Advancing Equity in the Built Environment

13th Annual North American Passive House Conference

Prairie View A&M University
School of Architecture

2018 Race to Zero | Team Mod Squad

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1 TON CO2 EMISSIONS/CAPITA BY 2050
Galveston’s seawall

Four years after the catastrophic 1900 hurricane, a seawall was built along the Gulf shore to protect Galveston from storm surges.

- Concrete seawall
- Curved face directs waves upward
- Ground raised with fill
- Wood sheet piling
- Beach

© 2008 MCT
Source: U.S. Army Corps of Engineers
Graphic: Fort Worth Star-Telegram
TS Allison Flood Damaged Residences

Total is over 73,000 and includes:
Single-family houses, apartment units,
mobile homes and travel trailers.
More than a third of the properties that flooded in Houston's Memorial Day 2015 and Tax Day 2016 floods are located outside areas that the Federal Emergency Management Agency deems to be at high risk of flooding.

- The Houston area has had three 500-year floods in the past 3 years.
- Harvey was a 1,000-year flood.
- NOAA is considering raising the 100 yr 24 hour event from 13” to 18”.
- The Houston ecology includes 19 watersheds.
- 4% of Houston is in a 100-year floodplain, including over 122,500 parcels.
A Year After Hurricane Harvey, Houston’s Poorest Neighborhoods Are Slowest to Recover

Texas has made progress recuperating from Hurricane Harvey, but low-income and minority residents have had a much harder time.
Existing Conditions

Vacant Lots in Independence Heights, TX
Total Vacant Residential Lots: 768
Total Lot Values: $202,306,218

Double lot selected for demonstration project:
Address:
509 E 41st Street, Houston, TX 77022

Community Engagement
**Economic**
- Affordability
- Ownership
- Address vacancy
- Economically healthy neighborhood

**Environmental**
- Address flooding
- Surviving hurricanes and flooding events with minimal damage
- Man/Nature Connection
- Health
- Net zero residence

**Social**
- Social Agency
- Community connectivity/relationship development
- Health
Resilience Methods

INDOOR airPLUS

WATERSENSE

ENERGY STAR

LOW IMPACT DEVELOPMENT

FEMA 499

LEED FOR HOMES

ZERO ENERGY READY HOME

PASSIVE HOUSE

Categories:
- Categories Not Applied
- Categories Met
- Sub-Categories: Met
- Sub-Categories: Not Met
Site: Pocket Neighborhood

Features:

- 100% stormwater run-off in 2-yr event handled on-site
- Encourage interaction & eyes on the street
- Low Impact Development/preservation of green space
- Encourage Man/Nature re-connection
Fly Roof:

- Constructed & installed on-site by professional: helical piers
- Welded connection to home
- Shade outdoor spaces
- Reduce solar heat gain to modular home
- Support solar panels/power additional homes
- Elevate home from flood plain
Design: Modular Home

- Modular approach
- Fabrication lab construction/on-site connection
- Continuous exterior insulation w/ open cavity for additional storage/built-in furniture
- Add-on capability
- Design flexibility
- Tight wet-core
- Natural Ventilation

Floor Plans
SCALE: 3/32" = 1'-0"
Fabrication

Step 1: Homeowner customizes & orders modular home via website

Step 2: Design/Build program constructs modules in Fabrication Lab

Step 3: Modules are transported to site for welded connection to other module & fly roof structure

http://www.designbuildteam.wixwebsite/flyflatmodularhomes
Affordability

Modularity

Packages

Land & Infrastructure

Economic Resilience

Social Resilience

Environmental Resilience

Modularity

Land & Infrastructure

Land
- Land Trust, Or
- Privately Owned

Fly Roof
- Land Trust, Or
- Privately Owned

Solar
- Solar Co-op Utility, Or
- Privately Owned
  - PPA
  - Mortgage
Affordability Scenarios

SINGLE PERSON
Monthly Income: $2,184.92
50% AMI: $26,219

38%

Property Tax $177
Insurance $79
Mortgage Payment $268
Maintenance $396
Water $48

SINGLE FAMILY
Monthly Income: $4,993.33
80% AMI: $59,920

38%

Property Tax $350
Insurance $79
Mortgage Payment $519
Maintenance $900
Water $14

ELDERLY COUPLE
Monthly Income: $2,995.03
80% AMI: $47,190

38%

Property Tax $506
Insurance $24
Mortgage Payment $646
Maintenance $190
Water $30
• 27.3 kW PV system per fly roof
• 5.2 kW PV system required for 3 bedroom home
Community Impact

Vacant lots in the studied area: 768 Lots
1,536 additional homes

Lara lots in the studied area: 11 Lots
22 additional homes

1 Fly Roof → Powers 5 homes

7,680 Homes powered by fly roofs
Energy Modeling

Conceptual Design
Sefaira

- Shifting connected modules will increase the EUI.
- Adding a pitched roof will increase the EUI by 1.

Schematic Design
BeOpt

Analysis of Heat Transmission Through Main Roof (without Fly Roof)

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Energy Star</th>
<th>ZEBH</th>
<th>PHUS+2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>WUFI-Passive</td>
<td>2,074.8 kBtu/yr</td>
<td>498.4 kBtu/yr</td>
<td>490.1 kBtu/yr</td>
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<tr>
<td>Manual Calculation: Heat Transmission Relative to Roof</td>
<td>4,756 kBtu/cooling season</td>
<td>3,714 kBtu/cooling season</td>
<td>3,084 kBtu/cooling season</td>
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<tr>
<td>Manual Calculation: Heat Transmission Relative to Outdoor Air Temperature</td>
<td>1,399 kBtu/cooling season</td>
<td>1,021 kBtu/cooling season</td>
<td>841 kBtu/cooling season</td>
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<tr>
<td>Manual Calculation: Heat Transmission Relative to Outdoor Air Temperature</td>
<td>3,447 kBtu/cooling season</td>
<td>2,693 kBtu/cooling season</td>
<td>2,213 kBtu/cooling season</td>
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</tbody>
</table>

Design Development
Remrate; Wufi-Passive; Manual Calculations

\[ T_{RS} = T_0 + \frac{GR \times SA}{RSE} \]

\[ Q = A \times U \times G \times T_1 \]

Module w/ windows
EUI: 25

Simple double roof
EUI: 24
*With a 5 kW Photovoltaic System, all packages achieve Net Positive Energy w/ a HERS Score between -8 to -12
### Mechanical & IAQ

**Ventilation**
- Balanced Ventilation
- BSC Standard 01
- 100 CFM Kitchen Hood with makeup air
- 12 MERV Filtration

**Heating & Cooling**
- Right sized ducted mini-split
- 1.34 ton system based on Manual J

**Dehumidification**
- Dedicated dehumidification
- Solves IAQ issues

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**Diagram:**
- PANASONIC INTELLI-BALLANCE ERV
- MITSUBISHI MINI-SPLIT
- ULTRAIAIRE DEHUMIDIFIER
Resilience: Safety and security in the next natural disaster

Affordability: Making home ownership financially feasible

Sustainability: Maximizing positive impacts on the environment

Rebuilding Community
The Fly Flat

Thank you!