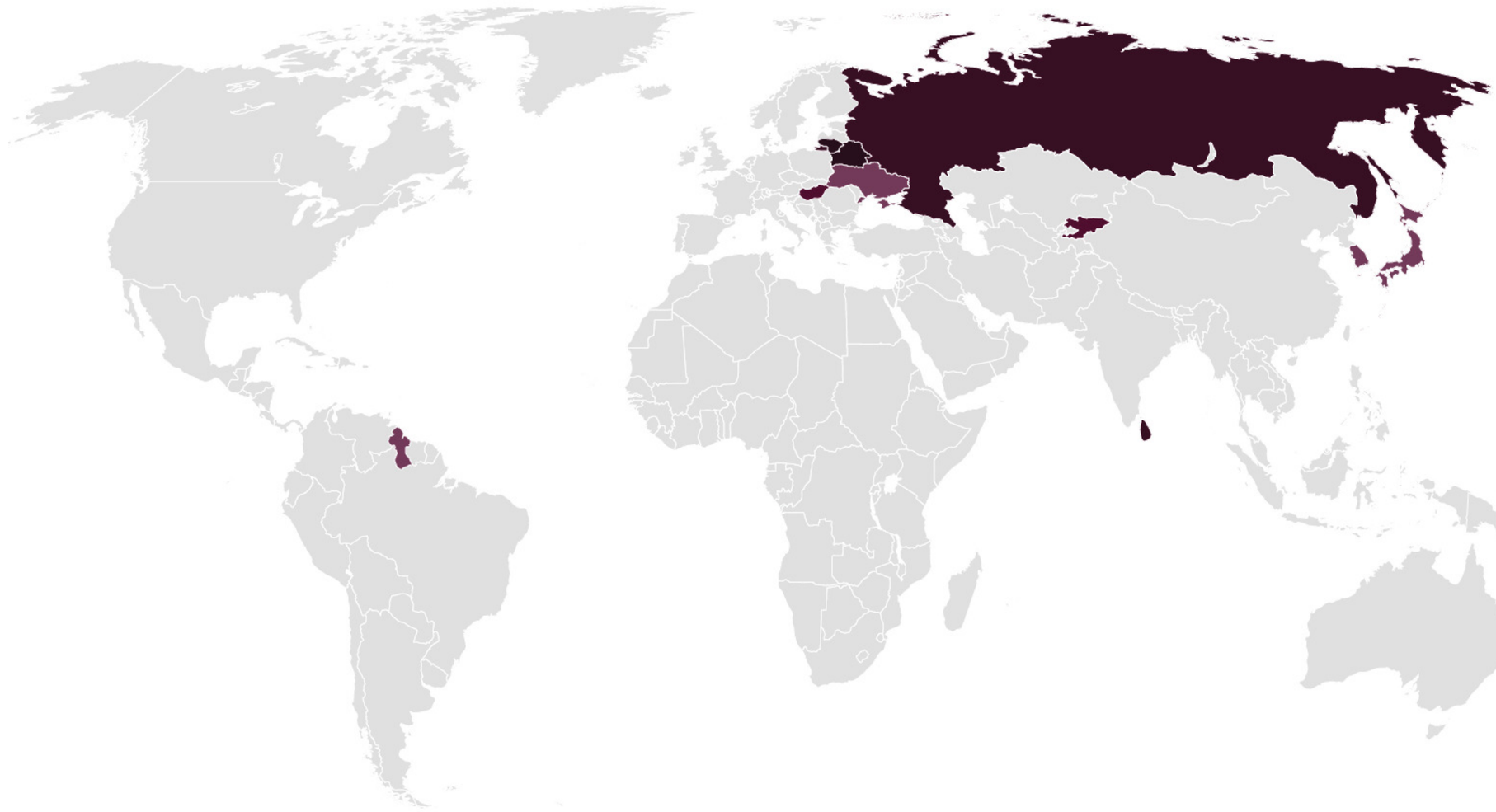
Rodrigo Garcia + Jennifer Lee | Master Project 2011

Social Stress



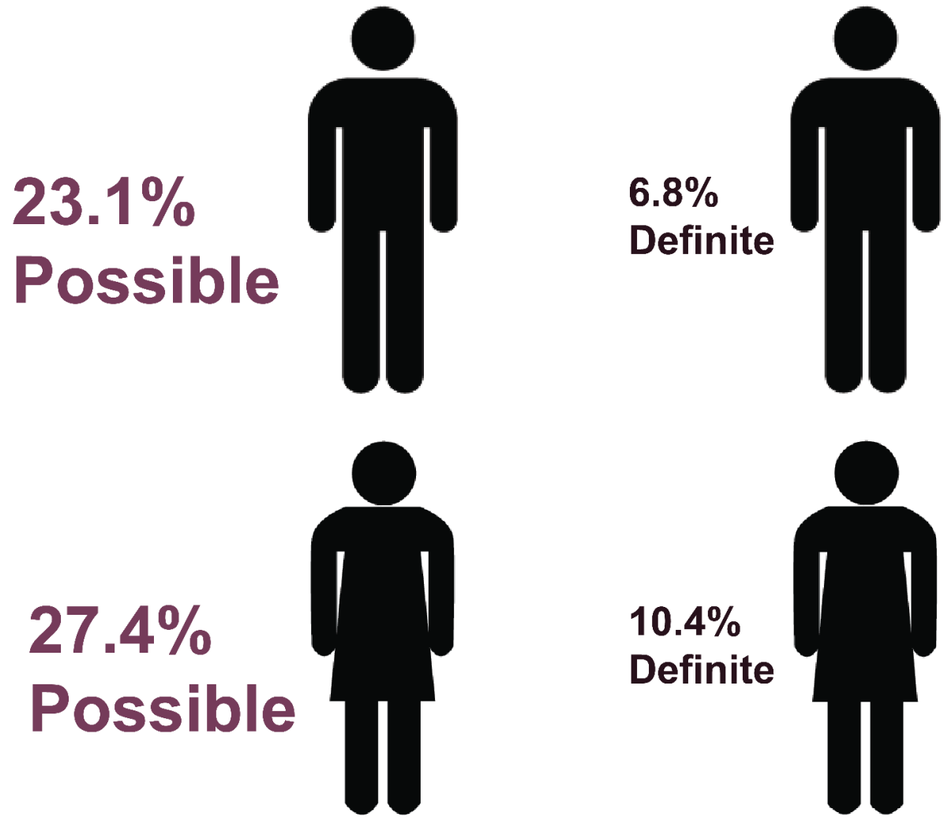
0 100

Depression



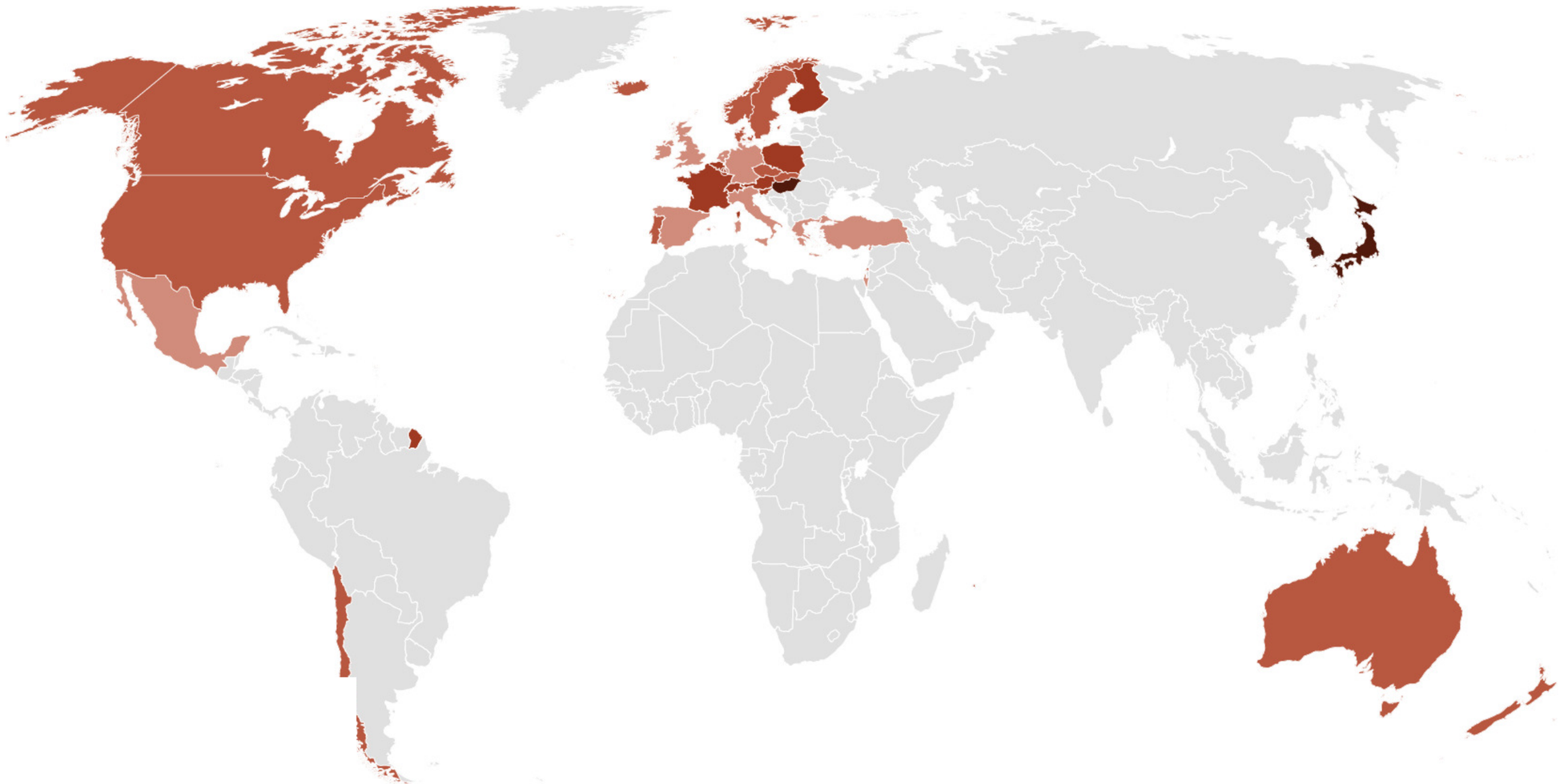
Low High

Depression in Adults



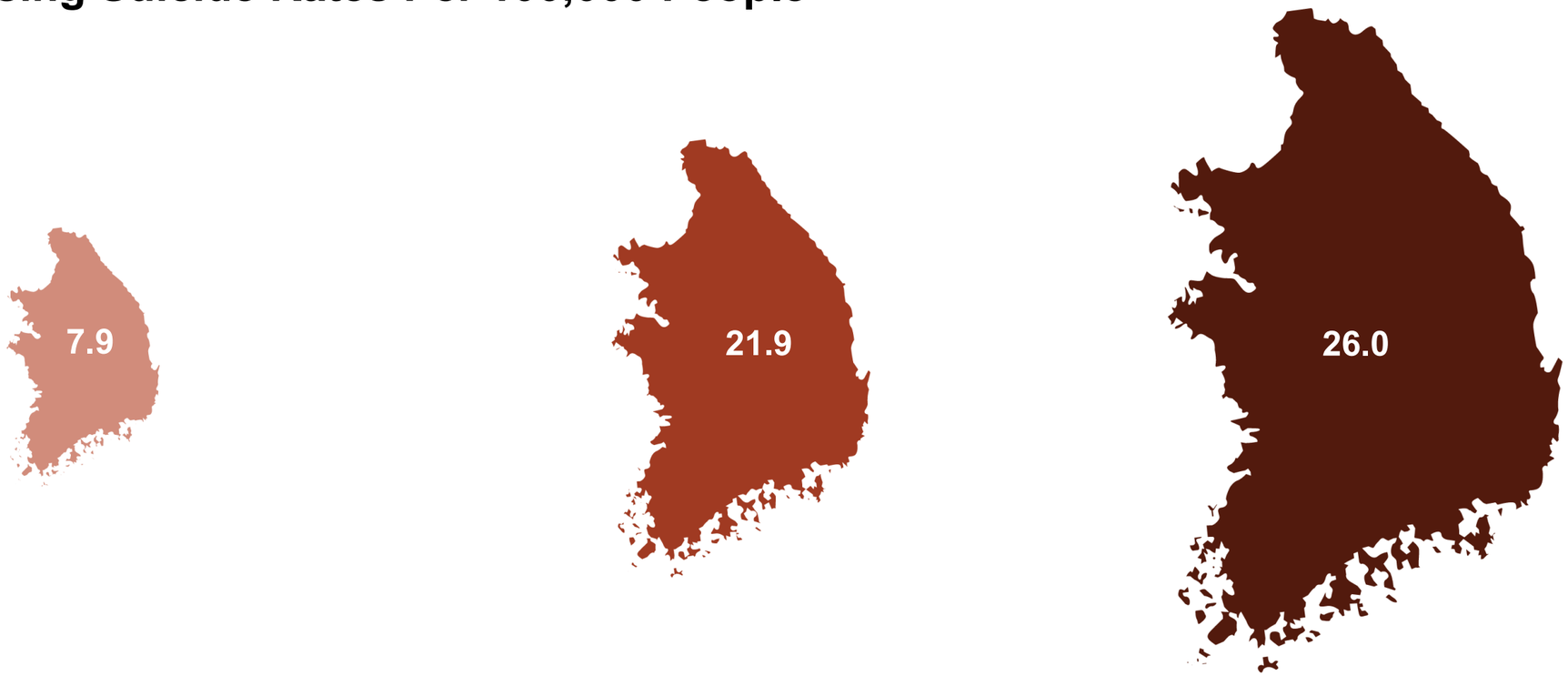
Source: Mental Health Atlas 2005 - World Health Organization

Suicides Per 100,000 People

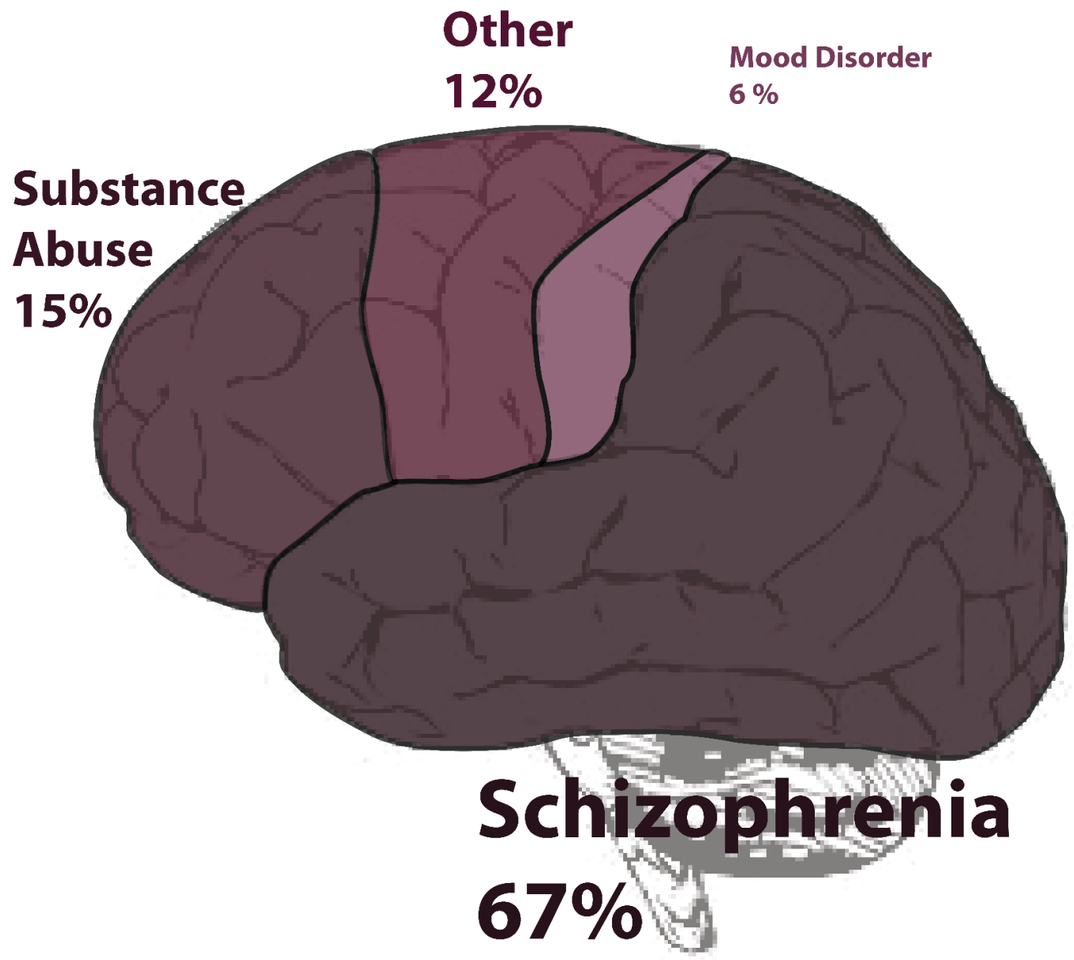


0 25

Increasing Suicide Rates Per 100,000 People

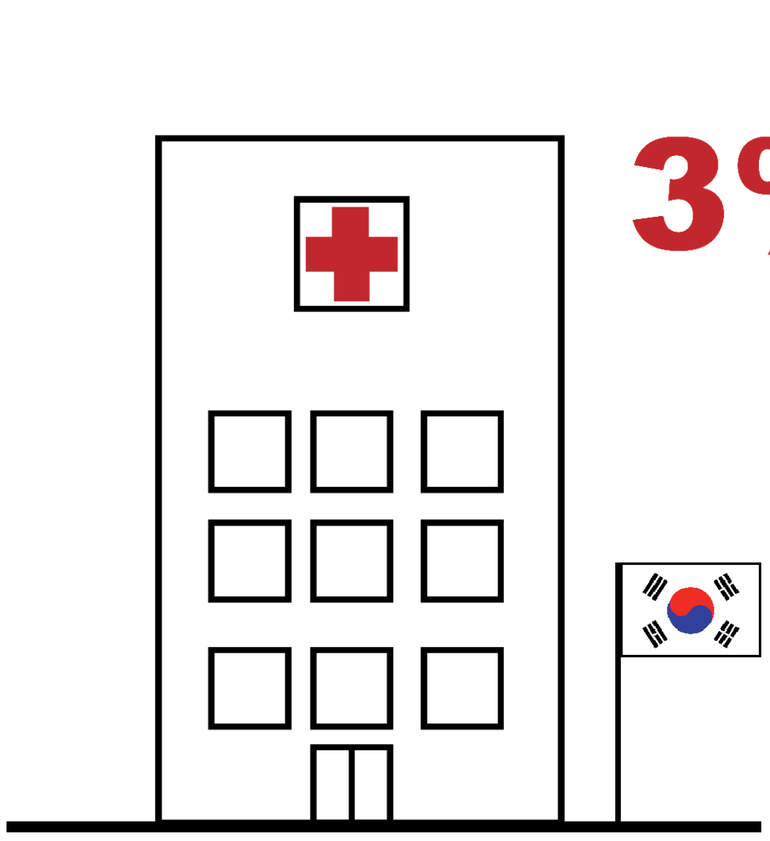


Mental Disorders

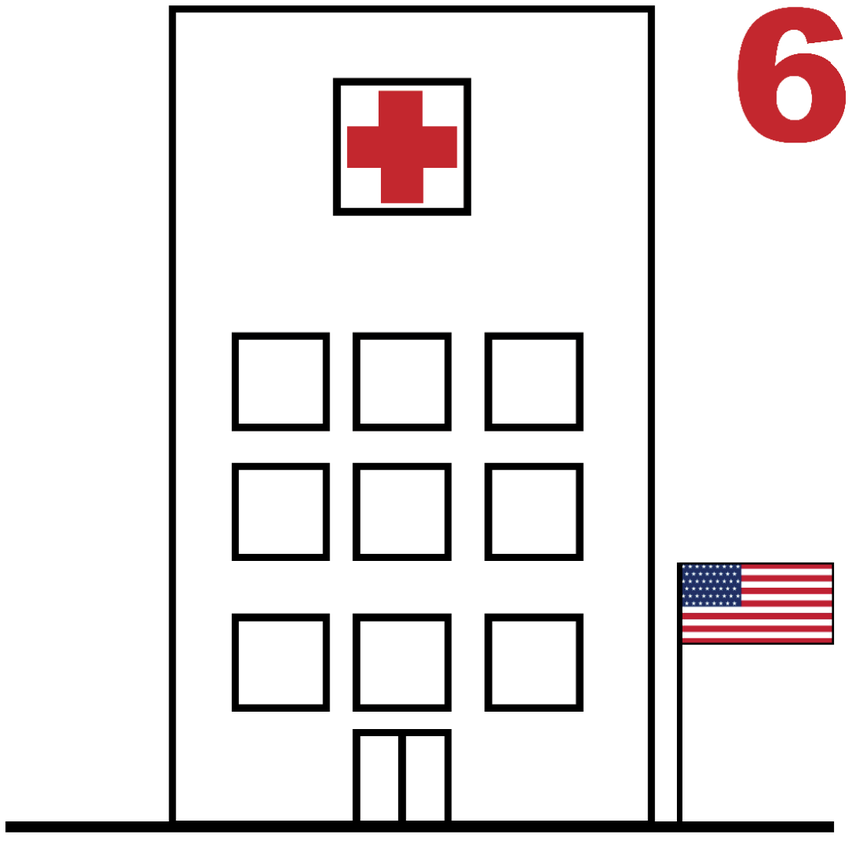


Source: Asian-Pacific Community Mental Health Project 2007.

Overall Budget Given to Mental Healthcare



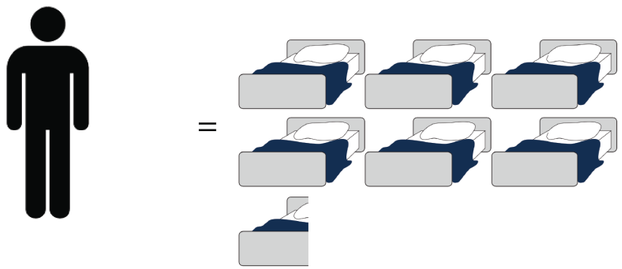
3%



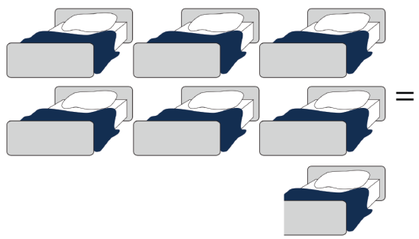
6%

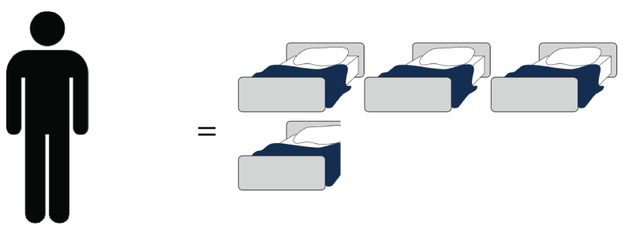
Source: Mental Health Atlas 2005 - World Health Organization

Hospital Bed Accomadations



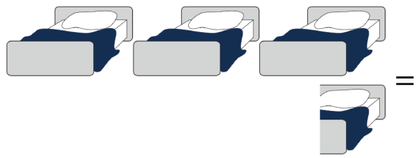
In Mental Hospitals





In General Hospitals

Other Settings

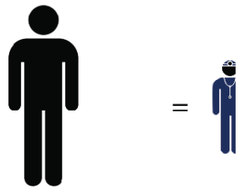


= 10,000 People

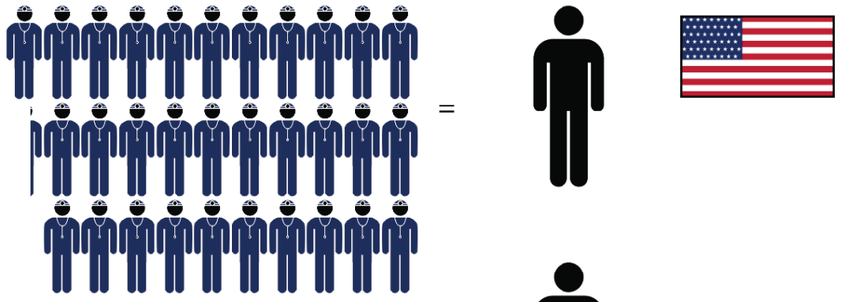
= 1 Psychiatric Bed

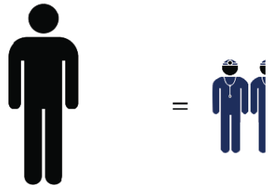
Source: Mental Health Atlas 2005 - World Health Organization

Doctor to Patient

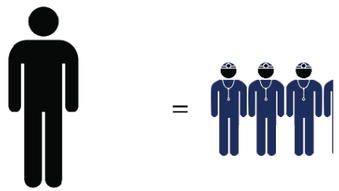


Psychologist

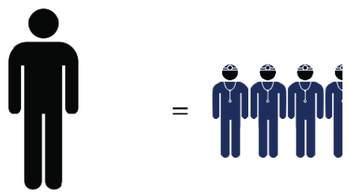




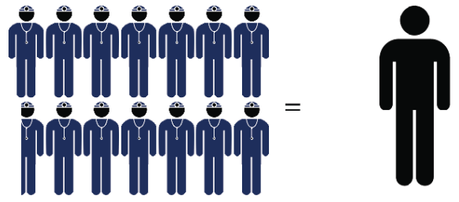
Neurologist

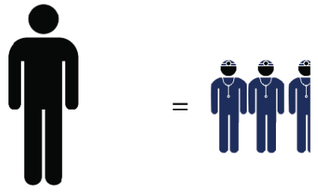


Neurosurgeon

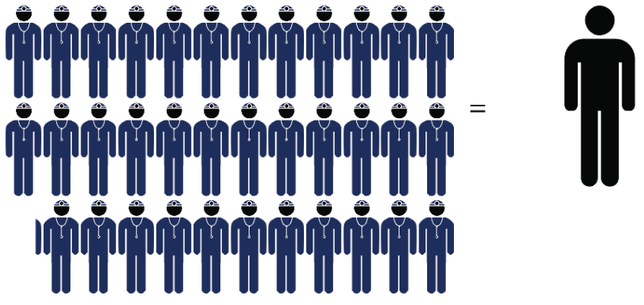


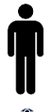
Psychiatrist





Social Worker





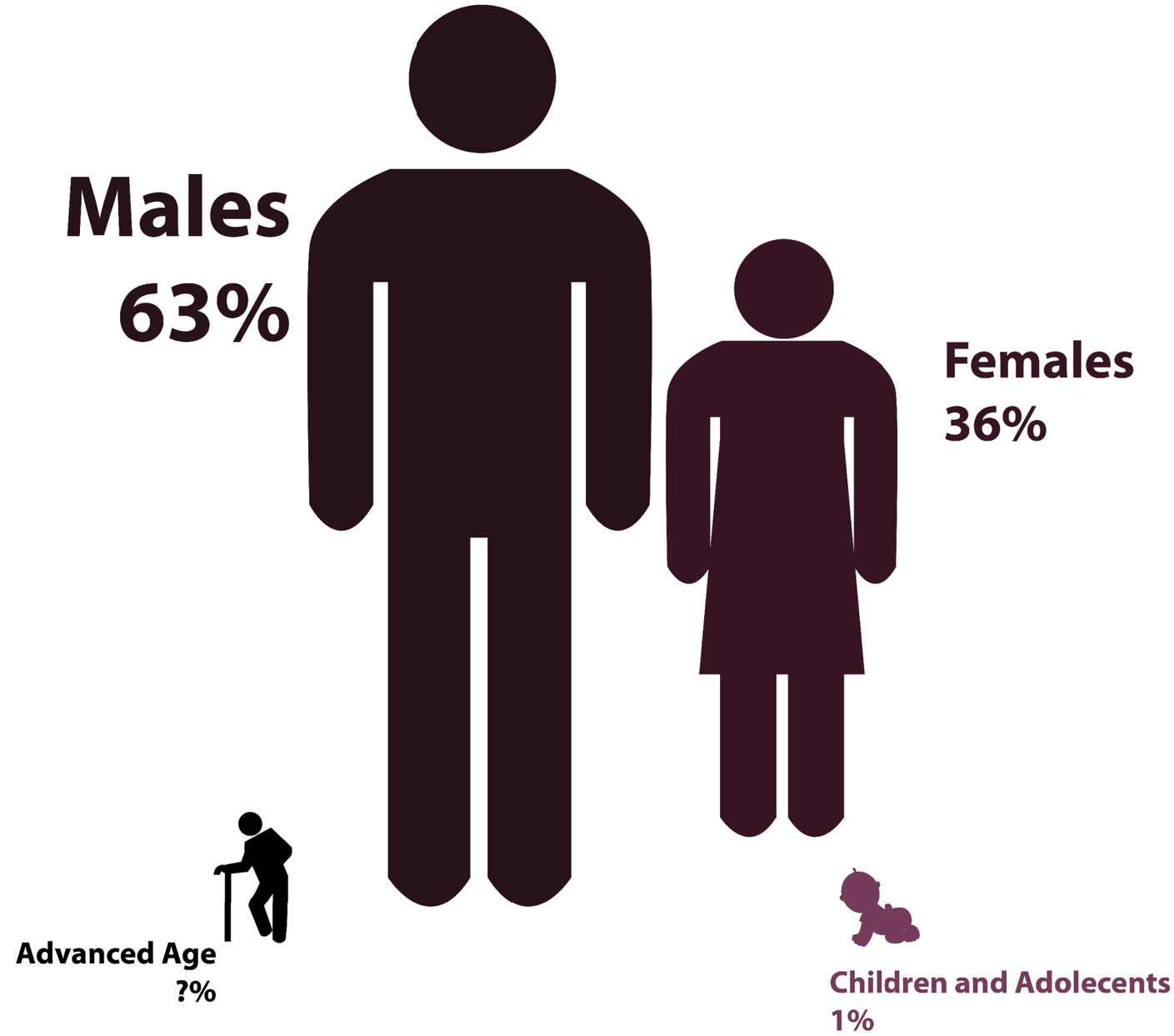
= 100,000 People

= 1 Doctor

Source: Mental Health Atlas 2005 - World Health Organization

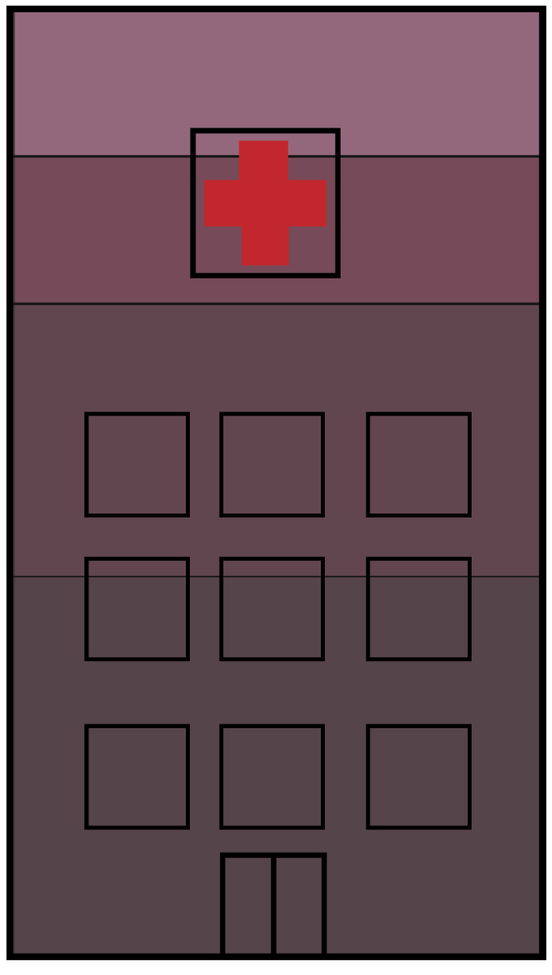
Chiyuui Jeon-won [Agricultural Rehabilitation] Tower

Patients of Mental Hospitals



Source: Mental Health Atlas 2005 - World Health Organization

Duration of Stay At Mental Hospital



14%
10+ Years

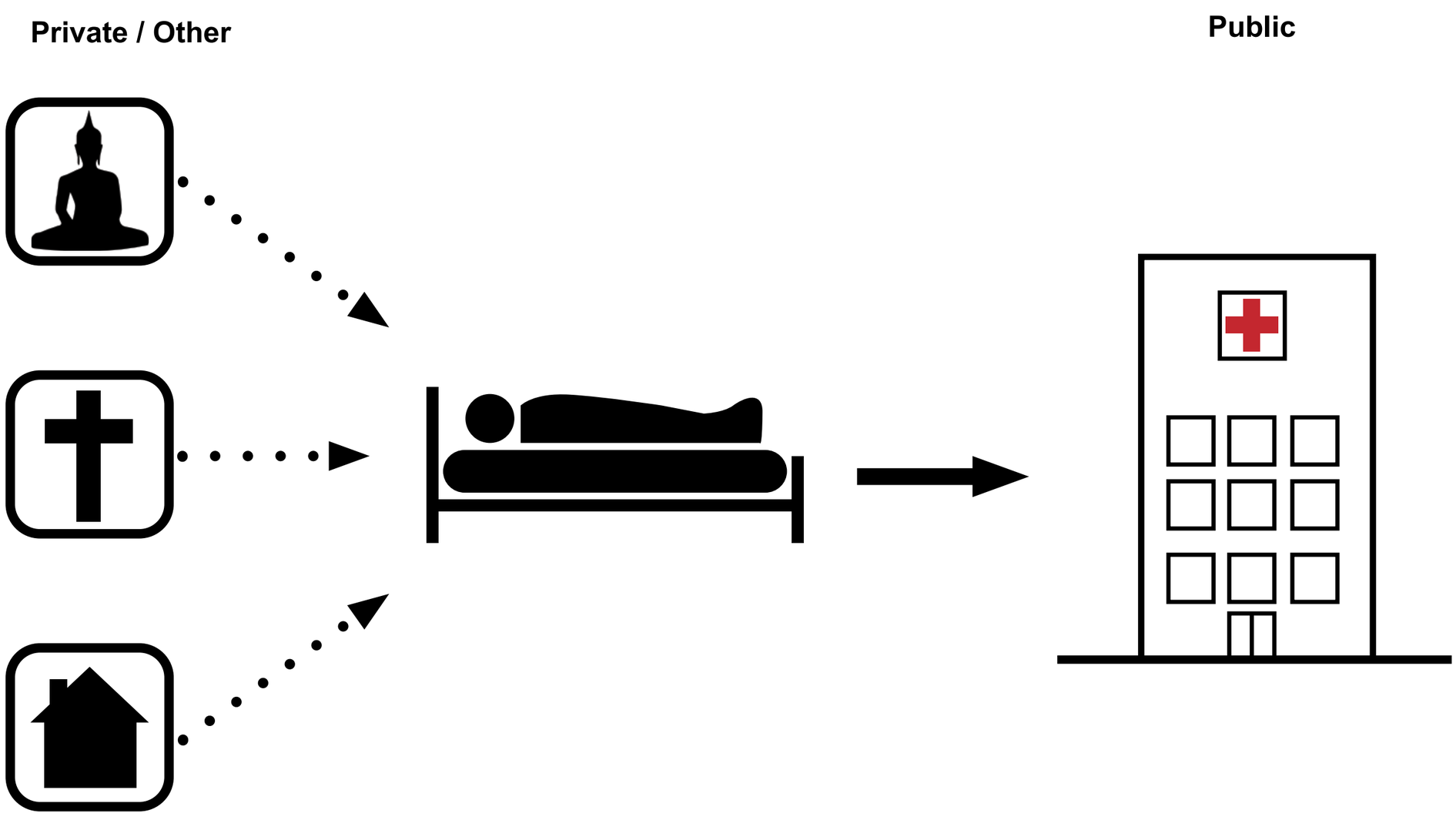
14%
5-10 Years

28%
1-4 Years

44%
140 Days

Source: Asian-Pacific Community Mental Health Project 2007.

Migration of Mental Patients



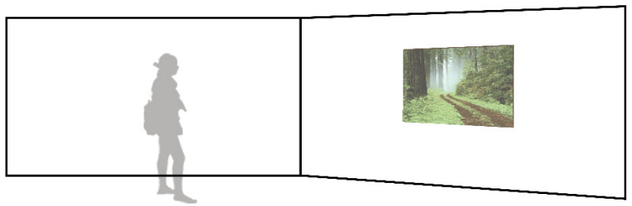
Source: Mental Health Atlas 2008 - World Health Organization

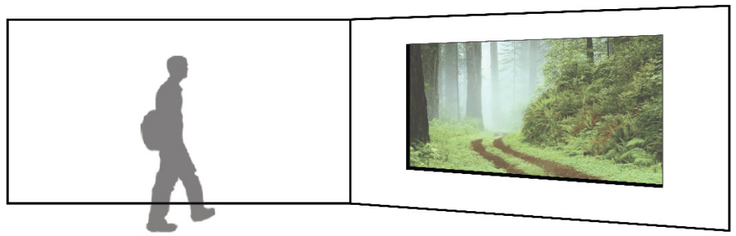
Levels of Interaction with Nature

Interaction

Passive

Active





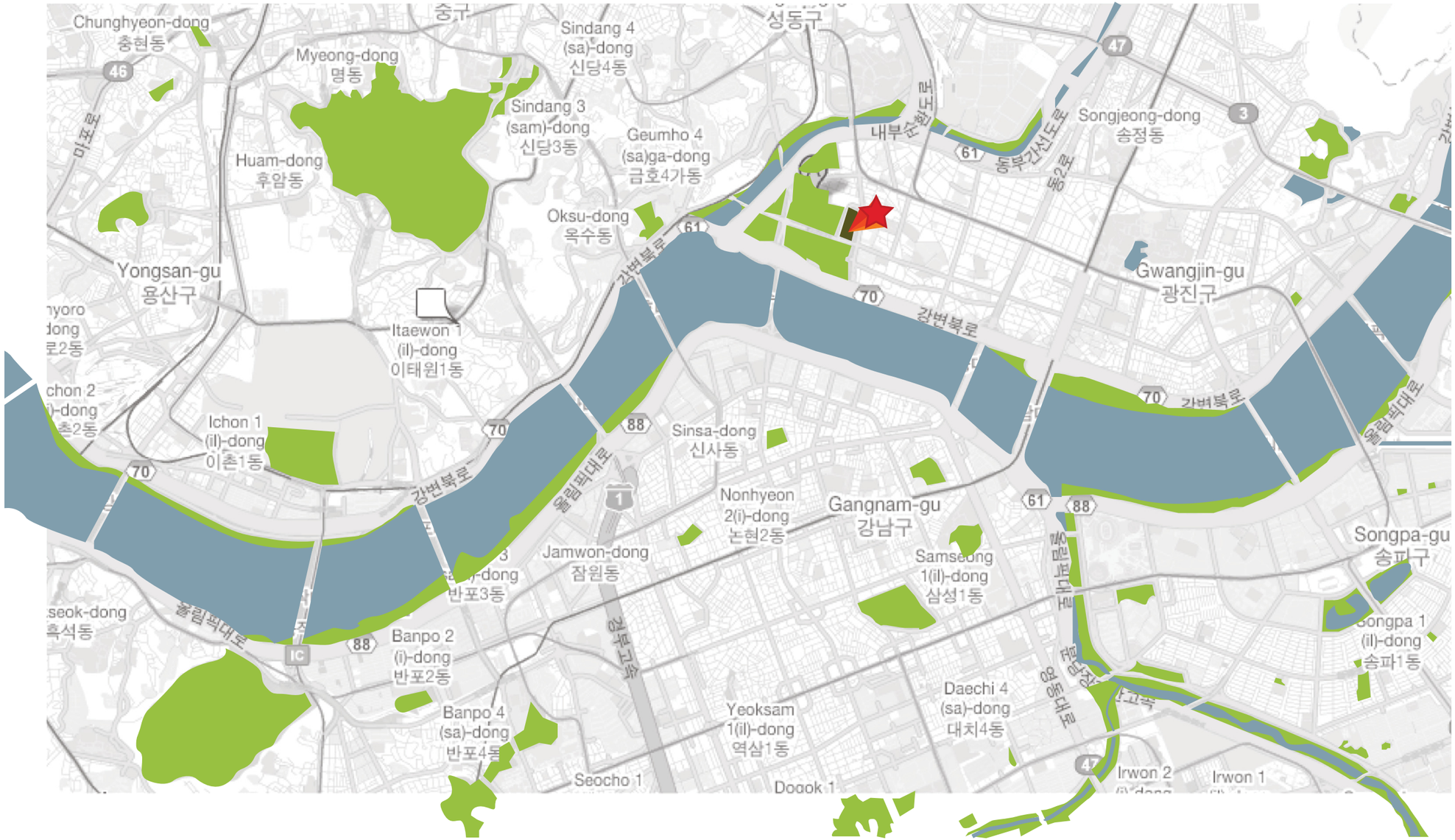
Level of Stress

High

Low

Climate Studies

Site


Chunghyeon-dong
충현동
중구
성동구
Myeong-dong
명동
Sindang 4
(sa)-dong
신당4동
Sindang 3
(sam)-dong
신당3동
Geumho 4
(sa)ga-dong
금호4가동
Huam-dong
후암동
Oksu-dong
옥수동
내부순환도로
동부간선도로
동2로
Songjeong-dong
송정동
Yongsan-gu
용산구
Gwangjin-gu
광진구
Itaewon 1
(il)-dong
이태원1동
Ichon 1
(il)-dong
이촌1동
강변북로
올림픽대로
Sinsa-dong
신사동
Nonhyeon
2(i)-dong
논현2동
Gangnam-gu
강남구
Jamwon-dong
잠원동
Samseong
1(il)-dong
삼성1동
Songpa-gu
송파구
Songpa 1
(il)-dong
송파1동
Banpo 2
(i)-dong
반포2동
Banpo 4
(sa)-dong
반포4동
Yeoksam
1(il)-dong
역삼1동
Daechi 4
(sa)-dong
대치4동
Seocho 1
Dogok 1
Irwon 2
Irwon 1
IC
46
47
3
61
70
88
1

Site

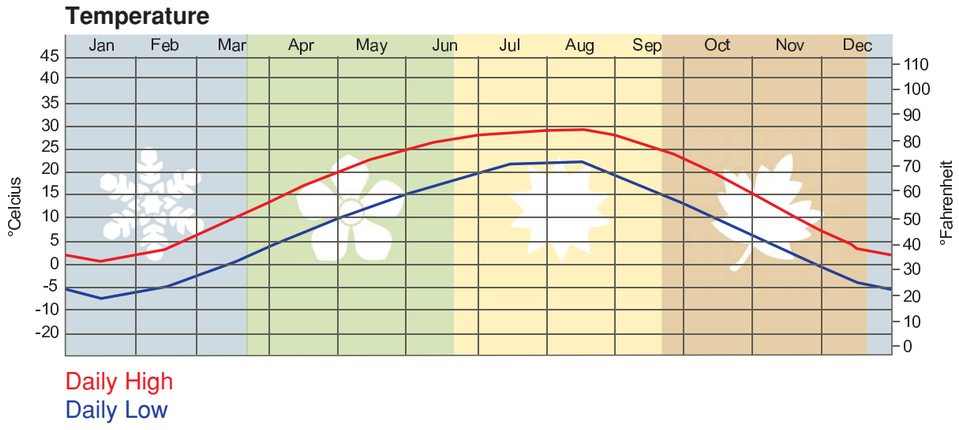
Latitude: 37°34’N
Longitude: 128°58’E
Elevation: 285’ or 87 m

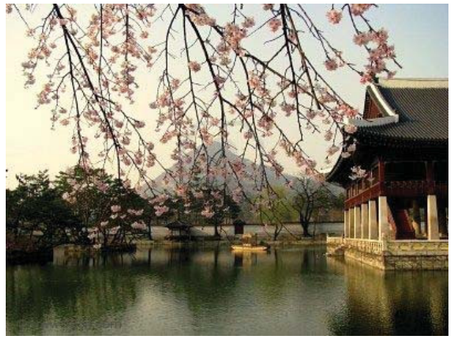
Project Site: East of the Seoul Forest
North of Han River

Population: 48.6 Million

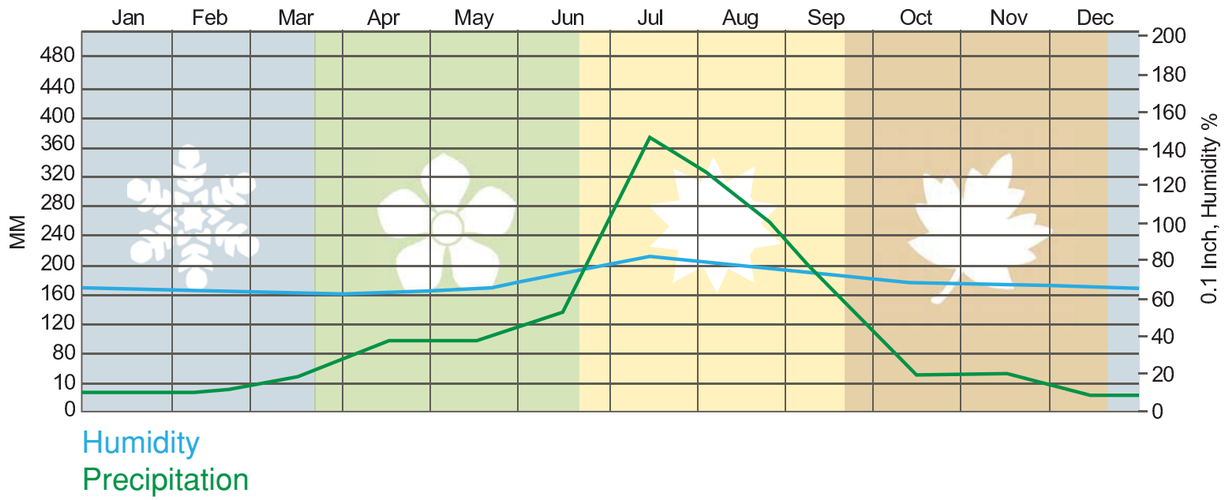
Climate Studies

Seoul lies in the border region between a humid sub-tropical and humid continental climate. Summers are generally hot and humid, with the East Asian monsoon taking place from June until July. August, the warmest month, has an average temperature of 22.1 to 29.5 ºC (72 to 85 ºF). Winters are generally much drier than summers, with an average of 28 days of snow annually. It is relatively cold with an average January temperature of -6.1 to 1.6 ºC (21 to 34.9 ºF).





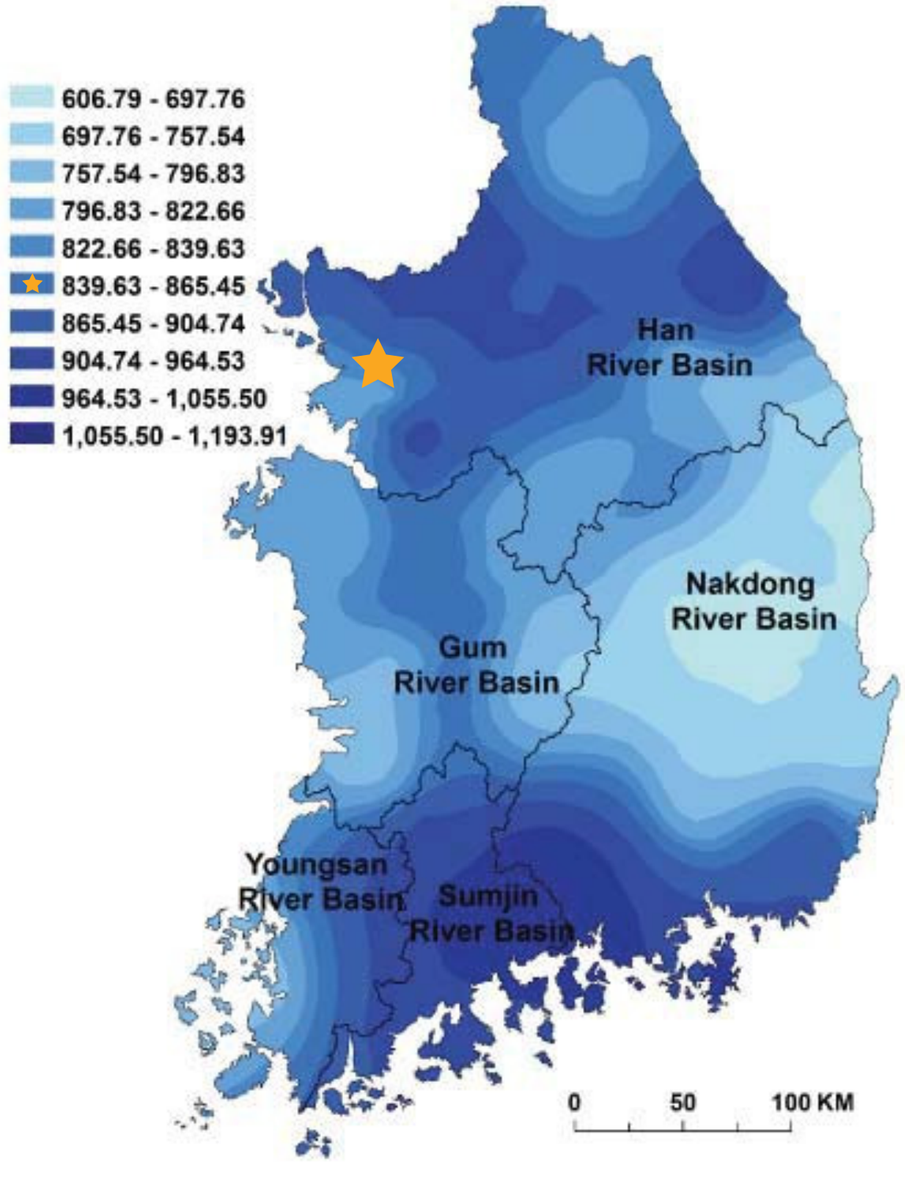
Precipitation



Highest Precipitation: July 383.54 mm/15.1 in.
2/3 of annual rain fall occurs between: June-September
Number of Typhoons per year 2-3
Maximum Flood Capacity of Metropolitan Area: 37,000 m^2
Years of Major Floods: 1925, 1936, 1972, 1984, 1990

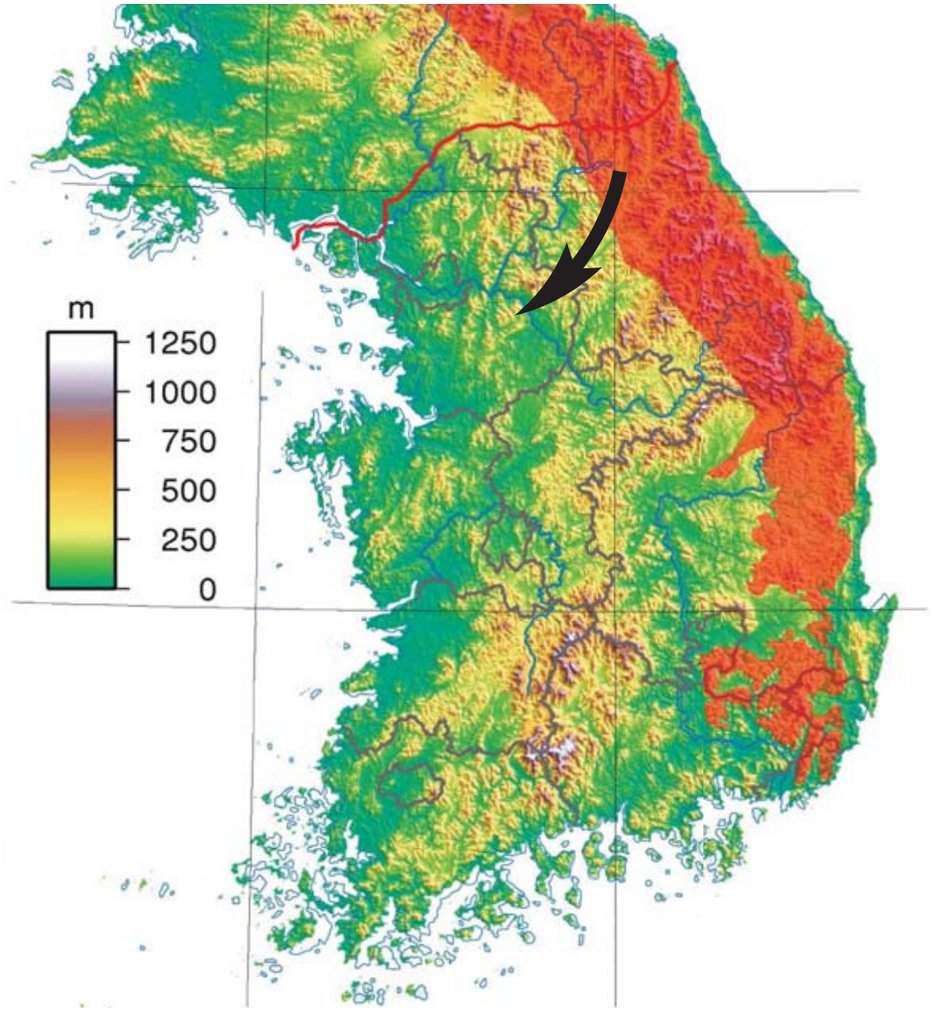
Precipitation

Mean Summer (Total) Precipitation (mm)



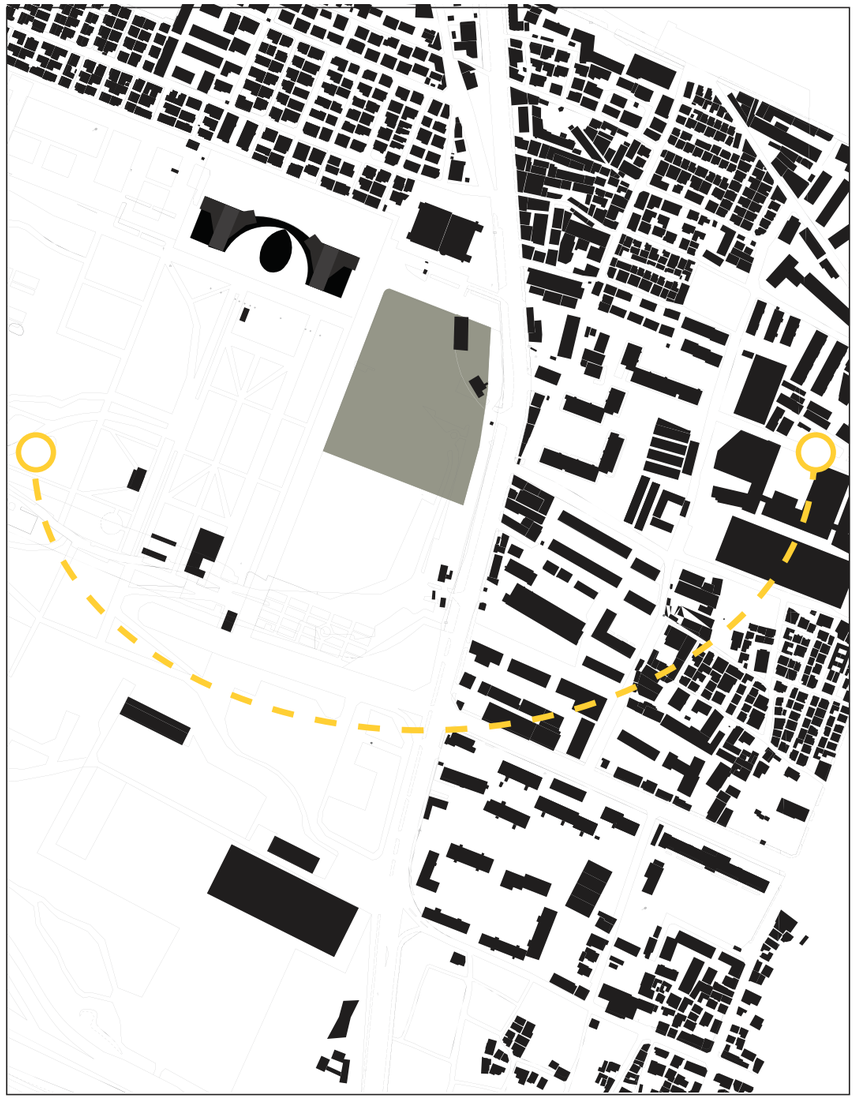
Topography

Flow of water from mountains to flat plains

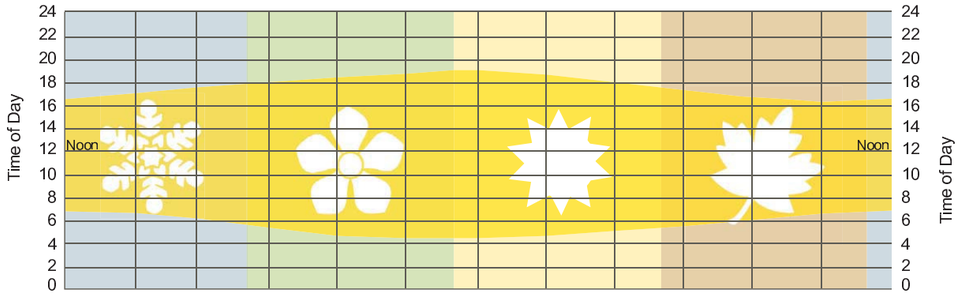


Sun Studies

Sun Path

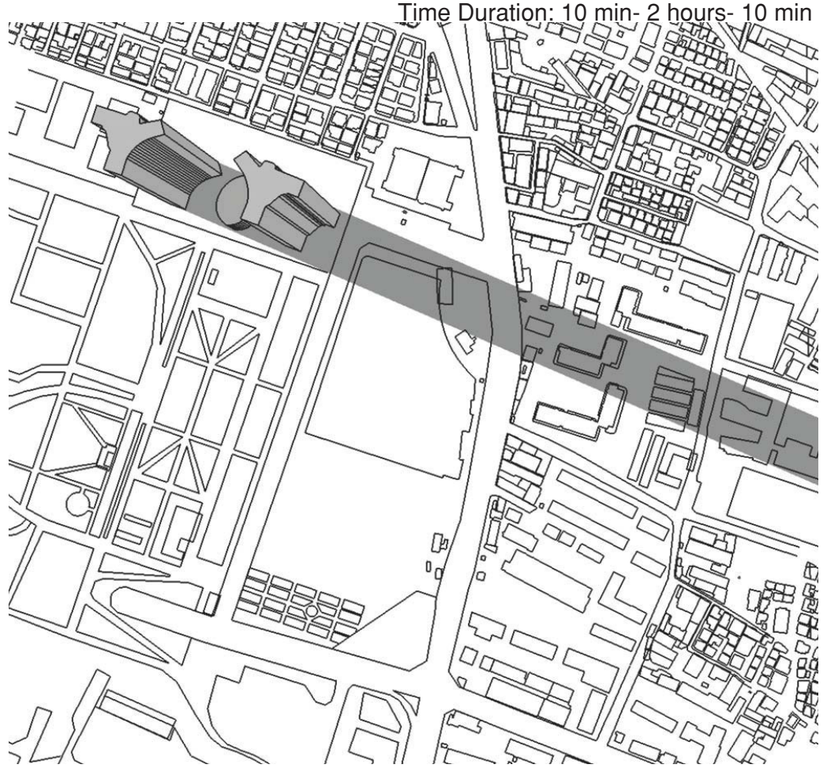


Daylighting

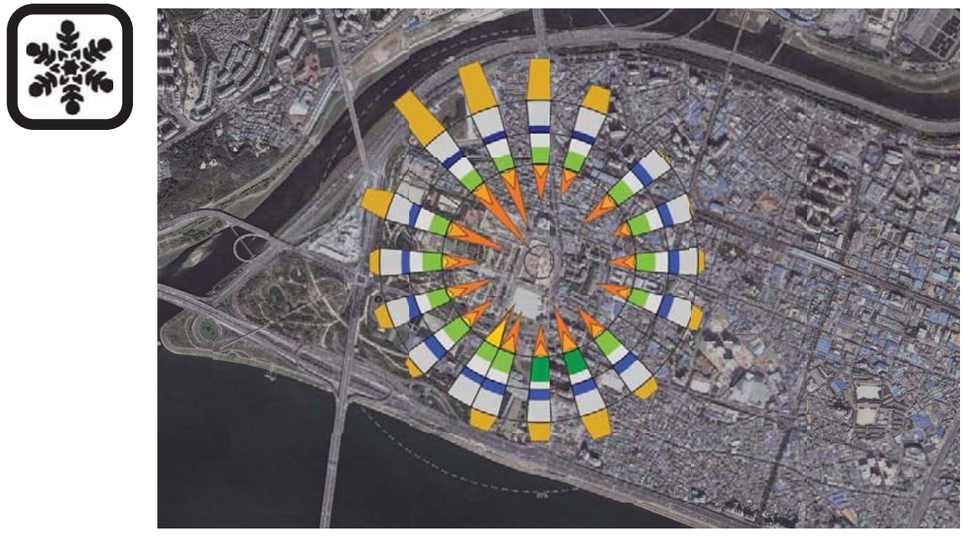


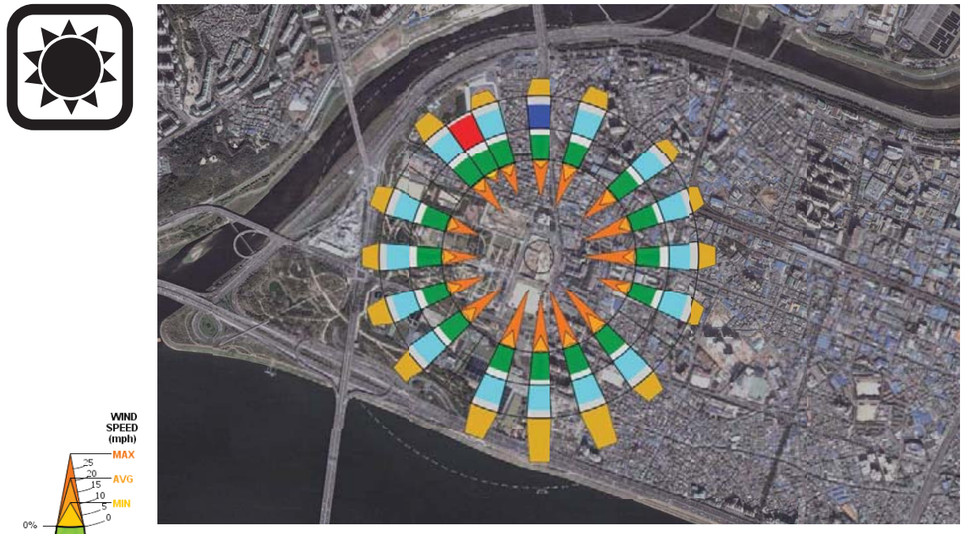
Shadows On Site

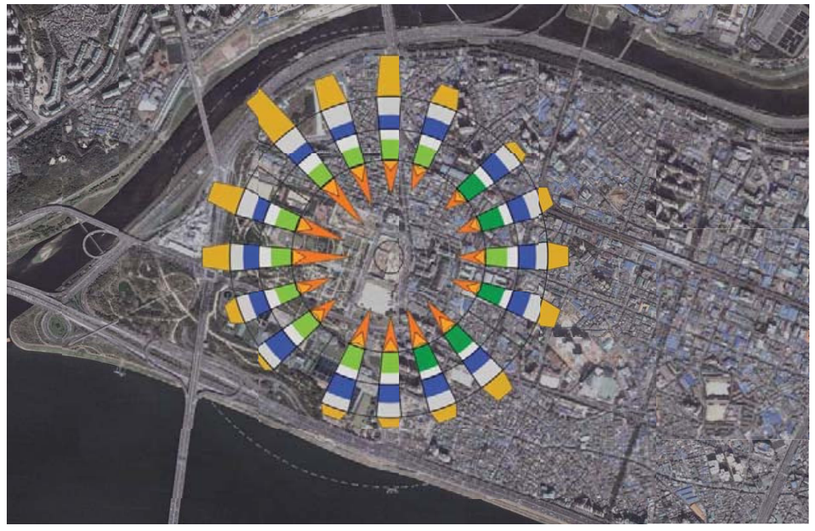
April - August
Time Duration: 10 min- 2 hours- 10 min

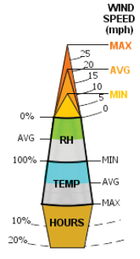


Wind Rose








WIND SPEED (mph)
MAX
AVG
MIN
25
20
15
10
5
0
0%
AVG
RH
100%
MIN
TEMP
AVG
MAX
10%
HOURS
20%

Wind Studies

Native Animals

Korean Cattle

Hog

Poultry

Atlantic Dolphin

Blue Whale

Black Finless Porpoise

Sperm Whale

Killer Whale

Minke Whale

Fraternal Myotis

Horseshoe Bat

Hodgson Bat

Asian Particolored Bat

Native Animals

Arctic Wolf

Jaguar

Leopard

Elk

Chinese Goral

Common Otter

Eastern Roe Deer

Common Seal

Chinese Water Deer

Asian Black Bear

Racoon Dog

Wild Boar

Native Plants

Calleryana var. fauriei

Corylopsis Pauciflora

Forsythia

Hibiscus Syriacus

Sorbus alnifolia

Pea Fruited Cypress

Fraser Fir

Big Cone Pine

Ginseng

Sesame

Cotton

Hemp

Tabacco

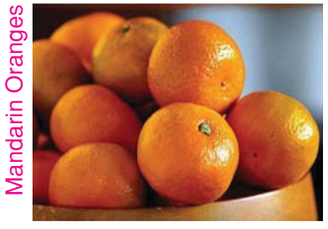
Native Plants

Asian Pears

Korean Apples

Korean Grapes

Mandarin Oranges



Peaches

Red Pepers

Corn

Chinese Cabbage

Sweet Potatoes

Korean Radish

Welsh Onion

Rice

Soybean

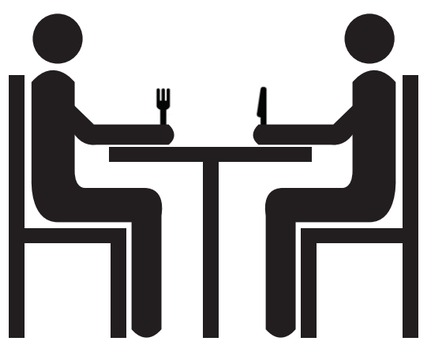
Buckwheat

Barley

Millet

Korean Diet Traditional Dining

Hanjeongsik, a full-course Korean meal with a varied array of banchan (side dishes)



Chili Paste

Spicy Beef Noodle

Bulgogi Marinated Beef

Kimchi

Seafood Pancake

Beef Stew

Seafood Stew

Cold Noodle

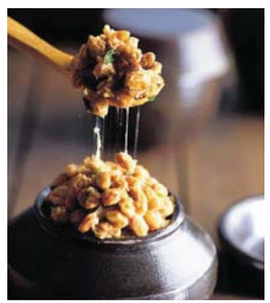
Ginseng & Jujube Stuffed Chicken

Grilled Mackeral

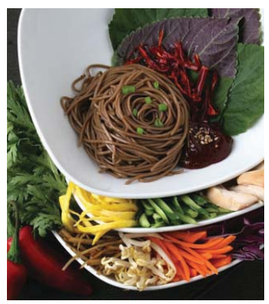
ChapChae

Bibimbap

Fermented Soybean



Buckwheat Noodle



BBQ Chicken & Lettuce Wrap

Korean Diet Street Food

Fish Pastry w/ Red Bean Filling

Walnut Pastry

Fish Cake & Sausage Skewers

Kim-bab

Tornado Potato

Fried Dumpling

Chapchae Hotcakes

Seaweed

Pig Intestines, Liver, & Lungs

Spicy Boiled Rice Cake

Silkworm Larve

Candied Sweet Potato

Chicken Skewer

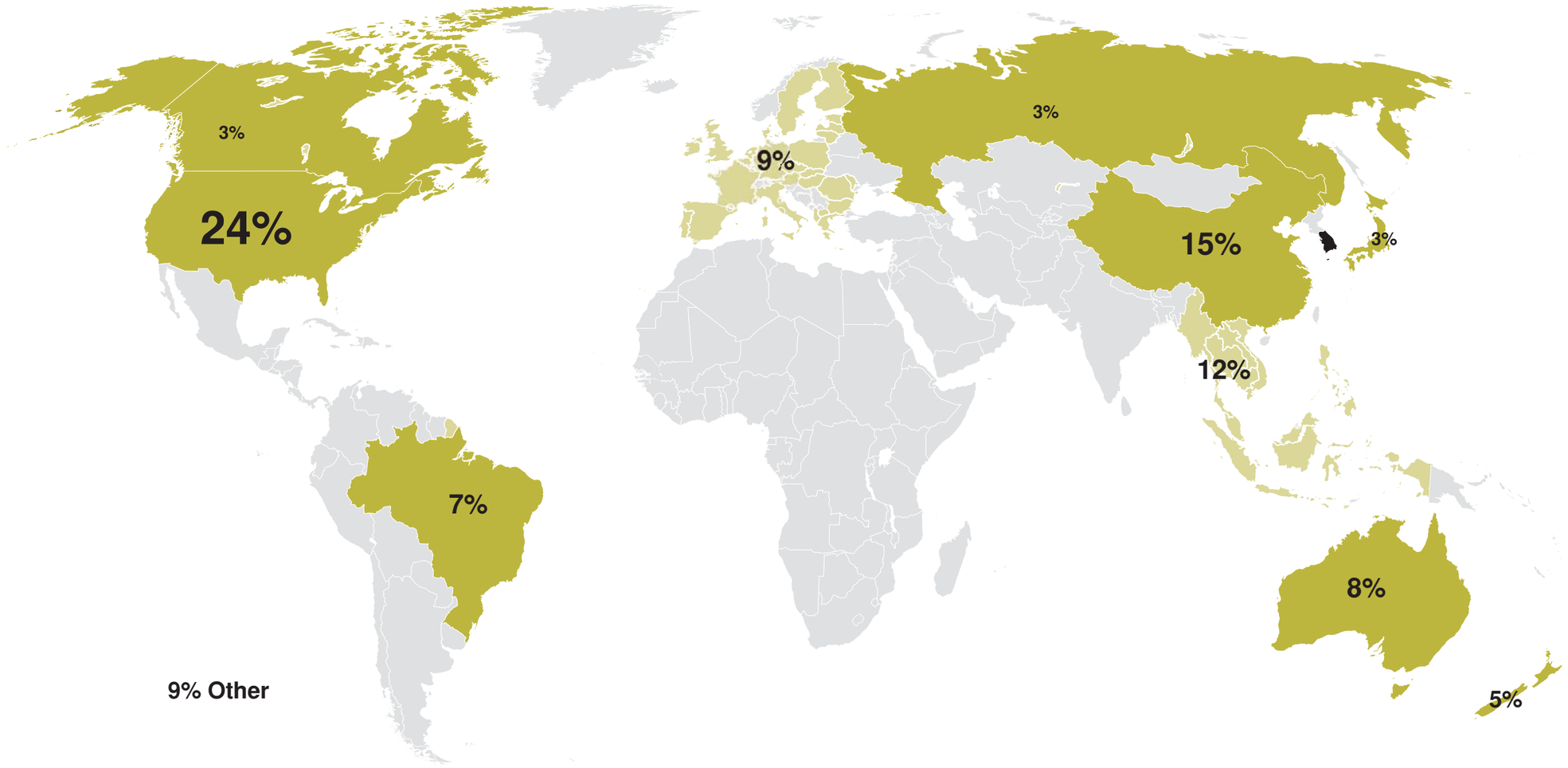
Egg Bread

Candied Strawberry

Ginko Nuts & Chestnuts

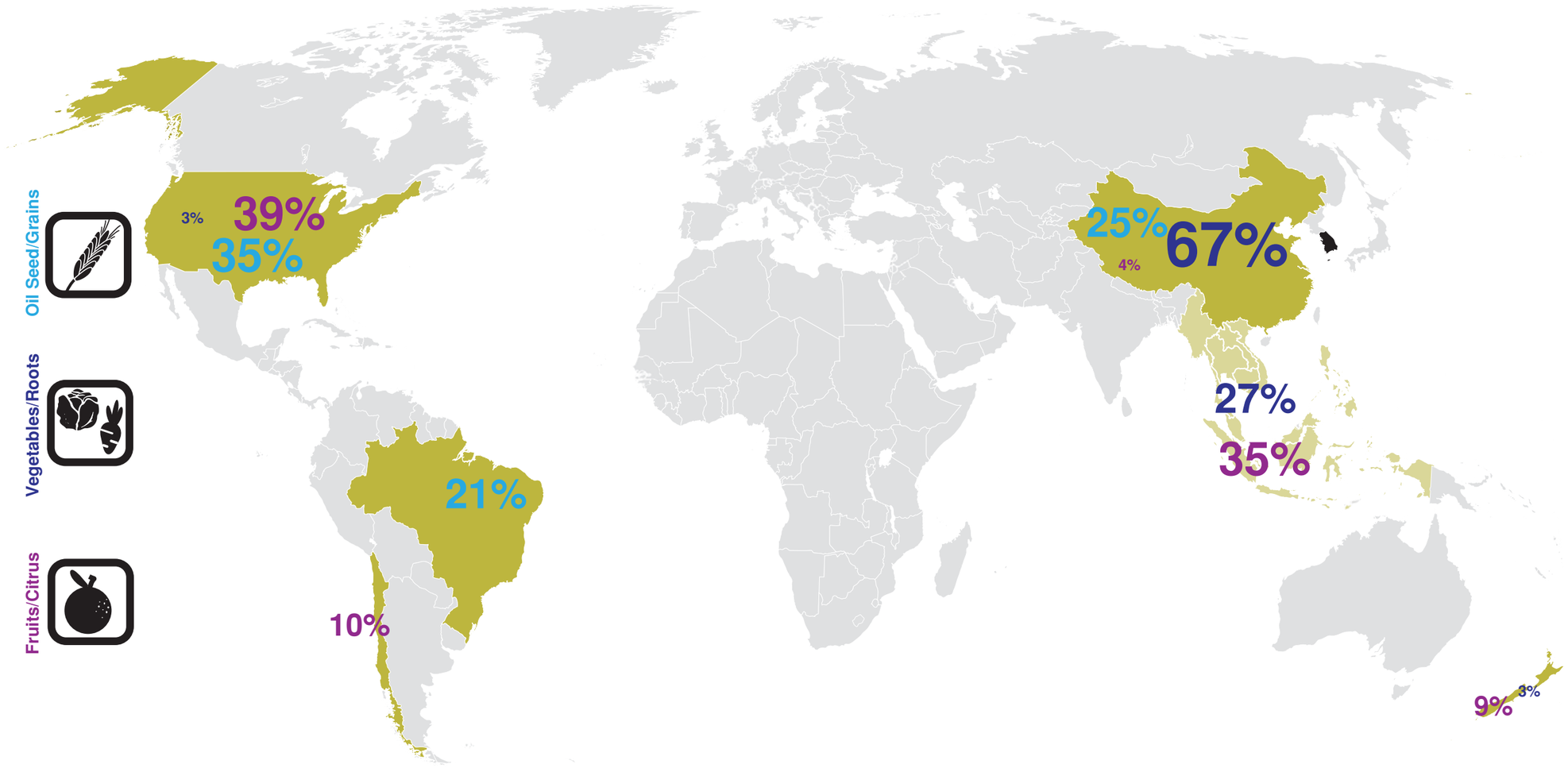
Imports

Top Importing Countries

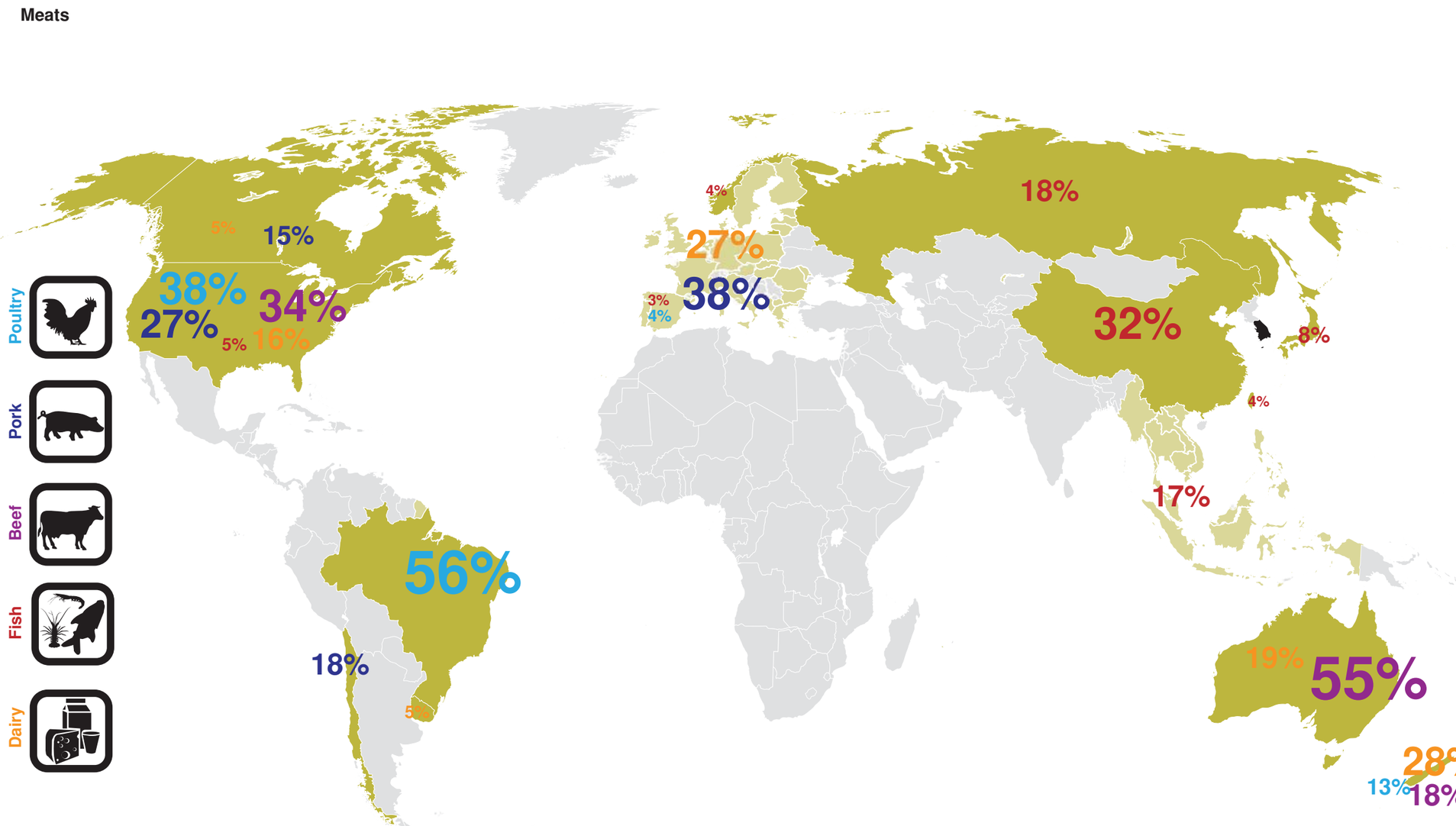


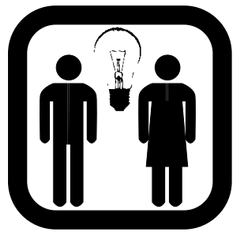
Imports

Fruits, Grains, Vegetables



Imports


Meats
Poultry
Pork
Beef
Fish
Dairy
5%
15%
38%
34%
27%
5%
16%
4%
27%
38%
3%
4%
18%
32%
8%
4%
17%
56%
18%
5%
19%
55%
28%
13%
18%

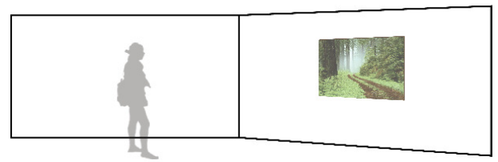


Design Development

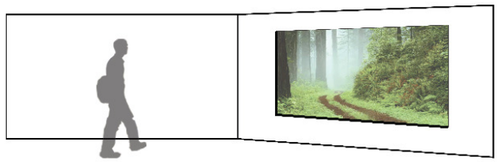
Levels of Interaction with Nature

Interaction with Nature

① Passive ② ③ Active ④ Working

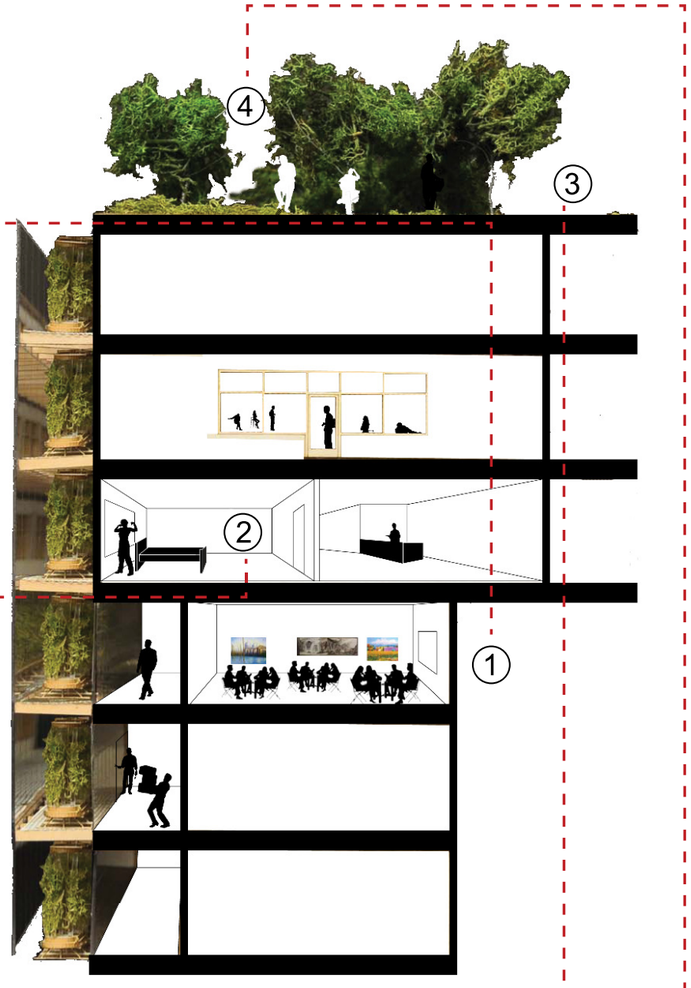


① Looking at a portrait of landscape



② Looking at nature through a window

③ Being in nature

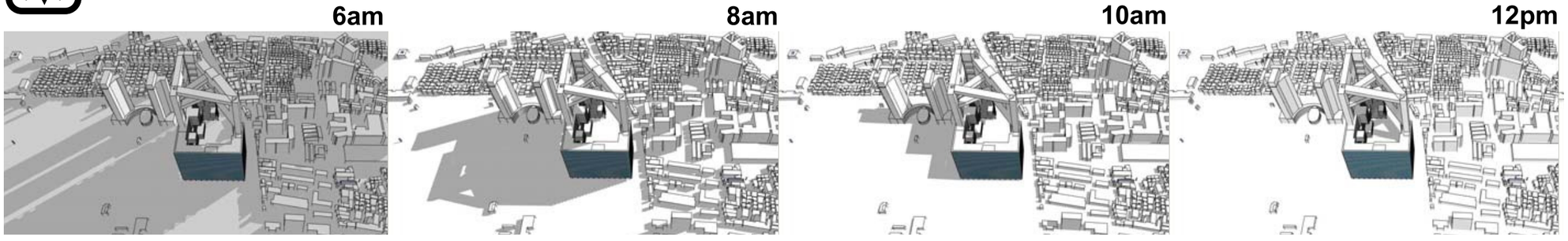


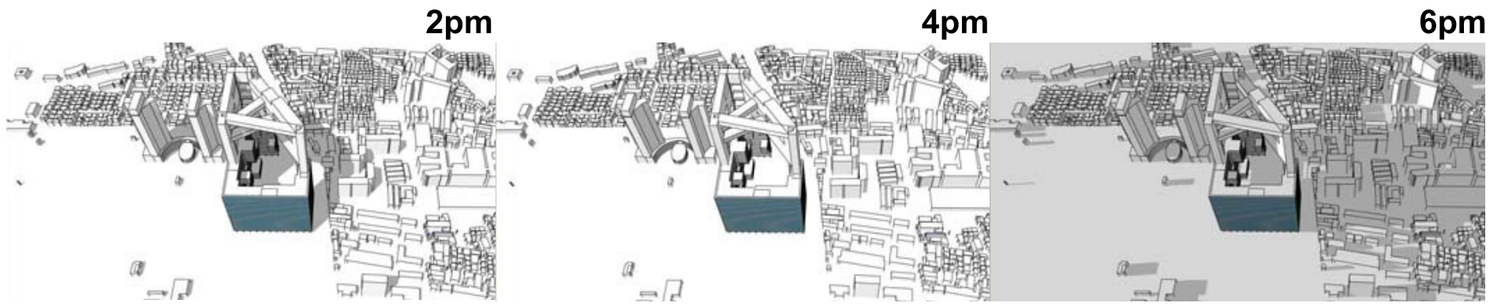
④

Level of Stress

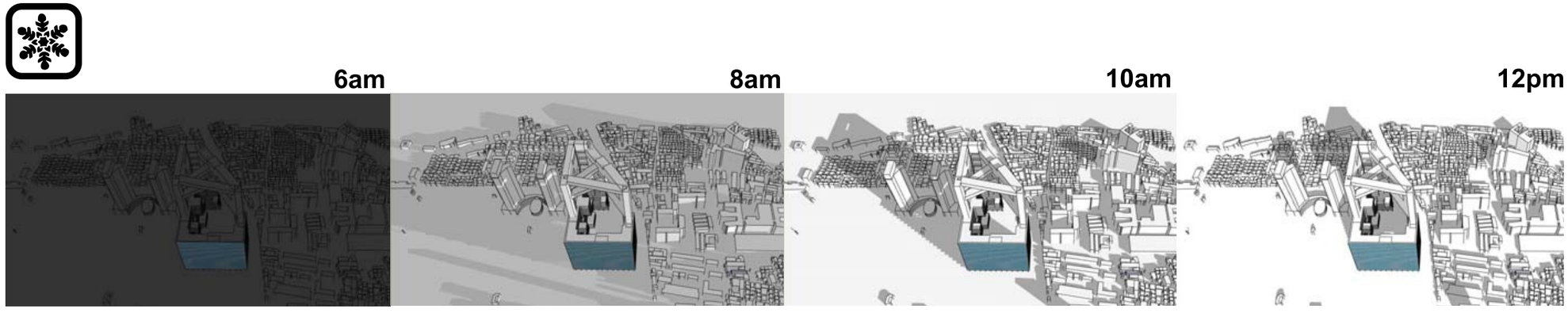
① High ② ③ ④ Low

Sun Study Summer

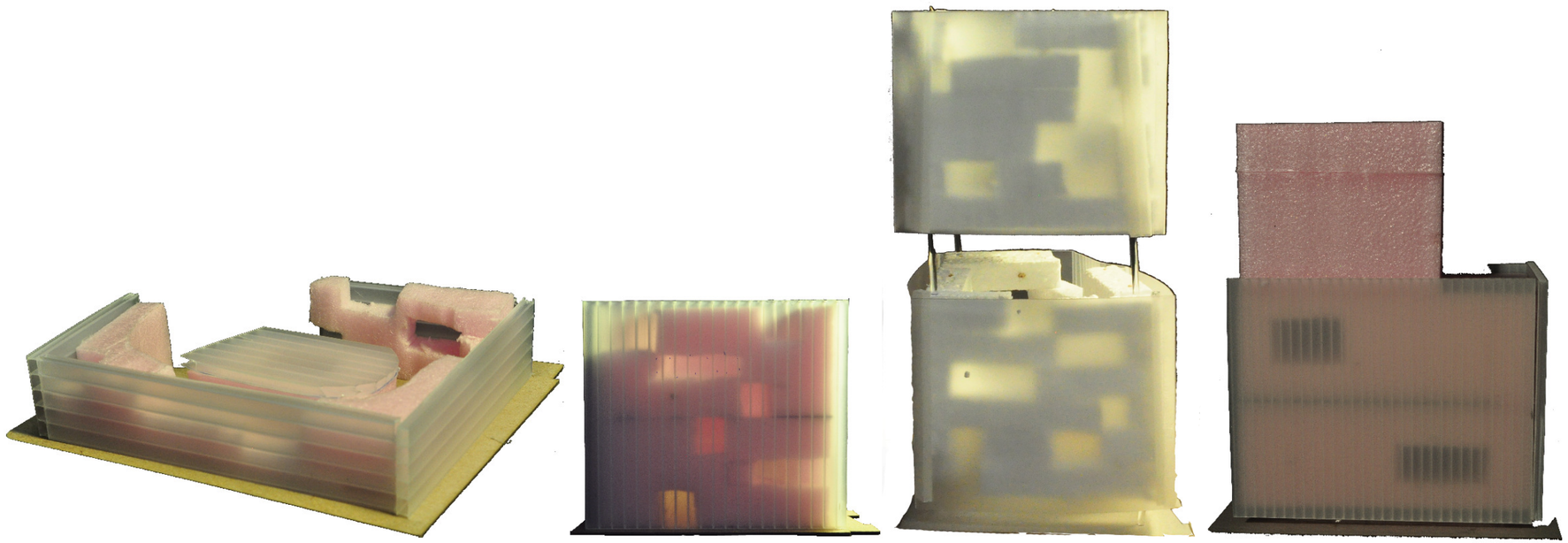


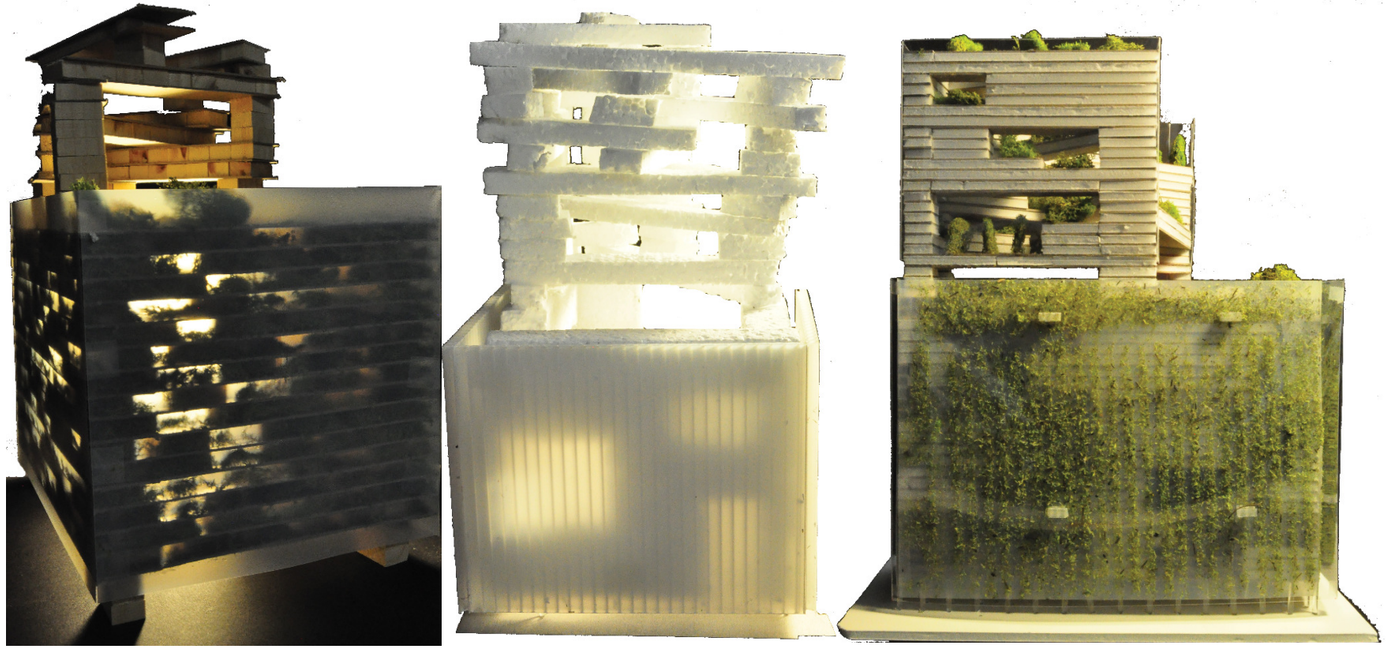


Sun Study Winter

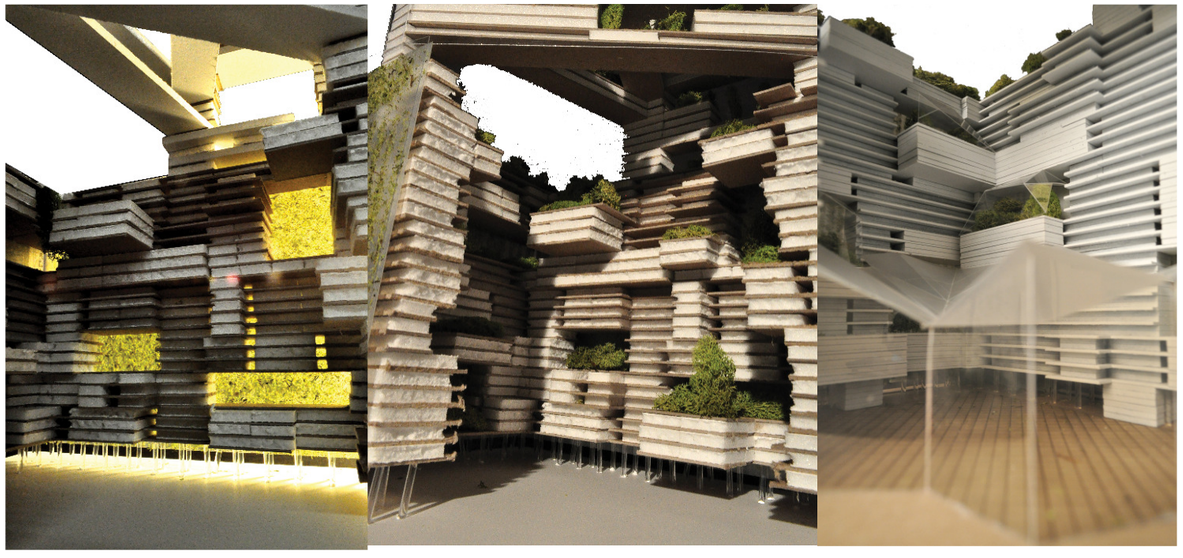


Volumetric and Facade Studies





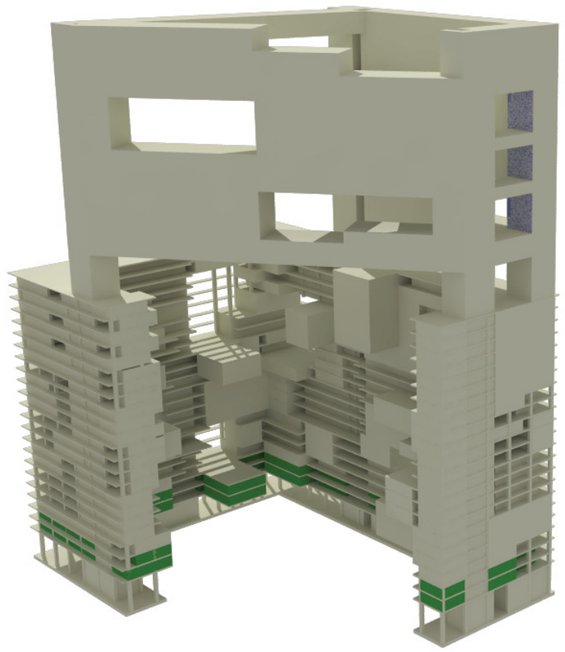
Internal Courtyard Studies



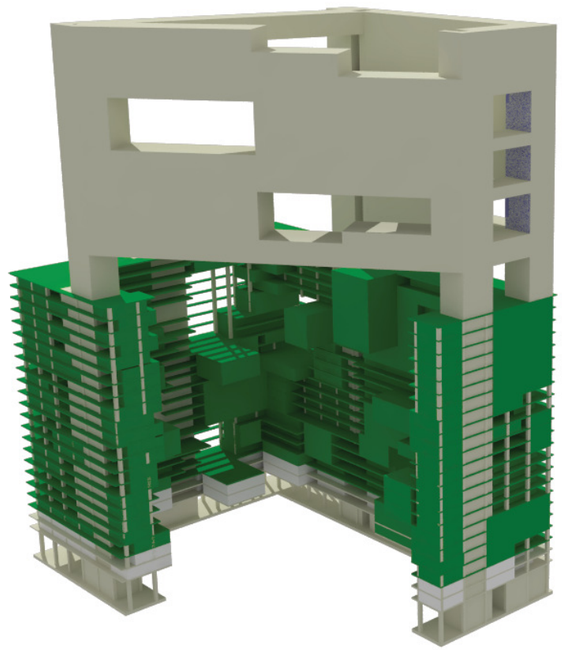
Long Term Residence Studies

Design Solution

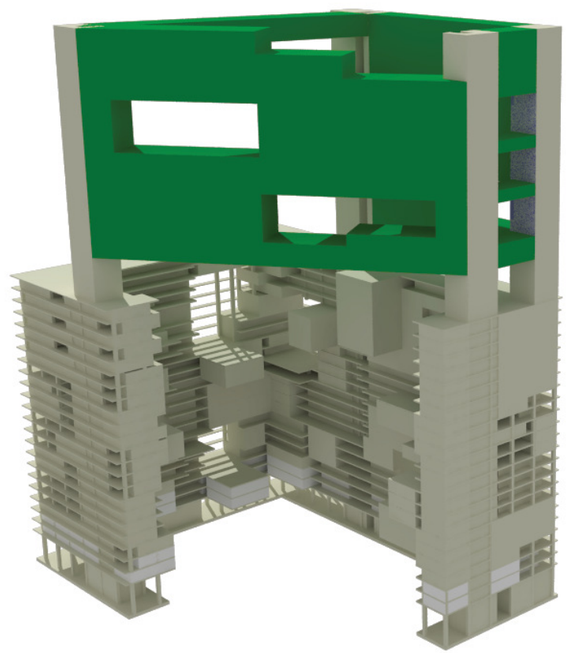
Levels of Occupancy



Medical Services
Levels 2-3

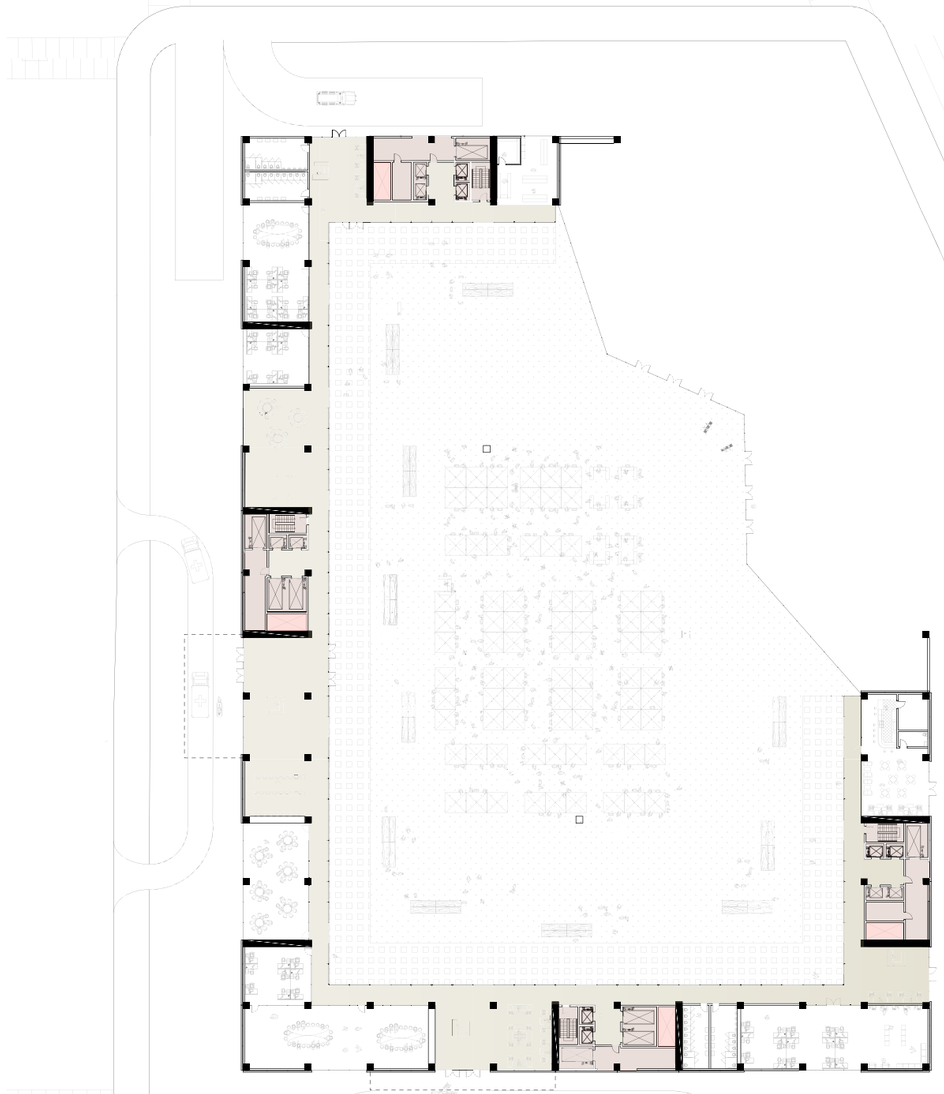


Short and Mid Term Residences
Levels 4-25

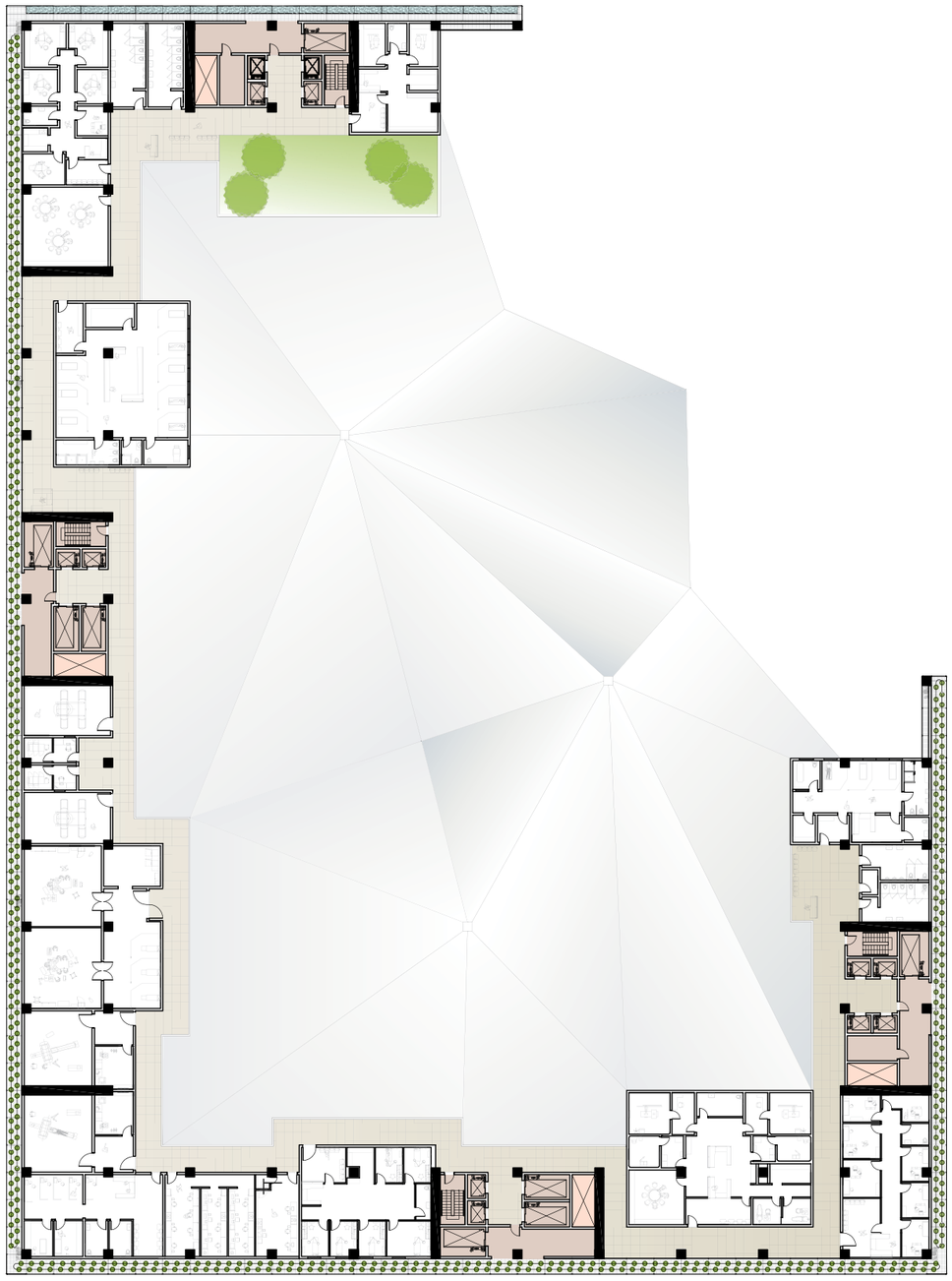


Long Term Residences
Levels 26-49

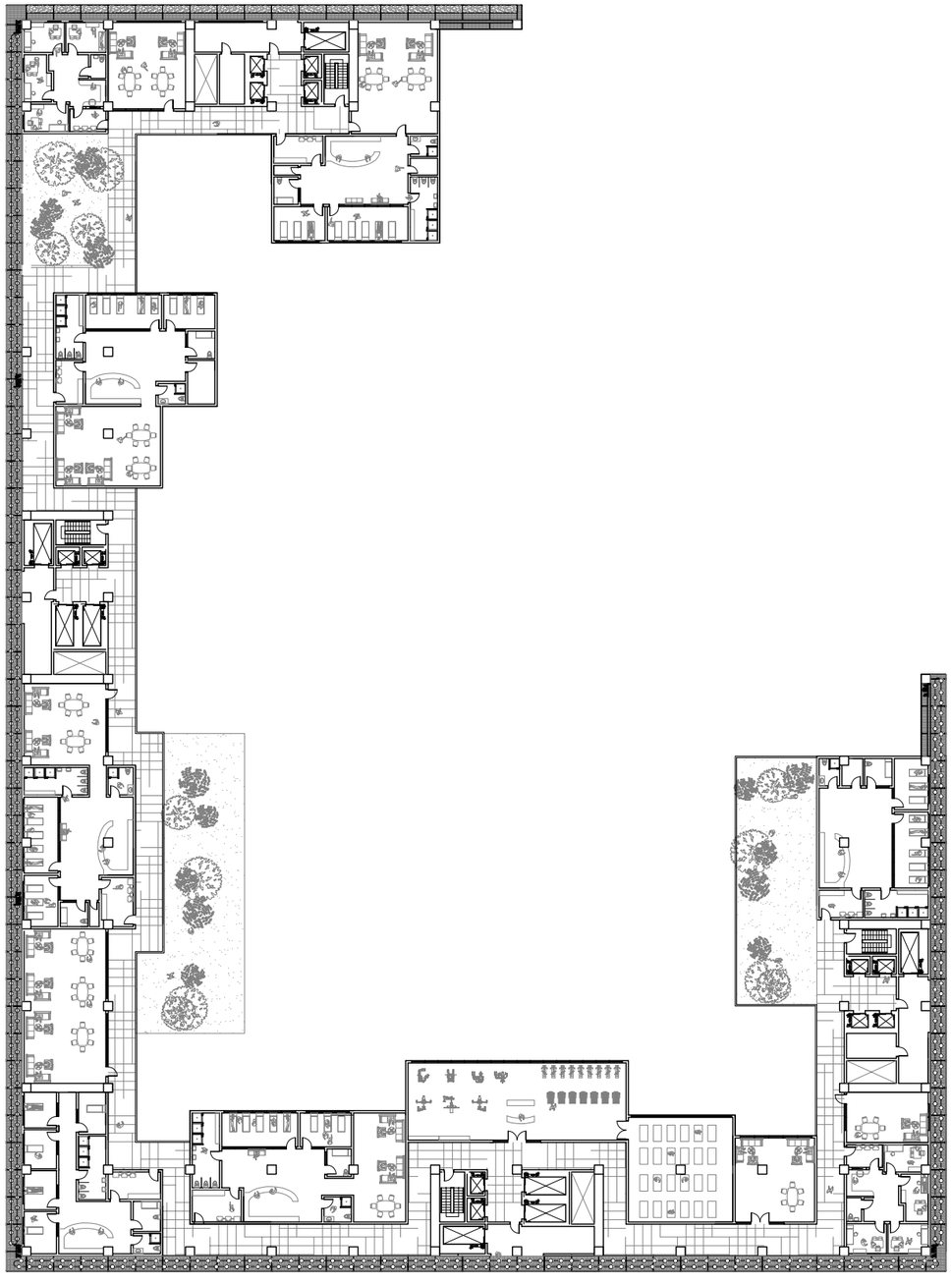
Site & Ground Floor Plan



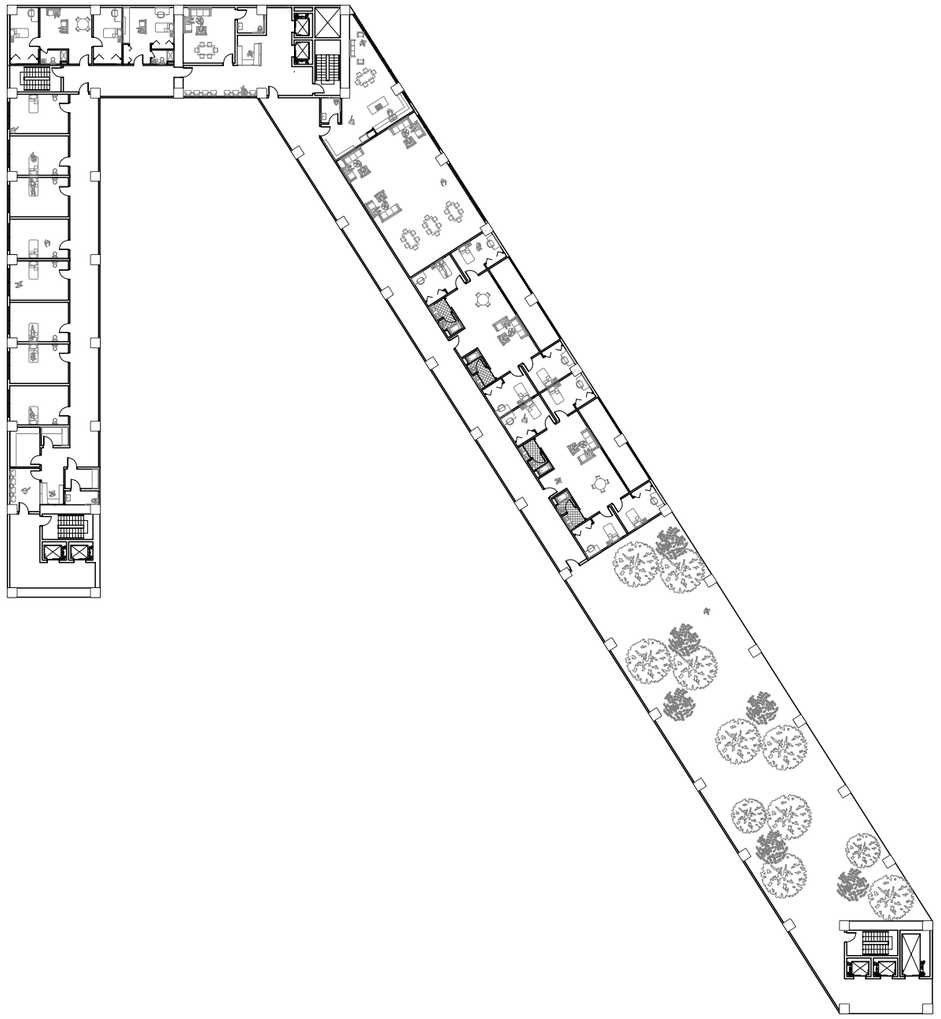
Medical Service Plan



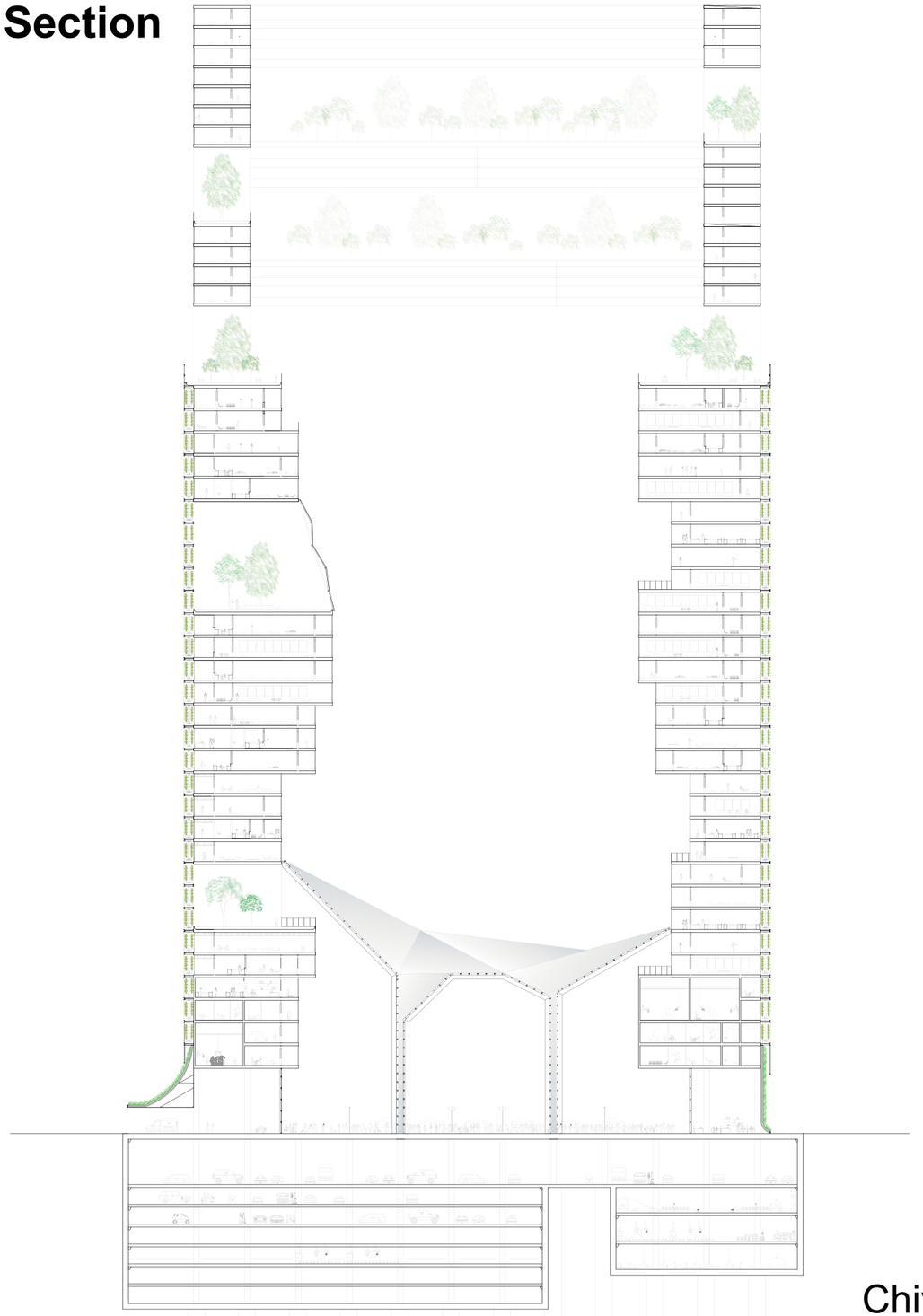
Short and Midterm Residences



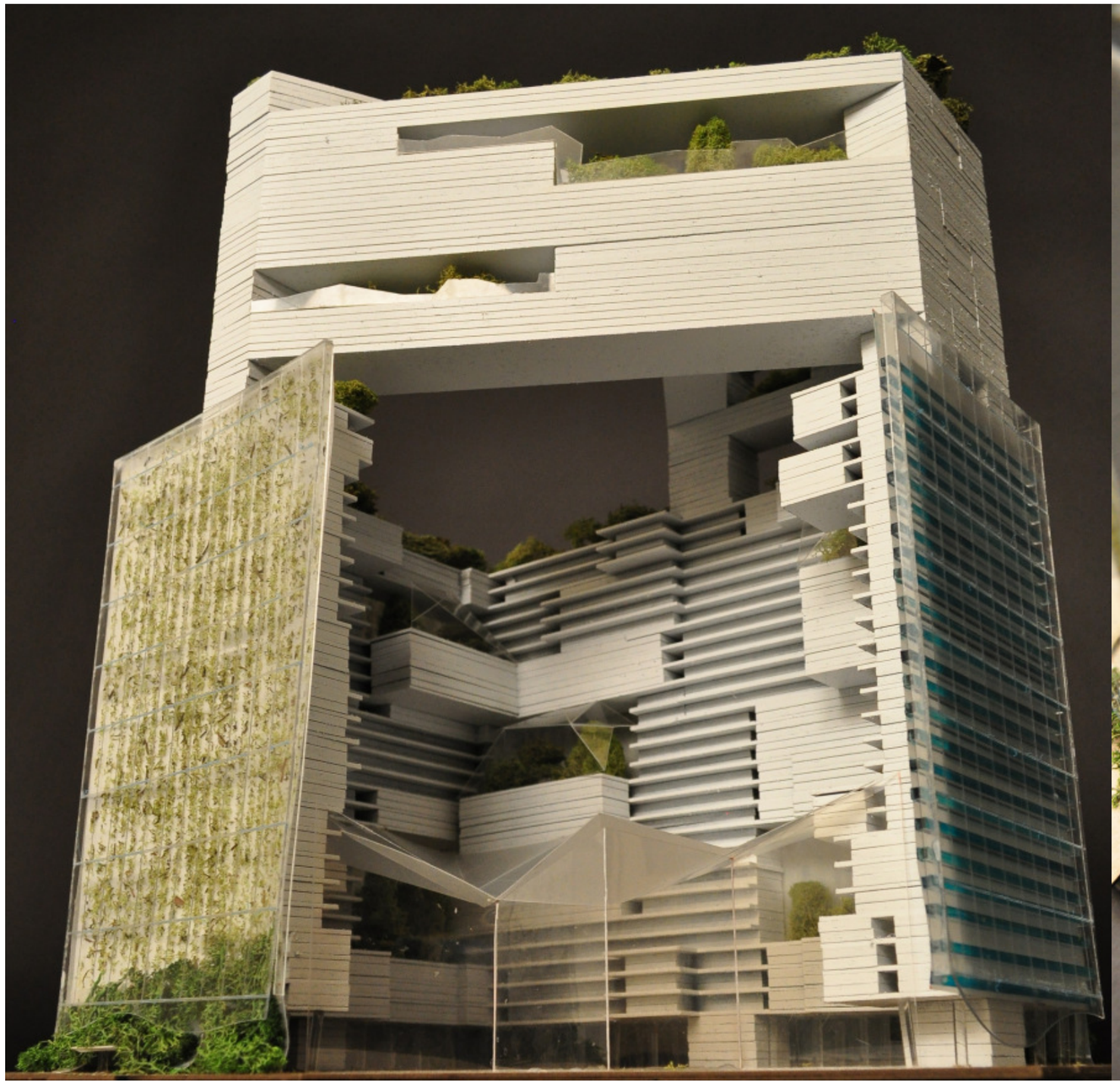
Long Term Residences

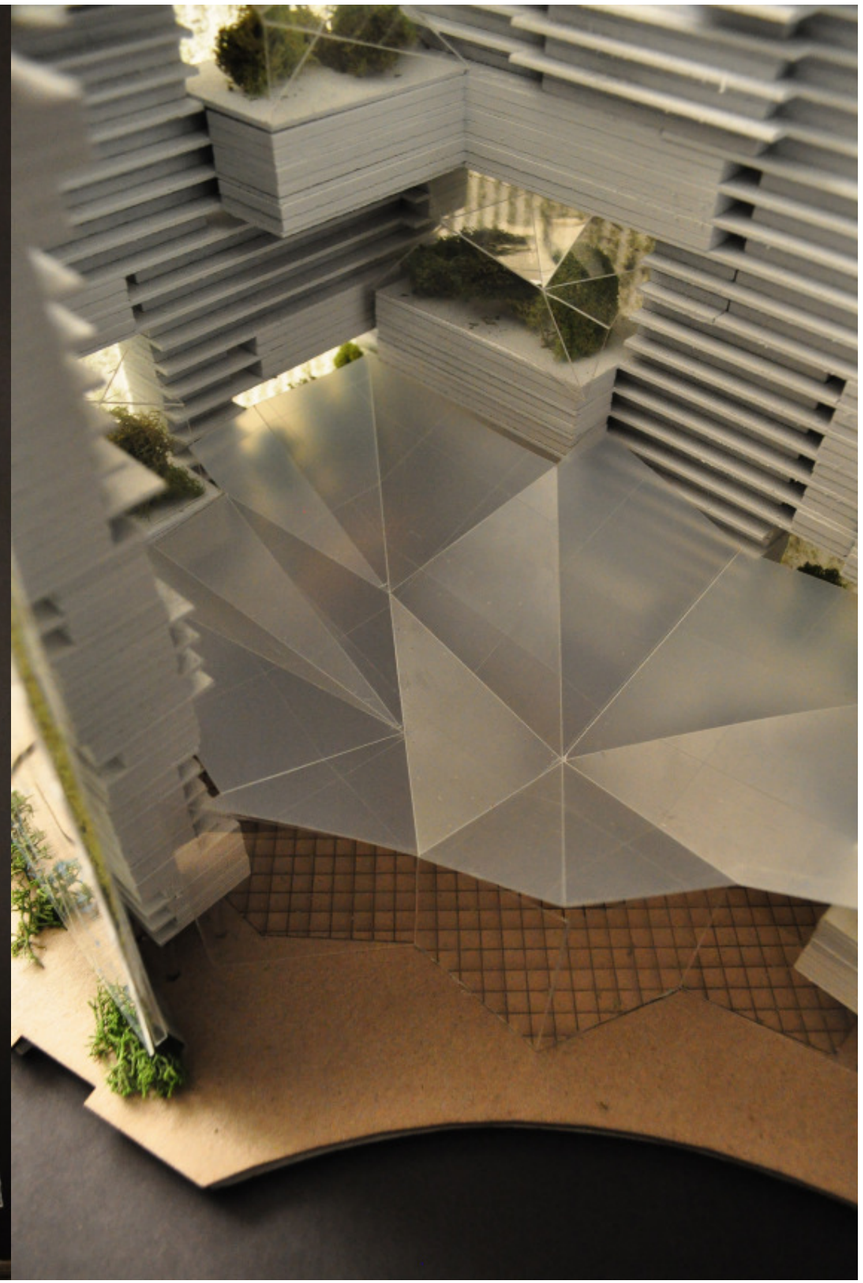


Section



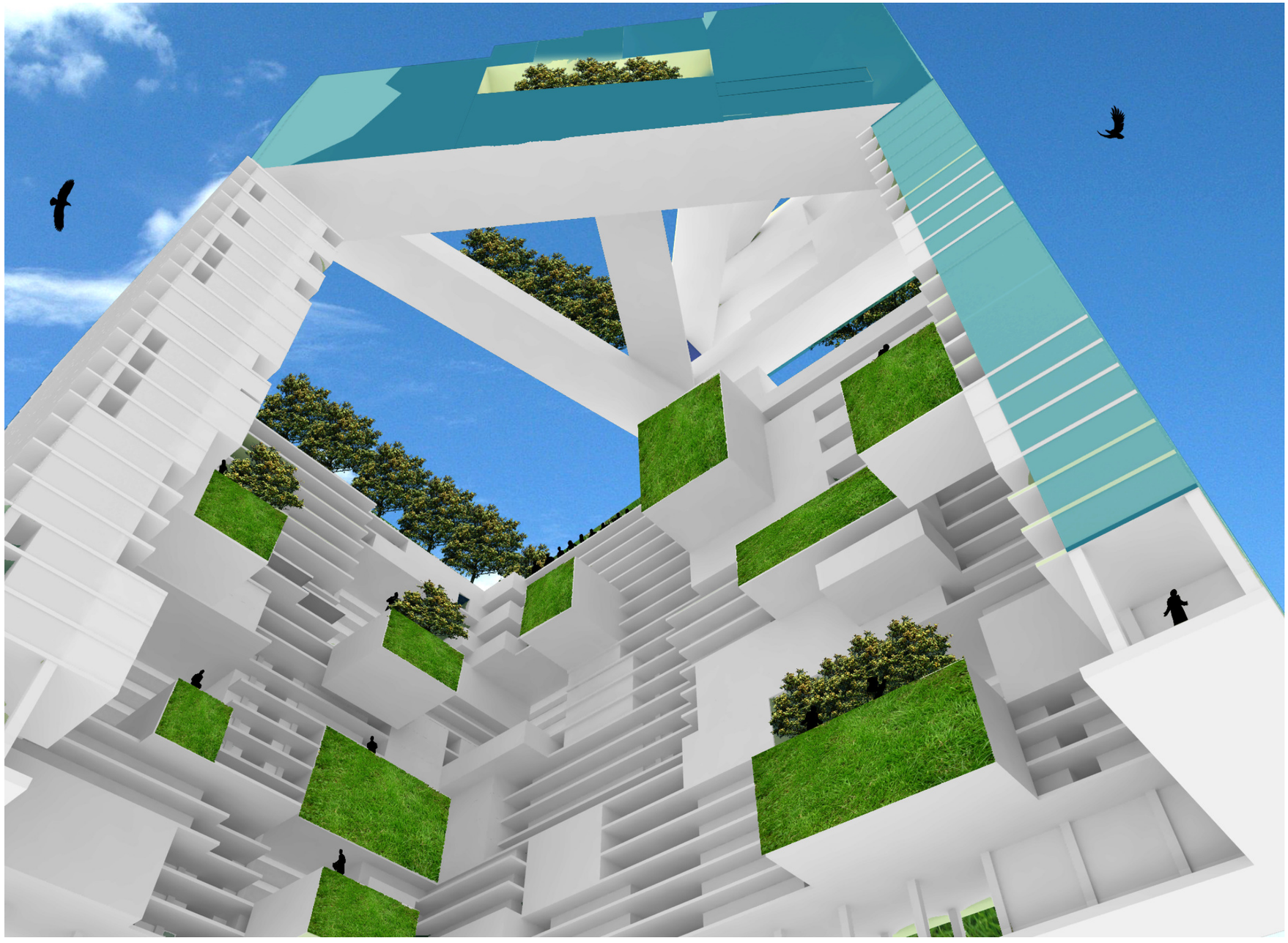
Final Model



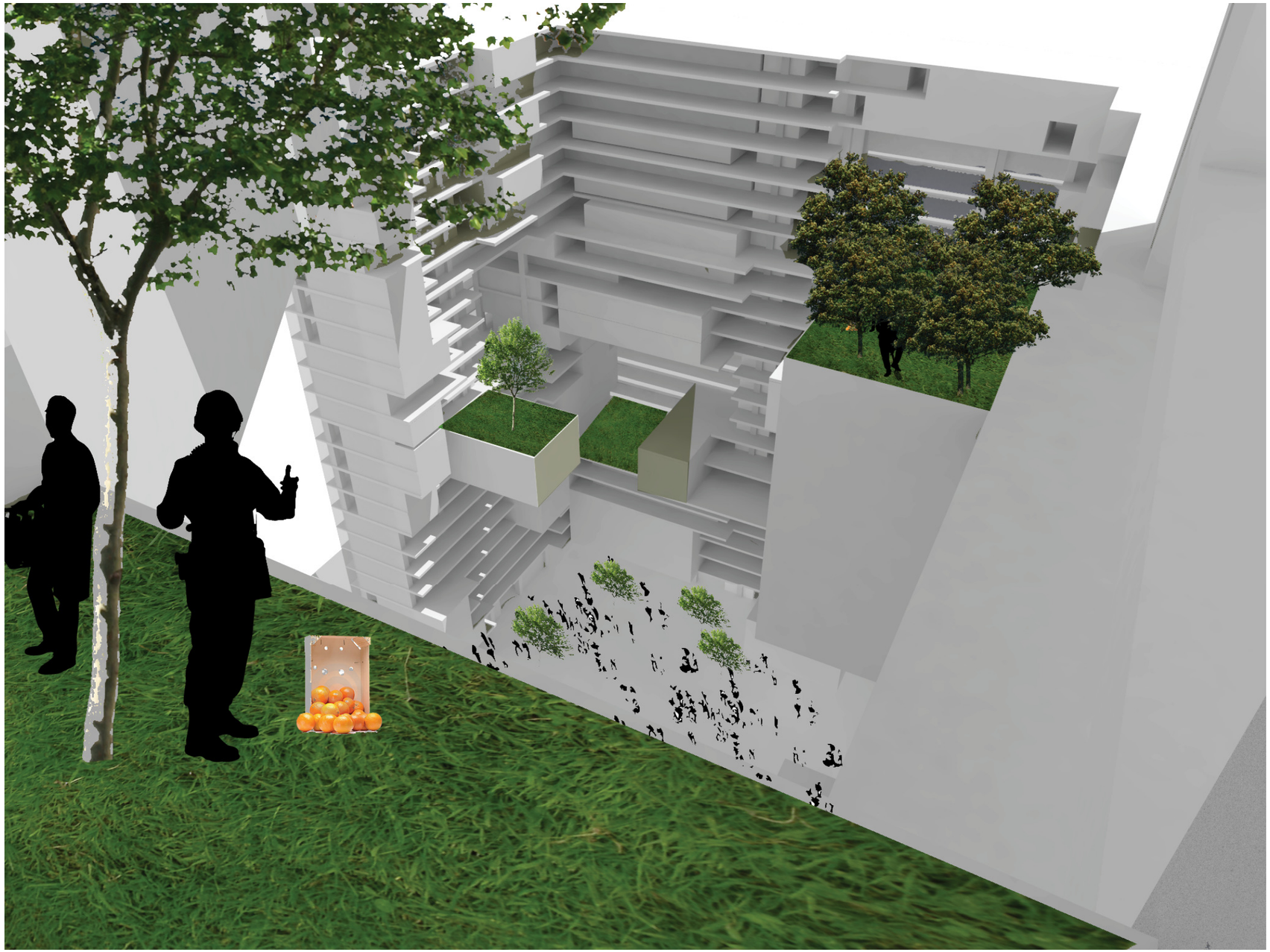


Final Model

View Towards Long Term Residences

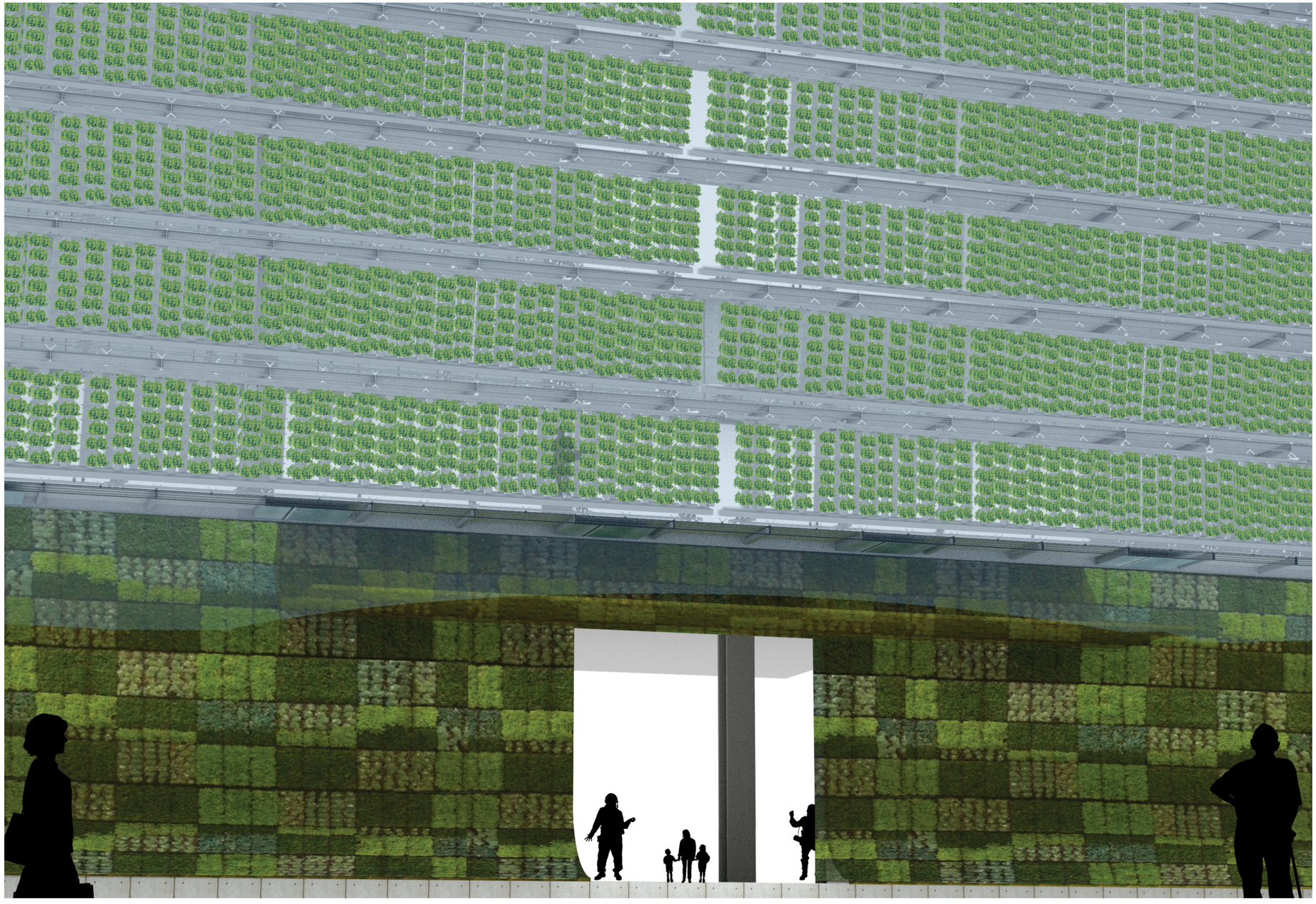


View from Long Term Residences

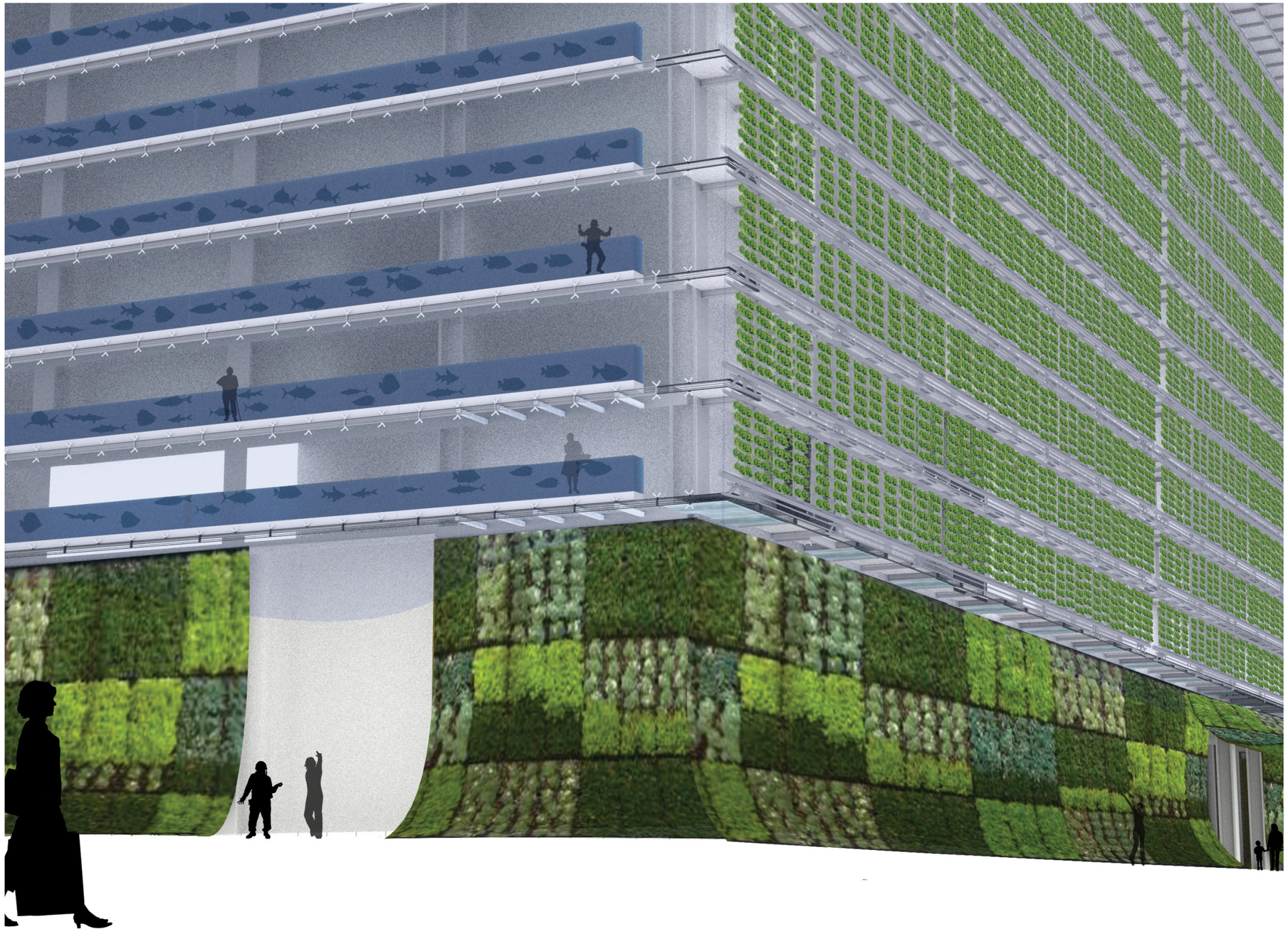


Market Place

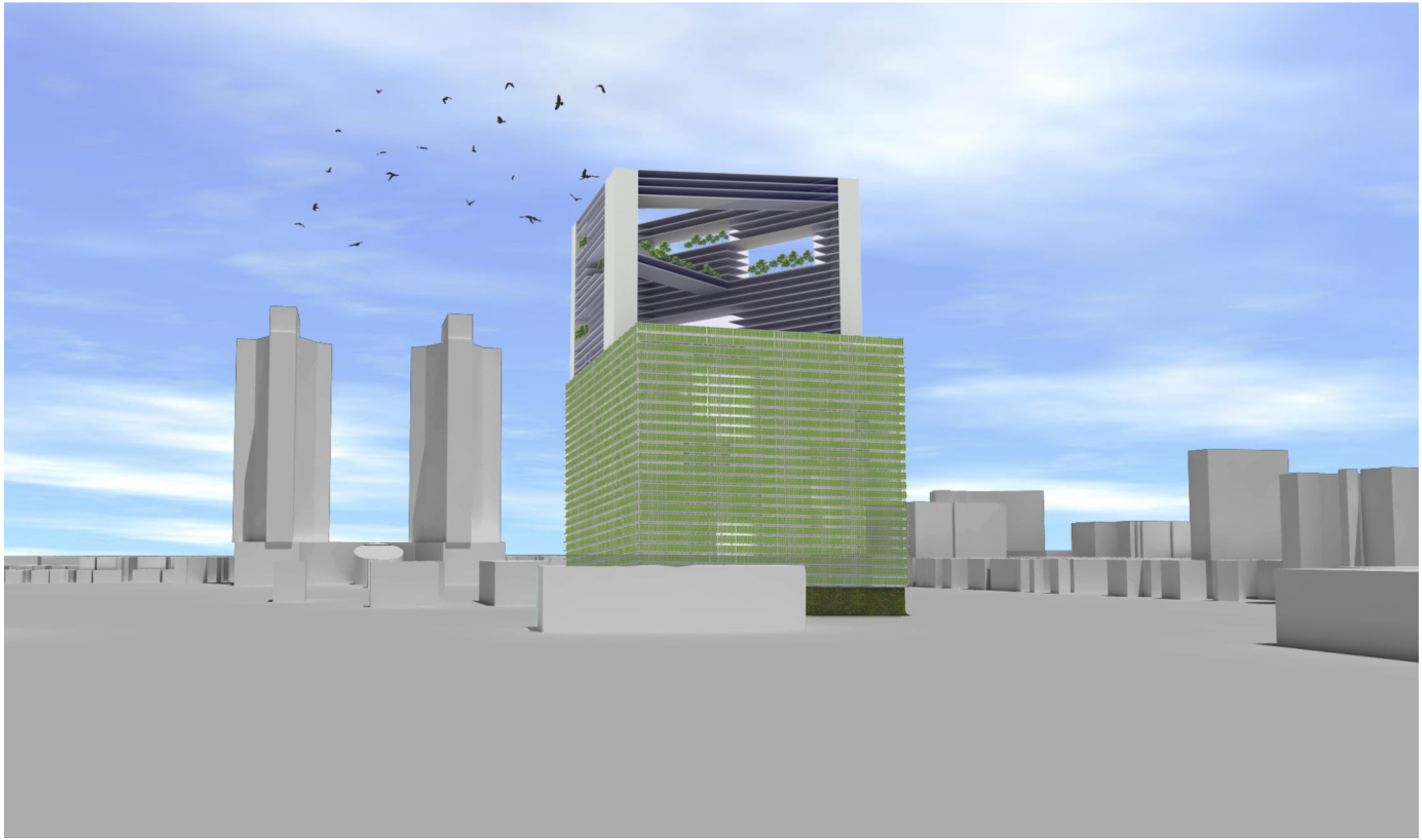
South Entry

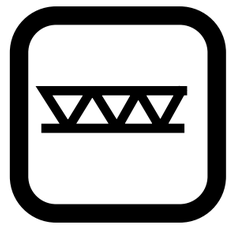


North East Entry



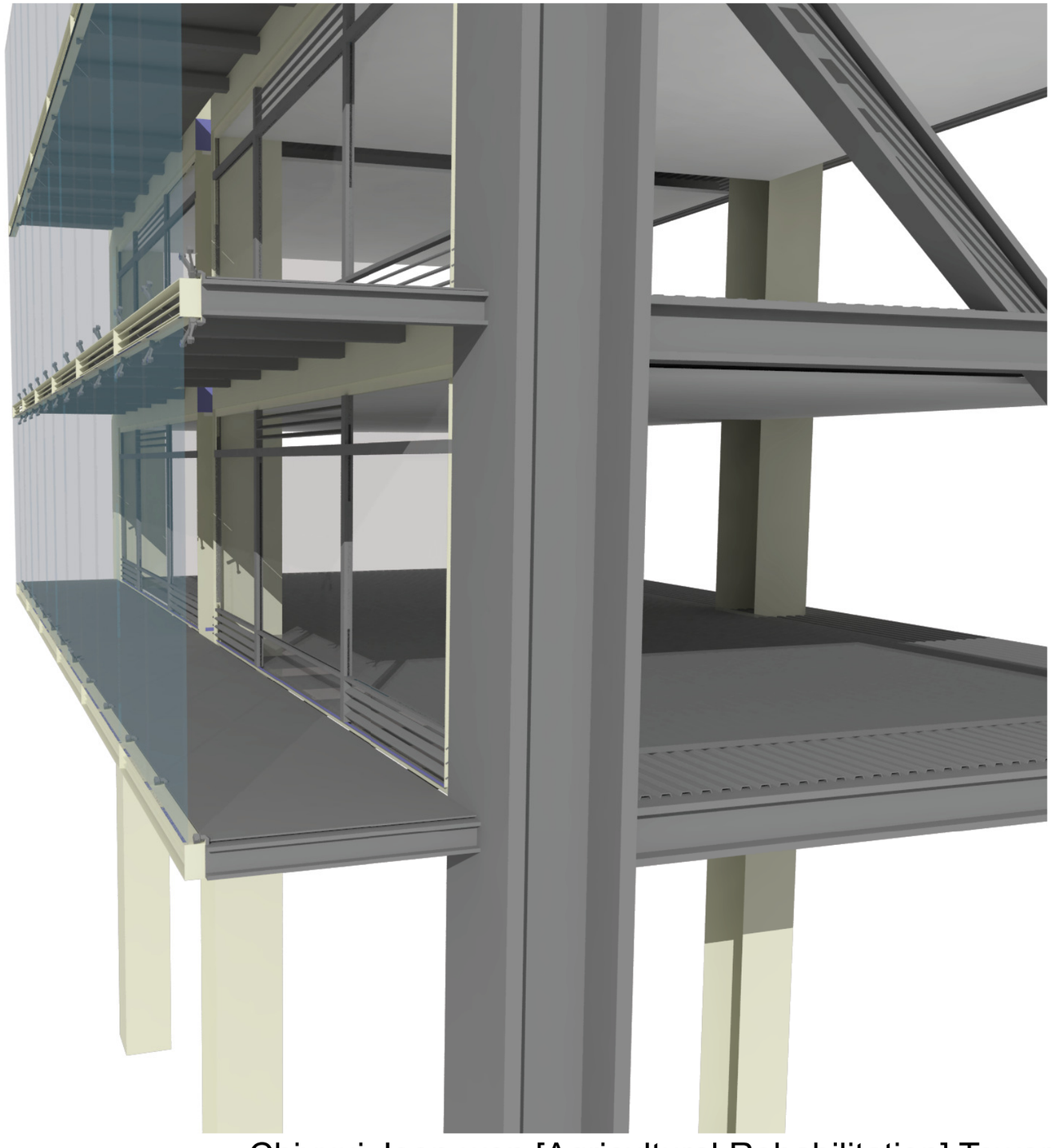
South West



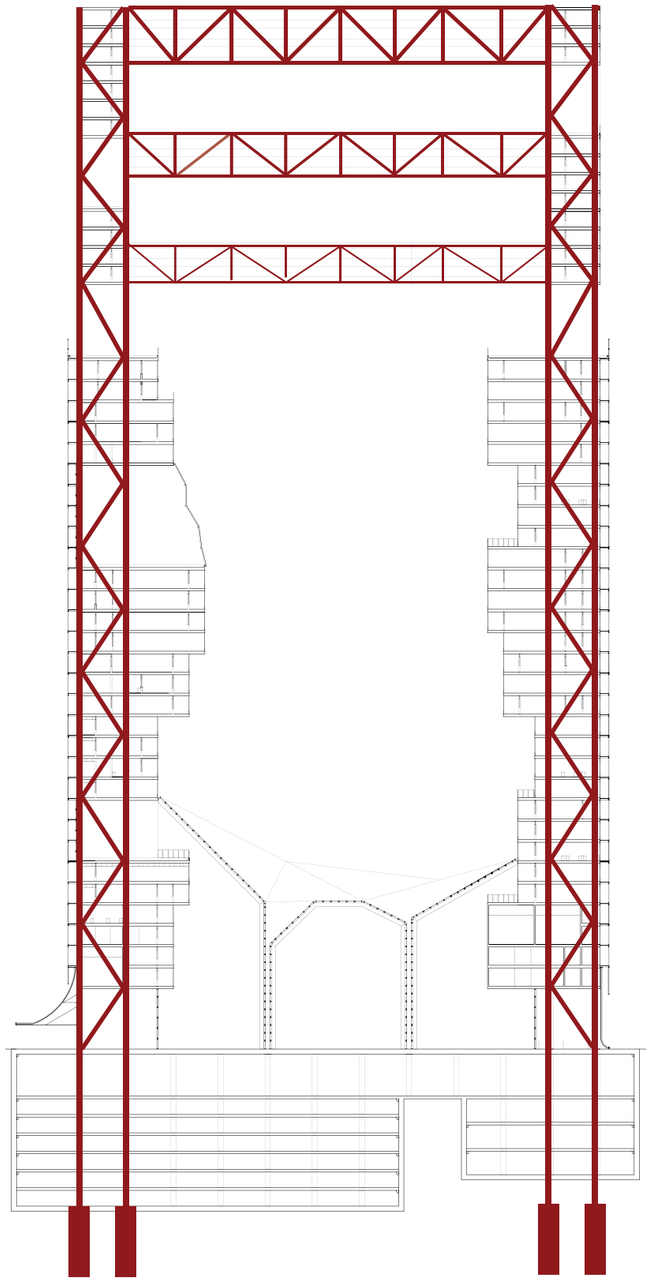


Structural System

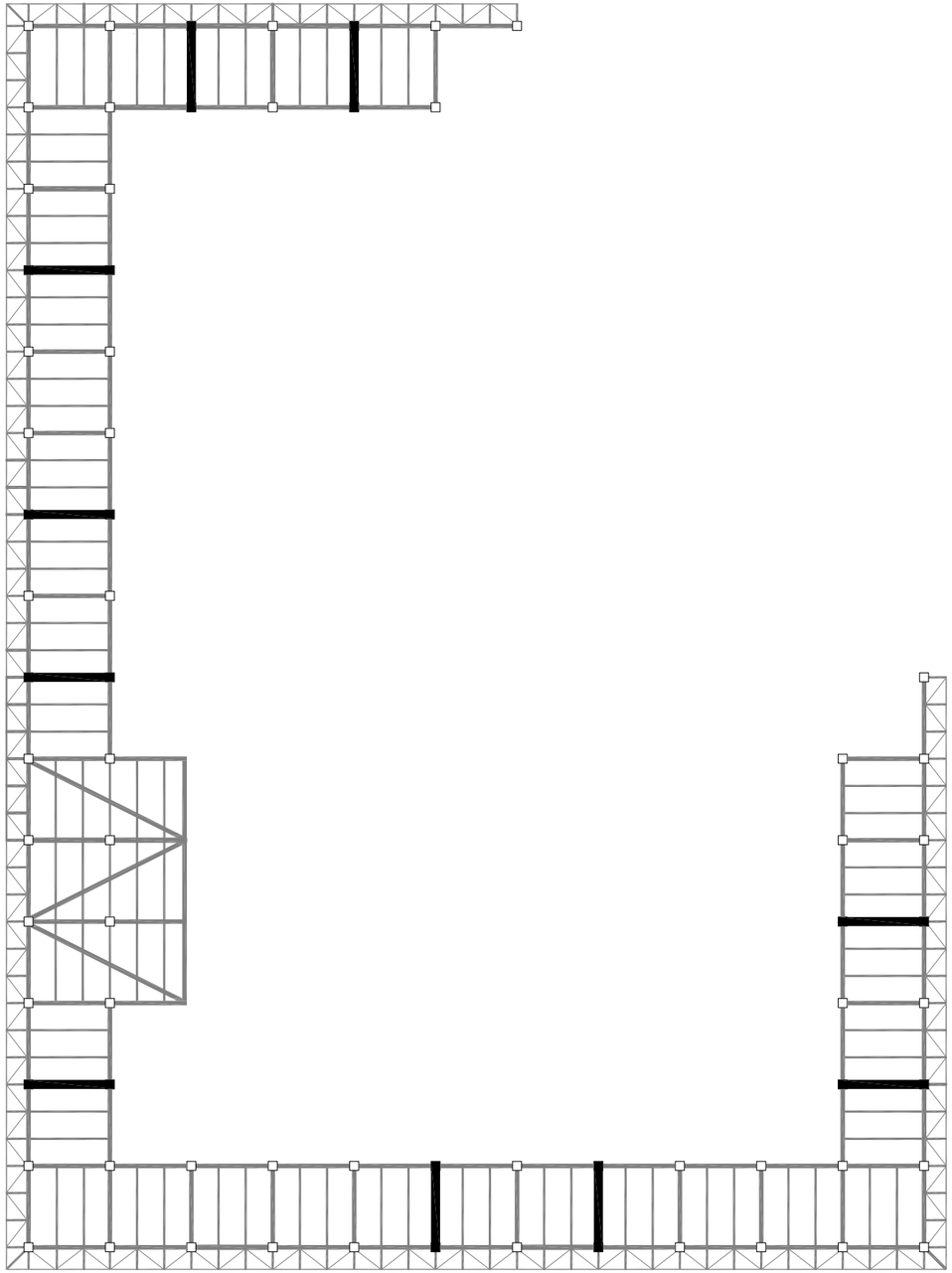
Structural 3D Detail



Structure

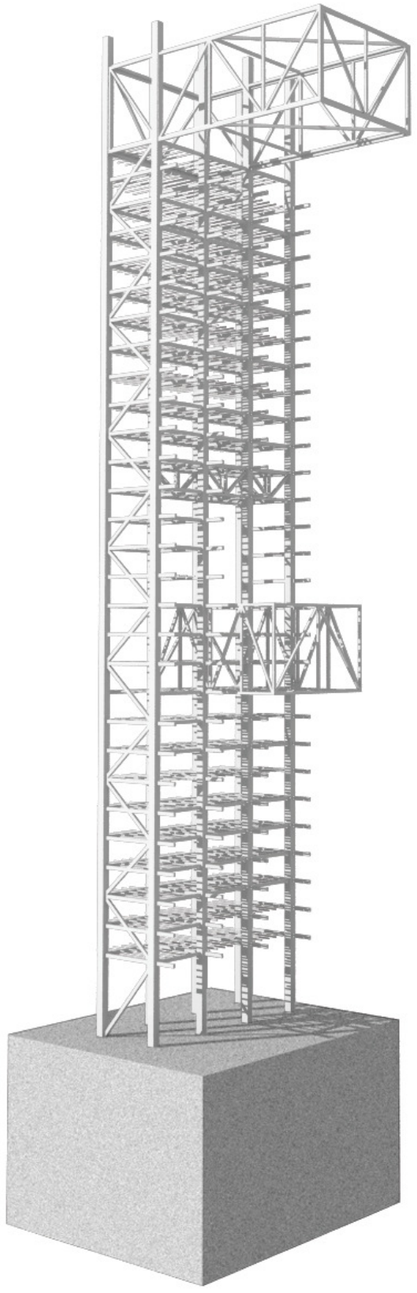


Structural Section Diagram

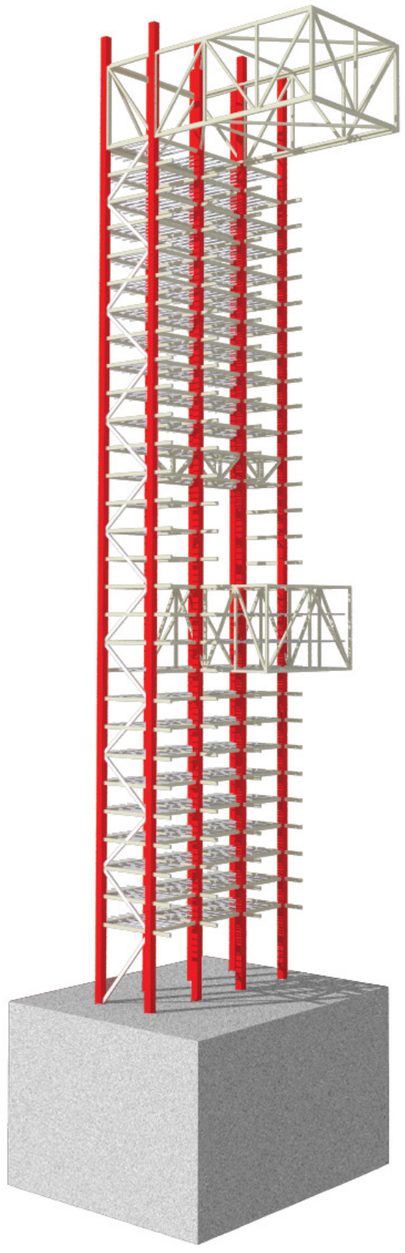


Structural Plan

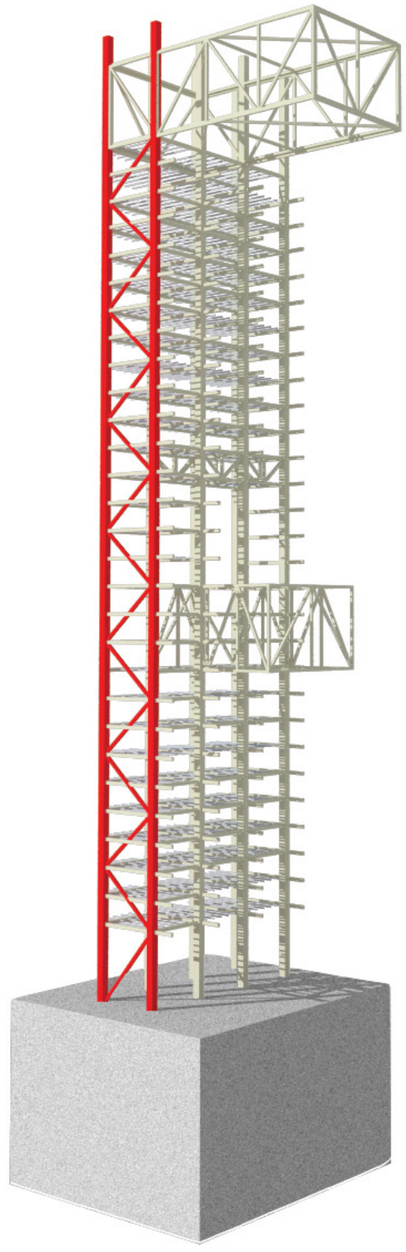
Structure



Structural System

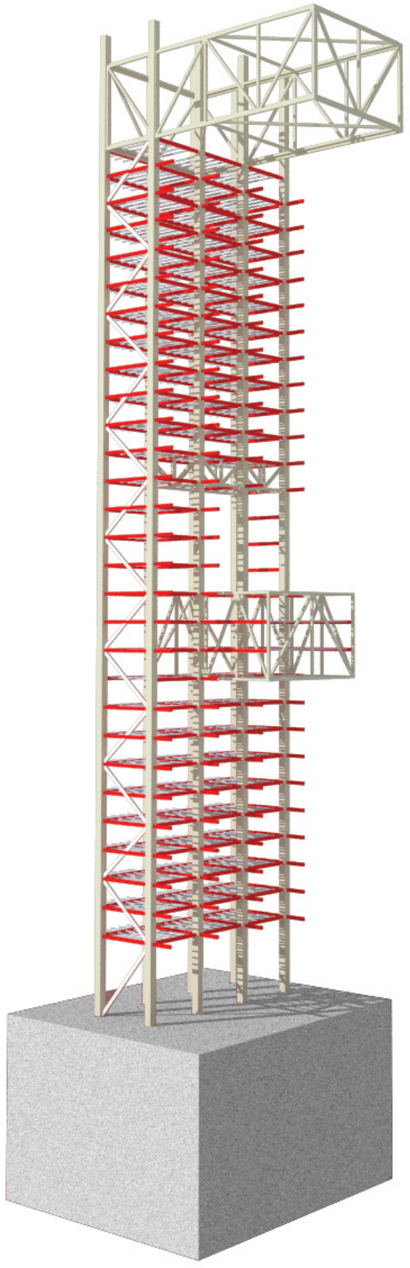


Columns

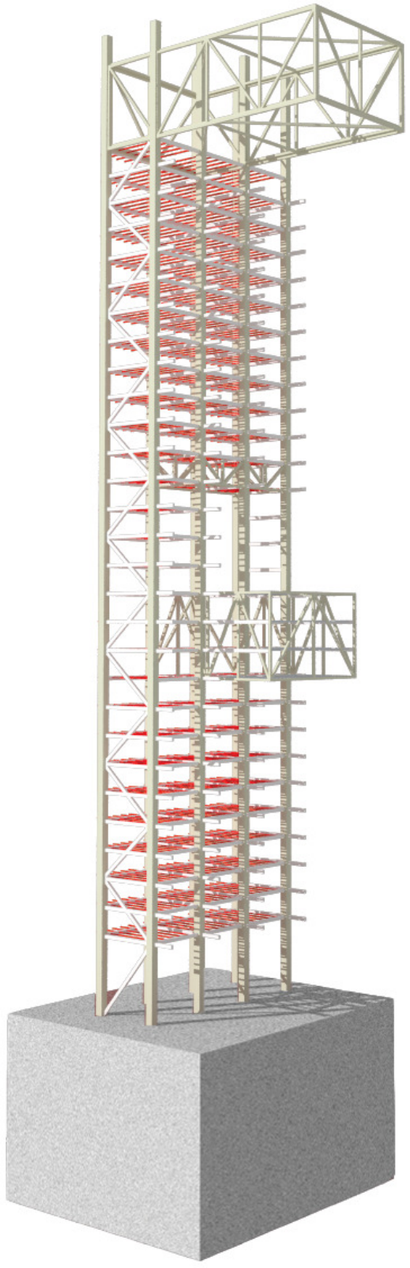


Braced Walls

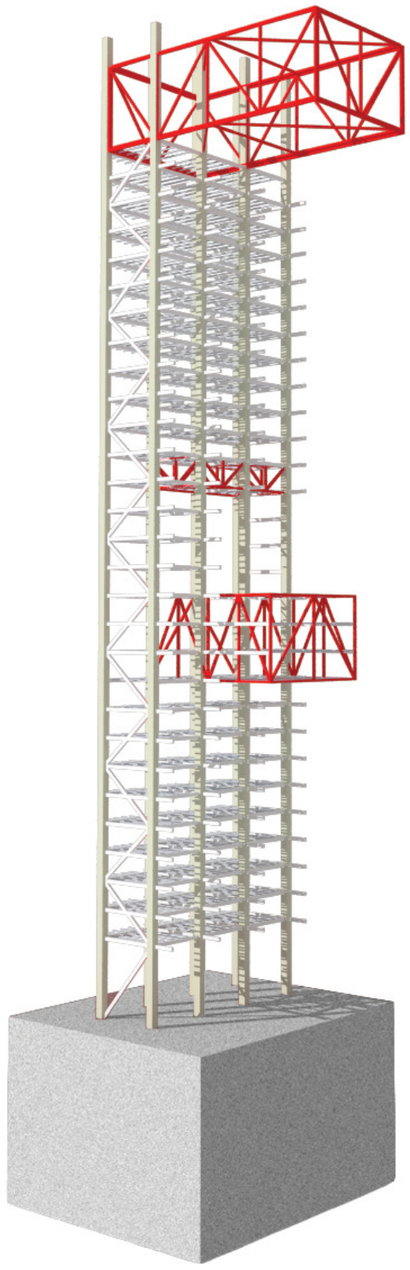
Structure



Beams



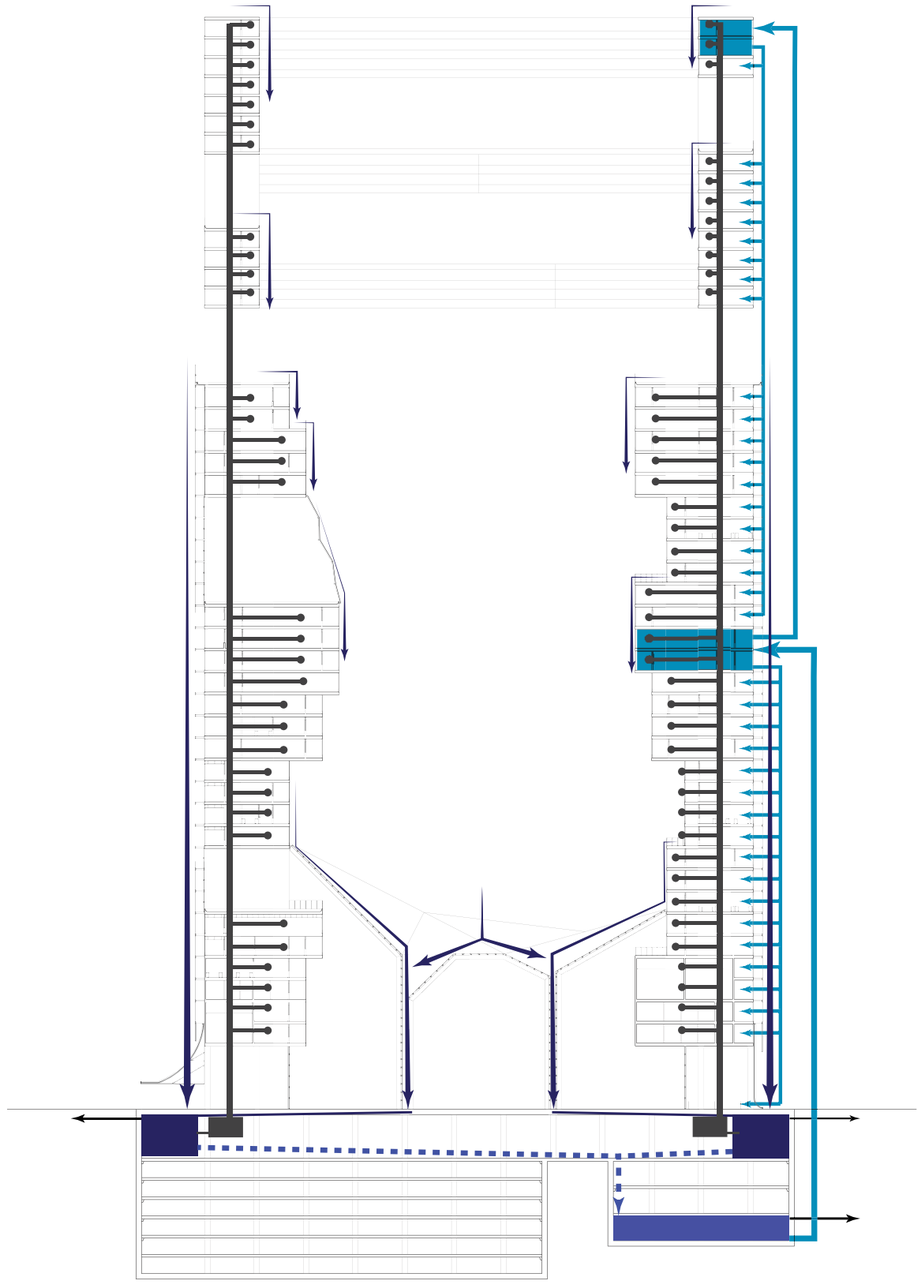
Floor Joists



Trusses

Water & Ventilation System

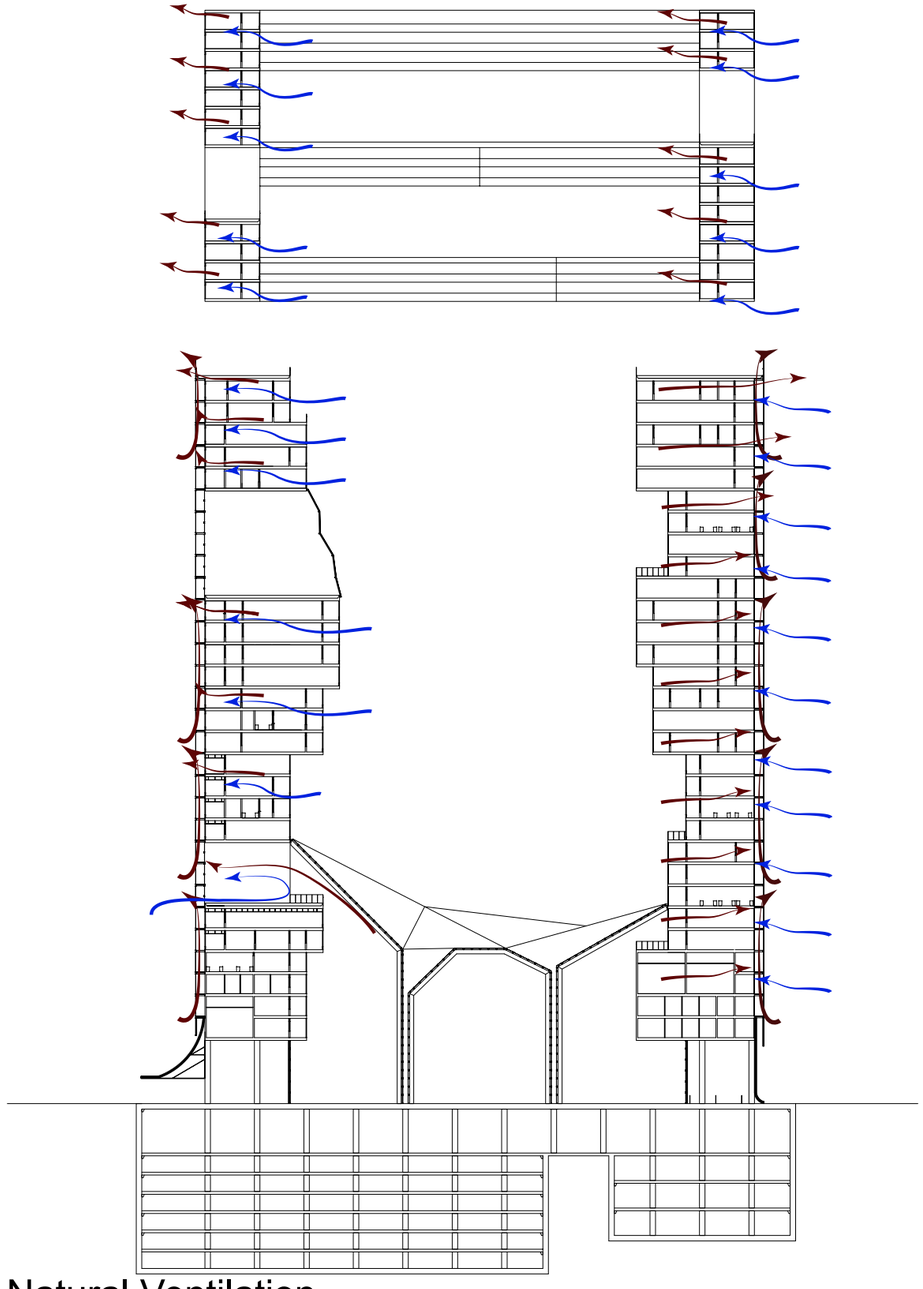
Water Catchment & Circulation System



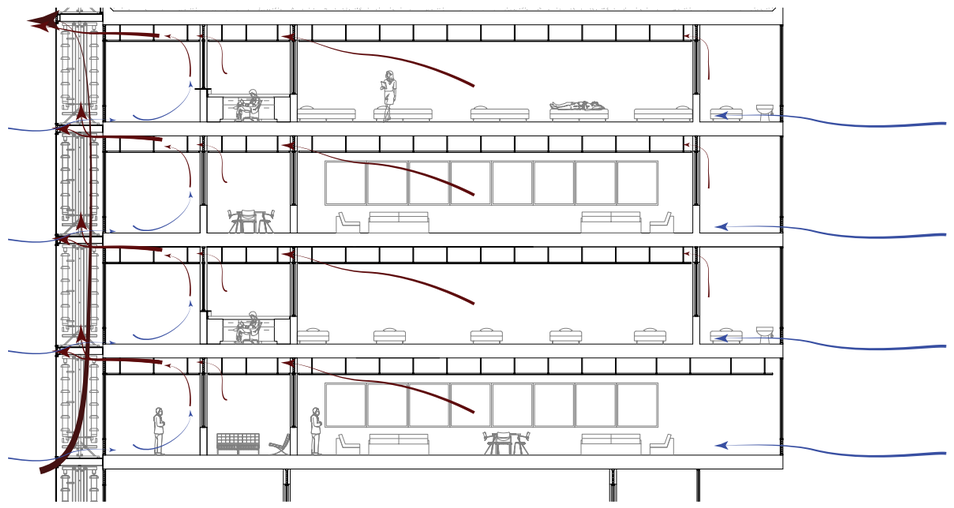
Average Use of Water (50% of regular amount from recycling water)	Monthly Precipitation (cm/month)	Monthly Water Collection (Liter/month)
	1.73	170,492
860,000 Liter/Day	2.15	211,883
25,800,000 Liter/Month	3.31	326,201
	5.35	527,243
	7.93	781,502
	11.57	1,140,224
	27.24	2,684,502
	30.3	2,986,065
	10.34	1,019,007
	3.68	362,664
	4.09	403,070
	1.51	148,811

- Rain Water Collection
- Grey Water Collection
- Water Distribution
- Water Filtration

Natural Ventilation



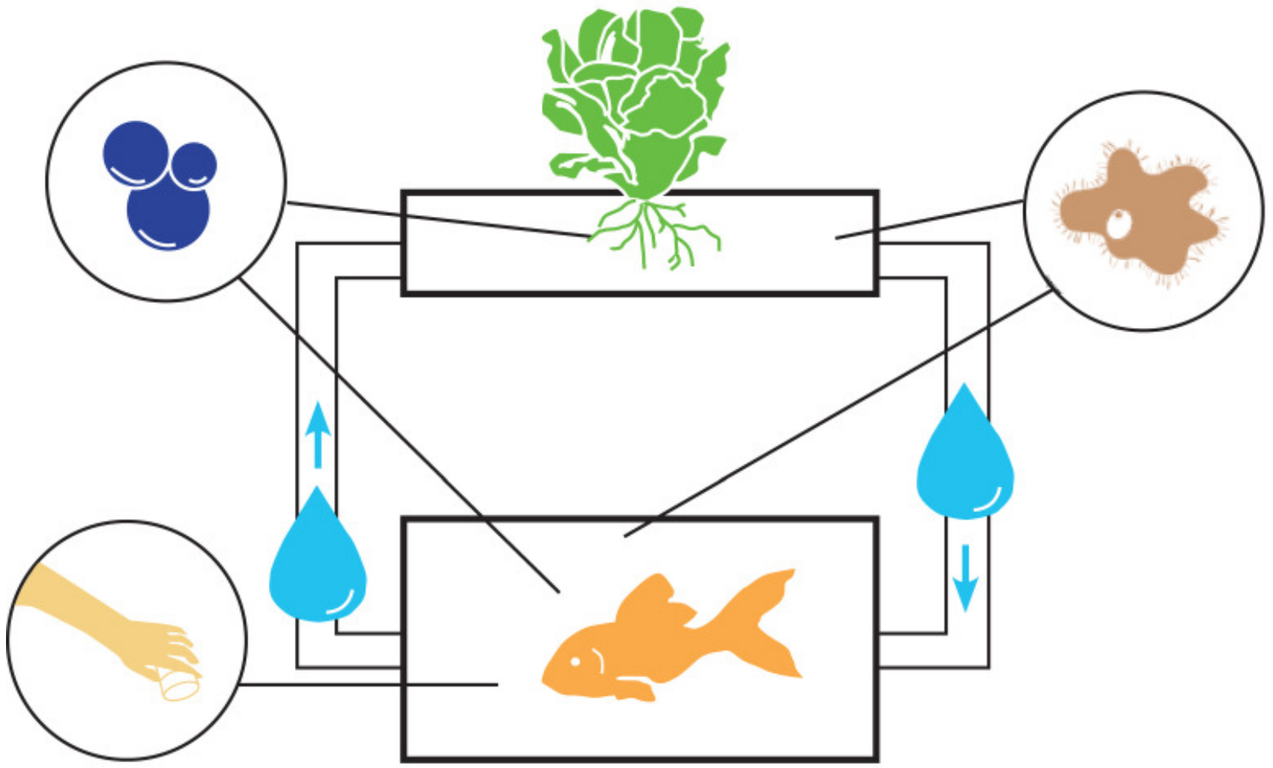
Natural Ventilation



Detailed Ventilation Diagram

Aeroponic & Aquaponic System

Aquaponic System



Fish are fed food and produce Ammonia rich waste. Too much waste substance is toxic for the fish, but they can withstand high levels of Nitrates.

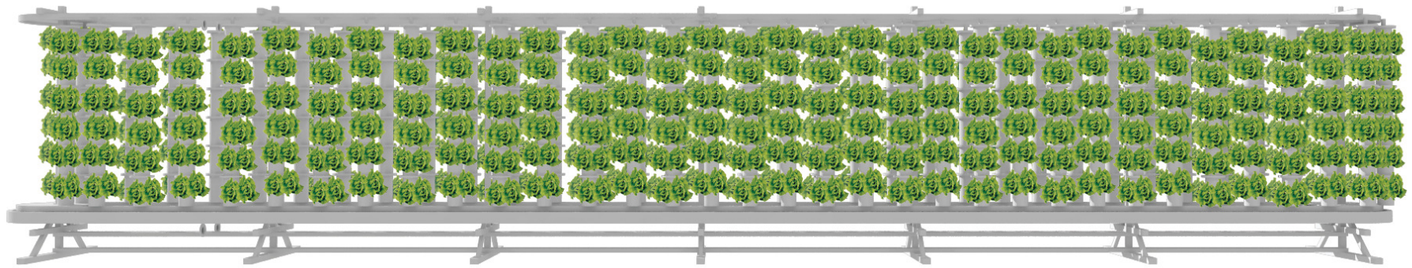
The bacteria, which is cultured in the grow beds as well as the fish tank, breaks down this Ammonia into Nitrites and then Nitrates.

Plants take in the converted Nitrates as nutrients. The nutrients are a fertilizer, feeding the plants. Also, the plant roots help filter the water for the fish.

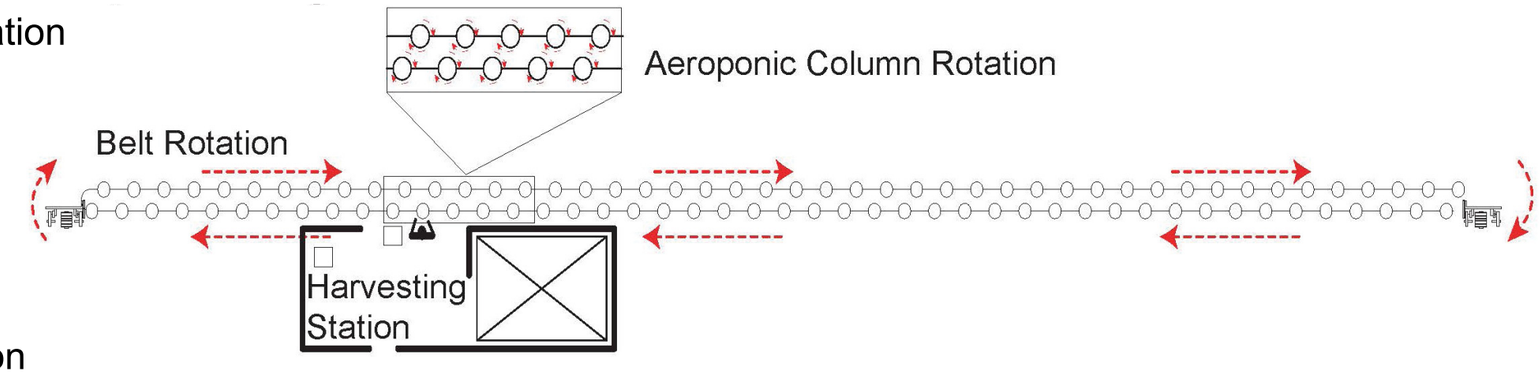
Water in the system is filtered through the grow medium in the grow beds. The water also contains all the nutrients for the fish.

Oxygen enters the system through an air pump and during dry periods. This oxygen is essential for plant growth and fish survival.

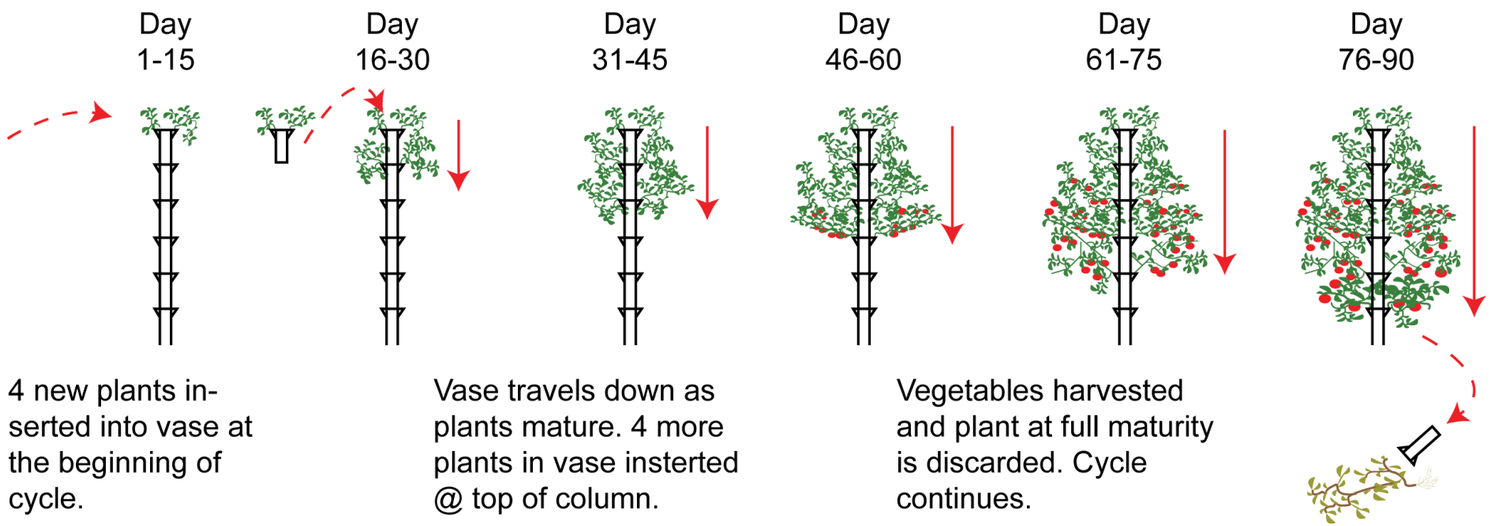
Aeroponic System



System Rotation



Plant Rotation



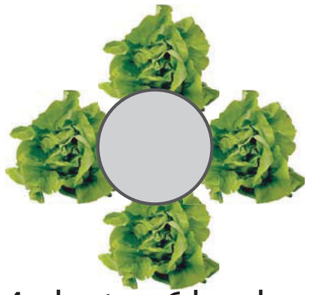
Existing Systems

Hydroponic System

Aquaponic System

Annual Harvest/ Annual Yields

Annual Harvest



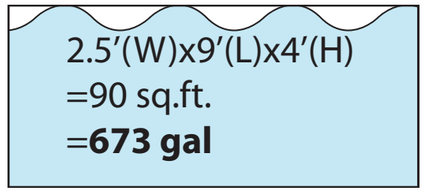
4 plants x 6 levels
24 plants per column

68 columns per system
1632 plants per system

16 systems total
26,112 plants total

Plants grow for 90 days cycle
26112 plants x4
=104,450 plants /year

Annual Fish Yeild



x4 tanks/floor
x25 floors
=**67,300gal**

1 fish per 3 gallons
67300 gal/3=22433 fishes

6 months to marketable maturity

22433 fishesx2
=44866 fishes/year
=appx. 200 tons/year