“Sustainable and Equitable Multifamily Housing”
OUR TEAM

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Minor in Architecture

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4th Year Undergrad
Civil Engineering

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Minor in Architecture

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1st Year Undergrad
Undeclared

INDUSTRY PARTNERS

DESIGN PARTNER
Perkins&Will
Neil Reindel, AICP, RELi AP
Designer and Adjunct Professor

SOM
BURO HAPPOLD

Northwestern
McCORMICK SCHOOL
OF ENGINEERING

FACULTY ADVISOR
David Corr, S.E.
Clinical Professor
Undergraduate Studies, Director
THE PROBLEM

40% OF GLOBAL ENERGY CONSUMPTION
Source: U.S. Energy Information Administration, 2022

2X MORE WASTE THAN MUNICIPAL SOLID WASTE
Source: U.S. Environmental Protection Agency, 2018
DISPLACEMENT

THE PROBLEM

Source: Chicago Sun-Times, 1995
CABRINI GREEN PRE-DEMOLITION

Source: Getty, 2005
CABRINI GREEN CONTEXT
CABRINI GREEN CONTEXT

2800 families displaced
CABRINI GREEN CONTEXT

2800 families displaced

85 families still on waiting list
CABRINI GREEN CONTEXT

2800 families displaced

85 families still on waiting list

<2% Promised contracts and jobs materialized
OUR MISSION:

Design a multifamily building which maximizes sustainability and strengthens community.
HOW WE ACHIEVE IT:

Maximize Sustainability
- Passive Design
- Healthy/Low CO₂ Materials
- Active Systems

Strengthen Community
- Equitable Programming
- Affordable Rents and Costs
- Holistic Live, Work, and Play
CONCEPT

COMMERCIAL

TreeHouse

⅓ commercial

121,000 sq.ft.
TreeHouse

CONCEPT

RESIDENTIAL

\( \frac{2}{3} \) residential

160 units

(25\% affordable housing)
TreeHouse

SPECIFICATIONS

Square Footage: 334,035 ft²

EUI: -2.9 kBtu/sf/yr

51% less Embodied CO₂
SUSTAINABLE
Design Approach
SUN ANGLES & WIND DIRECTION

- **Summer Solstice**: 71.6°
- **Winter Solstice**: 24.7°
- **Prevailing Wind Direction**
PASSIVE DESIGN

SOLAR SHADING

DAYLIGHTING
GENERAL MASSING
STRUCTURE

- Timber
- Steel
- Concrete

CLT/ Glulam Structure

Concrete Podium/CORE

Geothermal Pile FOUNDATION
PREFABRICATION

20%  20-50%  80%
Cost savings  Faster construction timeline  Reduced waste

25

STRUCTURE & ENVELOPE

Gypsum Board  Steel Stud  Cavity
Mineral Wool  Terracotta  Rainscreen
U-0.25  Windows

Cost savings  Faster construction timeline  Reduced waste
EMBODIED CARBON OVERALL

**BASELINE**

82

**TREEHOUSE**

40

Mass Timber (13x less CO$_2$E)
Mineral WOOL (3x less CO$_2$E)
Refrigerant 455A (14x less GWP)

Embodied CO$_2$ (lb CO$_2$/ft$^2$)
Mass Timber (13x less CO$_{2E}$)
Mineral WOOL (3x less CO$_{2E}$)
Refrigerant 455A (14x less GWP)

Embodied CO$_2$ (lb CO$_2$/ft$^2$)

51% REDUCTION
ACTIVE SYSTEMS
GEOTHERMAL BOREHOLES

TreeHouse’s 1st Floor
Extra Borehole Spaces
Borehole
ACTIVE SYSTEMS
DIRECT OUTDOOR AIR SYSTEM
ACTIVE SYSTEMS

PV SYSTEMS

1688 kW system: 2 million kWh/yr
LED LIGHTING
ACTIVE SYSTEMS

LED LIGHTING

APPLIANCES
LED LIGHTING

APPLIANCES

AUTOMATION & PLUG LOADS

Legrand Occupancy sensor

LUTRON Daylighting sensor

Legrand Plug-load manager
EUI (KBTU/SQFT-YR)

53

BASELINE
EUI (KBTU/SQFT-YR)

Baseline: 53
HVAC/Envelope: 17
EUI (KBTU/SQFT-YR)

BASELINE 53
HVAC/ENVELOPE 17
WATER HEATING
LIGHTING
AUTOMATION
R455A LEAKAGE
SNOW MELTING
EV CHARGING
18.7
EUI (KBTU/SQFT-YR)

- Baseline: 53
- HVAC/Envelope:
  - Water Heating: 17
  - Lighting: 18.7
  - Automation: -2.9
- PV: 38
LONG-TERM ENERGY PERFORMANCE

PV Generation vs. Energy Consumption

- PV Generation (million kWh)
- Energy consumption (million kWh)

25 YRS
net-positive guaranteed
GRID RESILIENCE

UP TO 70%

Reduced peak time loads

Monthly Peak Time Grid Utilization
WATER DISTRIBUTION

Sink, Shower, Washer → Carbon Filters → Greywater System → UV Disinfection → Greywater Reuse → Landscaping
WATER DISTRIBUTION

Sink, Shower, Washer

Carbon Filters

UV Disinfection

Greywater System

Greywater Reuse

Landscaping

40% WATER SAVINGS
STORMWATER MANAGEMENT

Native Vegetation
Concrete Liner
Sandy Loam
Filter Fabric
Gravel
Underdrain
WILD MILE INTEGRATION
COMMUNITY
Design Approach
FIRST FLOOR

- Local Shops
- Food Court
- Grocery Store
- Lobby
- Water Treatment/MEP Room
- Child-Care Services
SECOND FLOOR
RESIDENTIAL FLOOR

ARCHITECTURE
RESIDENTIAL FLOOR

3 bed
2 bed
1 bed

Communal Space
Visual Comfort

- Daylighting Sensors
- Biophilic Design
- Operable Shading
ENVIRONMENTAL QUALITY

OCCUPANT EXPERIENCE

Thermal Comfort and Air Quality

- Personalized temperature control
- Operable Windows
- MERV 13 Filtration
ENVIROMENTAL QUALITY

Acoustic Comfort

✓ Mineral Wool
✓ Thin Concrete between floors
✓ Minimized Vibration
MARTET ANALYSIS
Design Approach
TREEHOUSE RENT PRICES

1 BED

2 BED

3 BED
TREEHOUSE RENT PRICES

Chicago AVG ($2.75/sqft)

- 1 BED: $1925
- 2 BED: $2900
- 3 BED: $3850
Treehouse Rent Prices

**MARKET ANALYSIS**

- Chicago AVG ($2.75/sqft)
- Treehouse standard

- **1 BED**
  - $1530
- **2 BED**
  - $2300
- **3 BED**
  - $3000

- **3 BED**
  - $3850
TREEHOUSE RENT PRICES

Chicago AVG ($2.75/sqft)

Treehouse standard

Treehouse affordable

MARKET ANALYSIS
LIFECYCLE COST OVER 30 YEARS

BASELINE

- O&M $29.3M
- Construction $134M ($400/sqft)
MARKET ANALYSIS

LIFECYCLE COST OVER 30 YEARS

<table>
<thead>
<tr>
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<th>BASELINE</th>
<th>TREEHOUSE</th>
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<td>O&amp;M</td>
<td>$29.3M</td>
<td>$13.7M</td>
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<tr>
<td>Construction</td>
<td>$134M ($400/sqft)</td>
<td>$153M ($456/sqft)</td>
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$134M ($400/sqft)

$153M ($456/sqft)
LIFECYCLE COST OVER 30 YEARS

BASELINE

Construction
$134M ($400/sqft)

O&M $29.3M

TREEHOUSE

Construction
$153M ($456/sqft)

O&M $13.7M

Prefab: –$27M
Credits: –$23M
Social CO₂: –$3M
LIFECYCLE COST OVER 30 YEARS

BASELINE: $163 Million
TREEHOUSE: $114 Million
LIFECYCLE PROFIT

$205 MILLION
30 YR RENT REVENUE

BUILDING COST

$114 MILLION
“It’s time our cities turn over a new leaf, with TreeHouse”
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