THE WORLD'S LARGEST PASSIVE HOUSE BUILDING

Cornell Tech NYC Campus Residential Building
PARTNERSHIP: HUDSON COMPANIES AND RELATED COMPANIES

Seven Buildings on Roosevelt Island

Riverwalk 7:
25.5% better than ASHRAE 90.1–2007
LEED Silver and NYSERDA ENERGY STAR anticipated
The Hudson Companies: Green Leadership

Third + Bond

LEED Platinum and ENERGY STAR labels
Completed 2011

Gateway Elton Street Phases I, II, III

Largest Residential PV Installation in NYS
3 phase multi-building mid-rise development
LEED for Homes Gold or better expected
Plan to exceed NYSERDA’s energy-efficiency standard
RELATED: SINCE 2008 BUILDS GREEN EXCLUSIVELY
LEED Silver or Better

Completed:
14 projects, 6.4M SF, $3.7B
1 LEED Platinum
5 LEED Gold
8 LEED Silver

Underway:
32 projects, 14.5M SF, $10B
3 LEED Neighborhood Developments

Tribeca Green, NYC
Completed: 2004
LEED NC Gold
HANDEL ARCHITECTS: MIXED-USE HIGH-RISE DESIGNERS
December 2010
City launches "Applied Sciences NYC."

October 2011
Responses received from universities around the world.
Bloomberg hands over 12-acre plot for Cornell campus on Roosevelt Island

The Cornell Tech ‘Genius School’ under the Queensboro Bridge will ‘ensure that New York City businesses play a major role in determining how technology shapes our future,’ the outgoing New York City mayor says.

BY JENNIFER FERMIN / NEW YORK DAILY NEWS / Friday, December 20, 2013, 1:13 AM

Outgoing Mayor Bloomberg handed over a 12-acre plot to Cornell at a City Hall ceremony Thursday that will pave the way for a Cornell Tech ‘Genius School’ on Roosevelt Island.

It was a finishing touch on one of Mayor Bloomberg’s signature legacy projects — the Cornell Tech ‘Genius School.’

Bloomberg on Thursday formally handed over 12 acres of city land to Cornell at a City Hall ceremony, paving the way for construction of the 2 million-square-foot campus on Roosevelt Island.
NOVEMBER 2012

Cornell issues an RFP for the Phase 1 Residential Tower.

- Sustainable design
- Competitive rents
- Design Excellence
**PROJECT GOALS**

1. **Better Living Quality**
   - Improve indoor air quality and comfort
   - Provide acoustic separation from the surrounding environment
   - Allow individual control of heating & cooling

2. **Save the Planet**
   - Reduce energy consumption
   - Reduce Greenhouse Gas (GHG) emissions
   - Reduce dependence on fossil fuels

3. **Elevate the University**
   - Position University at the forefront of innovation

4. **Save Money**
   - Provide housing that is affordable to the community
   - Reduce energy costs for users
GREENHOUSE GAS EMISSIONS IN NEW YORK CITY (2014 = 47.9 MILLION TONS CO2)

- Residential Buildings: 16.3M
- Commercial Buildings: 9.8M
- Industrial & Institutional Buildings: 7.9M
- Non-buildings: 13.9M

BUILDINGS = 71% GREENHOUSE GAS EMISSIONS

- 33% Industrial
- 28% Transportation
- 21% Residential
- 18% Commercial
ENERGY CONSUMPTION IN NEW YORK CITY (2011)

- Small Buildings (<50k SF): 35%
- Large Buildings Heating & Hot Water: 23%
- Large Buildings Lighting: 12%
- Transportation: 17%
- Appliances, Cooling, & Other: 13%

BUILDINGS = 83% TOTAL SOURCE ENERGY
Median Energy Use of All NYC Buildings over 200,000 sq. ft.: 140.8 pEUI kBTU/SF per year

Energy Use of Passive House Buildings: 38.1 pEUI kBTU/SF per year
370% Improvement

Buildings = 83% Total Source Energy in New York City
Designing to Passive House = 775.9 MMBtu (77.5 %) reduction
Greenhouse Gas Emissions of All NYC Buildings:
38 Million Tons per year

Designing to Passive House:
24.8 Million Tons CO2 reduction
52% reduction
WHAT IS PASSIVE HOUSE?
Maximize your gains, minimize your losses

1. The most rigorous energy efficiency standard in the world
2. Based on absolute energy use, not enhancement over code
3. Focus attention on enclosure - insulation continuity and elimination of thermal bridging and air leakage
4. An emphasis on balanced filtered fresh air
5. Building maintains constant temperature allowing for a drastically reduced heating and/or cooling load
European response to climate change
First introduced in Darmstadt, Germany over 25 years ago
Born from a need for an energy independent strategy
Intended to change the face of low energy developments and architecture
Direct response to stopping global warming and reducing Green House Gas (GHG) emissions

THE BIRTH OF PASSIVE HOUSE
PASSIVE HOUSE AT A DIFFERENT SCALE

Allgemeine Angaben,
Germany - Current Tallest Residential Passive House Building

- 16-Stories
- 140 units
- 91,200 sq.ft.

Cornell Tech Residential

- 26 Stories
- 352 Units
- 272,500 sq.ft.
- 10,600 GSF/Floor
- 270' to Roof
# NEW YORK STATE CLIMATE ACTION PLAN 2050

In Million Metric Tons of CO2/yr

<table>
<thead>
<tr>
<th>Sector</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Baseline</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>7.5</td>
<td>37.6/45.0</td>
<td></td>
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<tr>
<td>Commercial</td>
<td>0</td>
<td>0</td>
<td>4.5</td>
<td>27.2/39.1</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>12.7</td>
<td>12.7</td>
<td>14.1</td>
<td>19.0/24.1</td>
<td></td>
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<td>Transport</td>
<td>20.1</td>
<td>20.1</td>
<td>51</td>
<td>88.3/126</td>
<td></td>
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<tr>
<td>Electricity</td>
<td>10</td>
<td>13</td>
<td>24</td>
<td>49.2/83.3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>12.3</td>
<td>12.3</td>
<td>12.3</td>
<td>28.8/43.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>55.1</td>
<td>58.1</td>
<td>113.4</td>
<td>250.2/360.5</td>
<td>Goal – 55.4</td>
</tr>
</tbody>
</table>

Source: Stokes, Gerald M., Brookhaven National Lab
To achieve 80% reduction in emissions by 2050, New York City must retrofit a large majority of today’s existing buildings.

Convert onsite combustion of fossil fuels to renewable or low-carbon energy.

Construct new buildings 75% more efficiently than existing construction standards; and greatly improve the efficiency of appliances & electronics.

Sources: New York State Climate Action Council, Climate Action Plan Interim Report, November 2010
PASSIVE HOUSE PERFORMANCE CRITERIA

- **Overall Source Energy Used**
  - 38 kBu/t per year

- **Heating Energy Used**
  - Max 4.75 kBu/t per year

- **Cooling Energy Used**
  - Max 5.39 kBu/t per year

- **Air Changes per Hour (ACH)**
  - 0.6 ACH - Very Tight Facade

- **Through the Facade @ 50 Pascals of Pressure**
  - Balanced supply and exhaust mechanical ventilation with energy recovery
INTEGRATION WITH OTHER CERTIFICATIONS

Many Passive House projects also pursue:

**LEED Certification**
- Green building certification program
- Save money and resources, have positive impact on health, and promote renewable, clean energy

**ENERGY STAR v3**
- Meet strict energy performance standards set by EPA
- Less expensive to operate and causes fewer greenhouse gas emissions

**DOE Zero Energy Home Program**
- Based on Energy Star
- Incorporates indoor air quality and moisture management principles
STRATEGIES TO ACHIEVE PASSIVE HOUSE CERTIFICATION

1 Siting: Solar Orientation and Shading
Maximize solar gains for winter, minimize gains for the summer.

2 Compact Building Shape
Low surface-to-volume ratio (<1)

3 Enclosure
   Continuous Insulation
   Create steady indoor temperatures that won’t drop below 50 degrees without heating source

   Thermal Bridge Free Construction
   Minimize heat transfer/condensation/building deterioration

   Airtightness
   Tightly air seal building - limit air leakage.
   Minimize moisture diffusion into wall assembly.

4 Balanced Ventilation with Heat Recovery
Provide exceptional efficiency, indoor-air quality & comfort.

5 Energy Efficient Appliances and Lighting
Use energy efficient equipment, appliances and lighting.

6 User Friendliness
Manuals are given to residents, but operational use should be very similar to typical buildings
IMPLEMENTATION PROCESS

Owners -> Architect

Engineers & Consultants

Architect -> Passive House Consultant

Passive House Consultant

PHA
Passive House Academy certifies application

PHI
Passive House Institute – Germany provides final certification

Local Certifying Body

CERTIFICATION
SHAPING OUR APPROACH: MASTER PLAN PRINCIPLES

RIVER TO RIVER EXPERIENCE

INDOORS AND OUTDOORS

OPTIMIZED PERFORMANCE

DIVERSE + ACTIVE OPEN SPACES

CAMPUS MARKER

LIVABLE + SUSTAINABLE CAMPUS
SITING

- MAIN CAMPUS ENTRY
- ENTRY COURT/HIGHEST POINT
- RIVERFRONT WALK
- CAMPUS LAWN

NORTH/SOUTH AXIS
BROAD SOUTHERN EXPOSURE.
SHORT SIDES FACE
EAST AND WEST

SITE

OUTDOOR CLASSROOM

RIVERFRONT WALK

CAMPUS PLAZA

NORTH LOOP ROAD
WEST LOOP ROAD
EAST LOOP ROAD

CENTRAL UTILITY PLANT (CUP)
EXECUTIVE EDUCATION CENTER (EEC)
CORPORATE CO-LOCATION (COLO)
FIRST ACADEMIC BUILDING (FAB)
ENCLOSURE: THERMAL WRAP

Rainscreen Cladding System
Angled Metal Spandrel
PANEL SYSTEM

Shop assembled panelized wall system leads to exceptional quality control.

Windows installed in factory, not on site.

Typical panel size 10’x35’, allows for quick site installation.

Air seal at panel joints at interior face of exterior wall.

Prefabricated metal wall panel installation.
EXTERIOR WALL DETAIL

Section View

- High Performance Glazing
- Angled Metal Spandrel Beyond
- Rainscreen Cladding System
- R32 Wall
- Thermally Broken Support Clip

- Thermally broken construction
- Airtight envelope: 0.6 ACH@50pa
- Window-to-wall ratio calibrated to maximize performance

ThermaBracket Assembly with Isolators
BUILDING BALCONY DETAIL - CONCRETE TO CONCRETE THERMAL SEPARATION

Key Plan

- Insulation
- Continuous Air/Water Barrier
- Continuous Vapor Barrier

Section Detail

- Building Slab
- Balcony Slab
- Rainscreen Cladding System
- Interior
- Exterior Balcony

Structural Thermal Break
BUILDING BALCONY - THERMALLY INSULATED DOOR

Insulation R value is 32 at 40°F.
BUILDING CANOPY DETAIL - STEEL TO STEEL THERMAL SEPARATION

- Insulation
- Continuous Air/Water Barrier
- Continuous Vapor Barrier
- Steel Structure

Key Plan

Steel Embed Canopy Cladding

Rainscreen Cladding System

Structural Thermal Break

Canopy Cladding

Section Detail

Interior

Exterior
WINDOWS

• **EN vs. NFRC**
  » The centre-of-glazing U-value (Ug), according to standard EN 673.
  » The frame U-value (Uf), calculated with THERM, according EN ISO 10077-2
  » The linear thermal transmittance through the glass edge (ψ-value)

• **Unit conversion US to Metric**
• **Condensation analysis**
• **Third party analysis**
## WINDOW + FRAME

Standard metal frame and window is .45

<table>
<thead>
<tr>
<th>Window Type</th>
<th>Frame U-Value</th>
<th>Average Overall U-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculated Value (Average)</td>
<td>Target Value</td>
</tr>
<tr>
<td>Window Type A</td>
<td>0.28 Btu/h·ft²·F (1.59 W/m²K)</td>
<td>0.28 Btu/h·ft²·F (1.59 W/m²K)</td>
</tr>
<tr>
<td>Window Type B</td>
<td>0.27 Btu/h·ft²·F (1.51 W/m²K)</td>
<td>0.28 Btu/h·ft²·F (1.59 W/m²K)</td>
</tr>
<tr>
<td>Window Type C</td>
<td>0.26 Btu/h·ft²·F (1.50 W/m²K)</td>
<td>0.28 Btu/h·ft²·F (1.59 W/m²K)</td>
</tr>
</tbody>
</table>

### Condensation Risk

- **Condensation Risk (Te=0°F; T_i=70°F; R.H.=30%)**
  \[ T_{s, \text{min}} = 50.2°F (10.1°C) \]
  \[ T_{dp} = 37.0°F (2.8°C) \]

- **Condensation Risk (Te=18°F; T_i=68°F; R.H.=50%)**
  \[ T_{s, \text{min}} = 54.0°F (12.2°C) \]
  \[ T_{dp} = 48.7°F (9.3°C) \]
AIR SEALING - CONTINUITY OF AIR BARRIER

Vapor barrier switches from inside to outside at point highlighted.

Vapor barrier on the wall between Trash and Electrical Rooms?
AIR SEALING - CONTINUITY OF AIR BARRIER
AIR SEALING - AT INSIDE FACE OF EXTERIOR WALL

- Smart vapor retarder on interior installed in the shop
- Taped to interior face of window and studs
- Overlaps at panel joints - held back at factory and connected in field
- Panel joints taped in the field - bypassing slab edge
Problem for Passive House blower door testing: caulking not complete until façade is completely installed. Therefore, there is no way to verify tightness during construction.

Interior vapor retarder will be used to determine compliance for air sealing during construction, therefore, continuity is critical.
AIR SEALING - TYPICAL WINDOW

- Façade consultant and contractor – caulk is what was proven and usually done.
- Tape not accepted – too hard to work with and ensure quality
- Push from PH consultant and team to incorporate tape to ensure tight envelope over time
- Sequencing issues with manufacturer
- Invite a supplier to show examples and solutions to your particular issues.

Interior

Exterior

Polyethylene foam insulation

Triple glazing with warm edge spacers

Polythermid thermal break

Caulk, typ.

Insulation

Thermal break @ support for metal panel wall

Continuity of thermal separation

Vapor impermeable tape
AIR SEALING - ACCESS AT FACADE COLUMNS AND SHEAR WALLS

TYPICAL COLUMN DETAIL
17 PER FLOOR

SHEAR WALL
CONDITION
AIR SEALING - ACCESS AT FACADE COLUMNS

- Allow for access at columns
- Columns set back 10"
- Max horizontal distance to panel joint = 8"
- Coordinate with facade design
AIR SEALING - AT FACADE ANCHORS

- 123 Anchors Per Floor
- Over 3,000 Anchors Total
AIR SEALING - AT FACADE ANCHORS

Exterior

Interior

PLAN AT FACADE ANCHOR

Facade anchor every 4'-0" +/-

Continuous insulation

Continuous air barrier
AIR SEALING - AT FACADE ANCHORS

• Construction method challenges
  » Caulk: 20 years. Industry standard for keeping water out of buildings
  » Tape: 100 years. Not yet proven in industry.
  » Site Monitoring. QA/QC
# AIR SEALING - MATERIALS

## Schedule 4 | Tape Schedule

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
</table>
| T-1 | Vapor impermeable tape | 1. Windows & Door openings  
2. Inside face of exterior wall in contact with vapor barrier  
3. Inside face of exterior wall in contact with vapor barrier  
4. Interior walls adjacent to hammerhead shear walls |
| T-2 | Vapor impermeable tape | 1. CMU block (Where no liquid applied membrane is present)  
2. Inside face of exterior wall to 1st floor slab & 3rd floor slab in rooms over porch and unenclosed mechanical  
3. Inside face of exterior wall to underside of roof slab (25th & 26th floors) |
| T-3 | Vapor impermeable tape | 1. CMU Block where the masonry has an liquid applied air barrier.  
A. Floor, ceiling and corner connections @ 1st and 2nd floor north wall.  
B. Transitions in the components around the porch area  
C. Transitions in the unenclosed mechanical area at the 2nd Floor |
**Trades Affected by PH Requirements**

- **Exterior Sealing**
  - Exterior Panel Fabricator
  - Window Supplier
  - Carpenter
  - Mason
  - Caulker

- **Interior Sealing**
  - Mechanical
  - Electrical
  - Plumbing

- **Heating / Ventilation / Airside Contractor**

**Control of Scope of Work**

- Bid/Buy documents need to be sure to cover passive house requirements
- Not enough to say "follow spec"
- Contractors will exclude certain details/requirements
AIR SEALING - AIR LEAKAGE TESTING

- On-going
- Various components to be tested along the way
- Full blower door tests not possible
- Mock-up indicates very tight façade
- Components that should be spot checked throughout construction
  - Slab/wall connection
  - Windows & store front
  - Doors to rooms outside the air barrier
  - Roof/Wall connections
  - Penetrations through the facade
• Air Tightness Testing requirements for Passive House
• Large Building Test Procedures from RetroTec
• Ultimately need to create a plan for your particular building – can show Single family house vs. Cornell Resi images to make the point.

Test Configuration of Intentional Openings

<table>
<thead>
<tr>
<th>Intentional Openings</th>
<th>Test Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, doors, skylights and hatches in the bounding enclosure</td>
<td>Closed and latched</td>
<td></td>
</tr>
<tr>
<td>Doors, hatches and operable windows inside the test enclosure</td>
<td>Open</td>
<td></td>
</tr>
<tr>
<td>Fire Dampers</td>
<td>Remain as found</td>
<td></td>
</tr>
<tr>
<td>Dryer Doors</td>
<td>Closed and latched</td>
<td></td>
</tr>
<tr>
<td>AHU-1 (ERV OA) Penthouse roof 26th Floor</td>
<td>Fan off, dampers closed, sealed</td>
<td>Ventilation units run continuously, so dampers closed and sealed.</td>
</tr>
</tbody>
</table>
MOCK-UP TESTS

Pressure Sensor

Blower Door Test Set-up
Exhaust Air
Exhaust air exits the building after passing through the ERV so heat energy can be captured.

Fresh Air
Tempered supply air provided to all units in separate supply risers.

Evaporator
Indoor unit for heating and cooling; individual control

Condenser
Outdoor unit

Refrigerant
VRF TECHNOLOGY

- Super efficient, highly variable, and very responsive
- Electric system: best energy efficiencies in the industry
VERTICAL REVEAL GRILLE

Section Detail

- Horizontal Grille Fins
- 3/8" Radius
- Applied Profile

Total pressure drop required = 0.13 in H2O

Condenser Exhaust Duct

Condenser

Grille Assembly

Applied Profile Paint
- Warm champagne with metallic sparkle to match main wrap cladding material

Horizontal Grille Fins Paint
- Flat warm dark grey to match window frame color

1"
UNITIZED VS. CENTRAL VENTILATION SYSTEMS

- Exhaust Air
- Fresh Air
- ERV
VENTILATION SYSTEM

- ERV Unit to be air tight/Passive House Certified
  - Min 75% heat recovery efficiency
  - Include frost protection and humidity control
  - ≤ 35 decibels
- Utilize constant air regulating dampers to balance supply/exhaust flows to within 10% of one another
- Provide Average of 0.35 air changes/hour
- Flow rates approved by EPA and LEED for Homes
- Provide boost flow for localized humidity or pollutants
- System on emergency generator to provide fresh air in emergencies
- Timed options acceptable
VENTILATION SYSTEMS

- As the building gets bigger, ventilation has a bigger impact on energy.
- As apartment size decreases, ACH increases.
- Central systems are easier to maintain, but less able to deal with variability.
- This project:
  - Uses continuous ventilation.
  - Average of 0.35 ACH.
  - Kitchenettes = 10 CFM.
  - Baths = 25 CFM.
  - Supply = 10-20 CFM.
  - Flow rates approved by EPA and LEED for Homes.
  - ERVs connected to emergency generator.
TYPICAL OVER-VENTILATED MULTIFAMILY BUILDING

Exhaust CFM at Each Floor of a 9-story Building

- Over-ventilation (energy waste)
- Under-ventilation (Potential indoor air quality problems)
- More cfm, closer to fan
- Balancing and IAQ
- Summer Comfort

30 CFM = SWA Recommended Ventilation Rate

- Green: Bathroom Ventilation
- Blue: Kitchen Ventilation
SOLUTION: BALANCED SYSTEM WITH MINIMAL FLOW

HOW?
AIR SEALING - DUCT SEALING

Automatic Balancing Dampers:
- Provide restriction in size of opening (increase static pressure)
- Dynamically self-adjust to changes in the system (automatic balancing)

Benefits:
- Improves comfort
- Improves indoor air quality
- Increases life span of HVAC units
- Save money
- Reduces noise
- Protect the environment
OVERLAPPING OF CERTIFYING AGENCIES

- NYC Department of Buildings
- LEED NC ASHRAE 62.1
- Passive House
- LEED for Homes ASHRAE 62.2
- Energy Star
CHANGE TO THE BUILDING CODE: MECHANICAL EXHAUST SYSTEM

- Permission by DOB to combine toilet and kitchen exhaust from multiple apartments in vertical shafts, which is not typically allowed by NYC code.
- Necessary for proper balancing and operation of ERV

Section of the Code:
501.5.1. Single or combined mechanical exhaust systems from bath, toilet, urinal, locker, service sink closets and similar rooms shall be independent of all other exhaust systems, except as permitted in Section 401.5.2.

TX/KX
Exhaust air exists the building at the roof after passing through the ERV so heat energy can be captured

HEAT EXCHANGER

FRESH AIR
Tempered supply air provided to all bedrooms and living rooms in separate supply risers
ELECTRIC SUBMETERING

Direct metering

7H
6H
5H
4H
3H
2H
1H

Utility

Submetering

Cogeneration

Solar PV

DR - Genset

Master Meter

Utility

7H
6H
5H
4H
3H
2H
1H
We Offer an Entire Suite of Advanced, Enterprise-Class Solutions

- Visibility & Reporting
- Utility Bill Management
- Measurement & Verification
- Budgeting & Planning
- Building Efficiency
- Benchmarking
- Occupant Engagement
- Tenant Billing

RESIDENT INTEGRATION AND UTILITY TRANSPARENCY
RESIDENT INTEGRATION AND UTILITY TRANSPARENCY

**Total Electricity Use**

- **High:** 56,890 kWh (May)
- **Median:** 34,590 kWh (Nov)
- **Low:** 16,720 kWh (Jul)

**Summary / 2015**

- **Total Utility Costs:** $125,780
- **Total Electricity Use:** 361,800 kWh
- **Total Water Use:** 267,350 gallons
- **Total Solar PV Production:** 35,710 kWh
- **Total CO2 Emissions:** 160,140 lbs CO₂

**Total Water Use**

- **Total Use:** 66,830 gal
- **Total Spend:** $3,550
- **Compared to Expected:** +2%
RESIDENT INTEGRATION AND UTILITY TRANSPARENCY

buildingOS

building spaces tenants
### Cornell

#### Specific building demands with reference to the treated floor area

<table>
<thead>
<tr>
<th></th>
<th>Treated floor area</th>
<th>Requirements</th>
<th>Fulfilled?*</th>
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</thead>
<tbody>
<tr>
<td><strong>Space heating</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Heating demand</td>
<td>3.69 kBTU/(ft² yr)</td>
<td>78% of 4.75 kBTU/(ft² yr)</td>
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<tr>
<td>Heating load</td>
<td>4.13 BTU/(hr*ft²)</td>
<td>130% of 3.17 BTU/(hr*ft²)</td>
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<tr>
<td><strong>Space cooling</strong></td>
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<td></td>
</tr>
<tr>
<td>Overall specific space cooling demand</td>
<td>4.87 kBTU/(ft² yr)</td>
<td>90% of 5.39 kBTU/(ft² yr)</td>
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<tr>
<td>Cooling load</td>
<td>2.97 BTU/(hr*ft²)</td>
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<td>-</td>
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<tr>
<td>Frequency of overheating (&gt; 77 °F)</td>
<td>%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Primary energy</strong></td>
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<td></td>
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<tr>
<td>Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances</td>
<td>37.4 kBTU/(ft² yr)</td>
<td>99% of 38.0 kBTU/(ft² yr)</td>
<td>yes</td>
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<tr>
<td>DHW, space heating and auxiliary electricity</td>
<td>15.9 kBTU/(ft² yr)</td>
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<tr>
<td>Specific primary energy reduction through solar electricity</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Airtightness</strong></td>
<td></td>
<td>0.6 1/h</td>
<td>yes</td>
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</table>

* empty field: data missing; *: no requirement

**Passive House?**

**yes**
TIMELINE TO CERTIFICATION

Register Project
- Project Approval
  - Develop Model
    - Model Approval
      - Construction Oversight
        - Blower Door Test
          - Power Usage Test
            - CERTIFICATION
THANK YOU