McKinlock Hall is the second House to undergo renovation as part of the House Renewal project at Harvard University. The House Renewal project consists of the renovation of the twelve undergraduate dormitories. It began in 2007 and is anticipated to take over 15 years. The purpose of this renovation is to upgrade the facility to meet current code, accessibility, and sustainability standards with the goal of allowing it to meet the needs of the university for the coming 75 years.

The project team took a close look at the sustainable measures implemented as part of the Stone Hall project (the first project as part of House Renewal) and adopted several strategies including rainwater collection to supplement irrigation; efficient wall and roof insulation; and replacing single-paned windows with double-paned. In addition, the project built upon those strategies implemented in Stone Hall and created an estimated 10% more efficient building.
**PROJECT HIGHLIGHTS - VARIABLE REFRIGERANT FLOW**

A variable refrigerant flow (VRF) system is a type of energy efficient mechanical system that provides heating, cooling, and/or ventilation. The system consists of five main components: a condenser, compressor, branch controller, refrigerant, and evaporator(s). One of the advantages of VRF systems over traditional mechanical systems is the size of the refrigerant lines are much smaller than ductwork. This is particularly helpful in existing building such as McKinlock Hall where existing conditions made it difficult to locate ductwork.

The compressor motor in a VRF system is a variable speed. This enables the system to efficiently perform when only part of the load is required. If the system is in heating mode, then the condenser takes in heat energy from the outside air, transfers it to the refrigerant medium, the branch controller distributes the refrigerant to evaporator units located in the interior spaces, and the heat energy is used to heat the spaces. In cooling, the opposite occurs—the evaporators absorb heat energy and the condenser rejects the heat energy outside the building. VRF systems deliver the precise amount of refrigerant to where it’s needed. Therefore, it’s ideal over traditional reheat system where energy is wasted to reheat cool air. Some systems also has the capability to transfer heat from one zone to another if heating is required in one zone and cooling is required in another, or visa versa. The refrigerant bypasses the condenser and the branch controller redistributes the refrigerant to where heating or cooling is required. This saves energy that would typically be used to run the condenser.

VRF systems are ideal for multi-family units, schools, and office buildings where zoning control is required. VRF systems aren’t ideal for spaces that require 100% outside air or spaces with high latent loads. VRF systems were used in electrical, intermediate distribution frame (IDF), and main distribution frame (MDF) rooms as part of the McKinlock Hall project. Low ambient kits allow the system to operate at 100% cooling capacity at reduced outdoor temperatures, which is particularly important in these types of spaces where there is a high heat concentration throughout the year.
ENERGY EFFICIENCY AND INDOOR ENVIRONMENTAL QUALITY

ENERGY EFFICIENCY

ECM 1: Demand Control Ventilation
Demand control ventilation (DCV) is a strategy that modulates the amount of outside air provided to a space based on CO2 levels. This reduces the unnecessary heating and cooling of incoming outside air when outside air isn’t required.

ECM 2: Exhaust Air Heat Recovery
High performance enthalpy heat recovery wheels are in all 100% outside air units and energy recovery ventilators are in toilet cores to recover heat from toilet exhaust.

ECM 3: Fan Coils Units with Electronically Controlled Motors
Electronically controlled motors (ECM) are more efficient than traditional PSC motors, require less maintenance due to a soft start and stop, and the life of an ECM is more than twice that of a traditional PSC motor. The fan coil units in this project have ECMs.

ECM 4: Occupancy Sensors
Occupancy sensors are installed in common spaces to turn off the lights and setback room temperatures when spaces are unoccupied. This helps save lighting, heating, cooling, and ventilation energy.

ECM 5: Displacement Ventilation
Displacement ventilation is a more efficient strategy than traditional mixing ventilation because displacement ventilation systems have higher supply air temperatures, reduce thermal loads by stratifying room air, and have increased economizer usage due to higher supply air temperatures. Displacement ventilation is used in the dining halls, common rooms, and theater.

INDOOR ENVIRONMENTAL QUALITY

IAQ 1: Demand Control Ventilation
Exposure to elevated levels of CO2 has a number of negative effects on the human body including difficulty concentrating, increased heart rate, and breathing issues. Demand control ventilation is a mechanical system control strategy that increases the amount of outside air provided to a space in order to dilute elevated levels of CO2.

IAQ 2: Displacement Ventilation
High ceilings (typically 9’ or higher) are characteristic of displacement ventilation systems and allow for the air to stratify such that the pollutants are concentrated above the breathing zone resulting in a heathier indoor environment.

IAQ 3: Low Emitting Materials
The selection of low chemical-emitting construction and finish materials was an important driving force in the design phase. The project includes low VOC adhesives, sealants, paints, coatings, and primers. All wood and agrifiber products are also free of urea-formaldehyde.
PRODUCTS AND MATERIALS

LIGHTING AND CONTROLS

- **40% reduction** in lighting power density (watts/square foot)

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definity PAR30 HO</td>
<td>Lighting Science</td>
</tr>
<tr>
<td>LED Downlight</td>
<td>BK Lighting</td>
</tr>
<tr>
<td>Square Linear Fluorescent</td>
<td>Birchwood lighting</td>
</tr>
</tbody>
</table>

- LED Lamp
- Total fixture wattage = 18 watts
- Life: 50,000 hours

- LED Fixture
- Total fixture wattage = 8 Watts
- Life: 50,000 hours

- No VOCs

ENERGY EFFICIENT APPLIANCES & WATER EFFICIENCY

- **44% reduction** in annual water use when compared to EPAct 1992 baseline standard.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual-Flush Flushometer Model WES-111</td>
<td>Sloan</td>
</tr>
<tr>
<td>Electronic Faucet Model #116.101</td>
<td>Chicago Faucets</td>
</tr>
<tr>
<td>Shower Model #1-100</td>
<td>Symmons</td>
</tr>
</tbody>
</table>

- 1.28 gallons per flush (average) vs. EPAct baseline of 1.6 gpf.
- 0.1 gallons per flush (average) vs. EPAct baseline of 0.25 gpf.
- 1.75 gallons per minute (gpm) vs. EPAct baseline of 2.5 gpm.

LOW-EMITTING MATERIALS

- **100%** of the project’s adhesives, sealants, paints, coatings, and engineered wood are low-emitting.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-flat Paint Speedhide Zero Semi-Gloss</td>
<td>PPG</td>
</tr>
<tr>
<td>Architectural Sealant Hydro Ban</td>
<td>Laticrete</td>
</tr>
<tr>
<td>Engineered Wood VESTA FR ULEF Flakeboard</td>
<td></td>
</tr>
</tbody>
</table>

- No VOCs
- No VOCs
- Meets CARB Phase II for ultra low emitting formaldehyde products

Please note that while many products are described in this project profile, these are provided for informational purposes only, to show a representative sample of what was included in this project. Harvard University and its affiliates do not specifically endorse nor recommend any of the products listed in this project profile and this profile may not be used in commercial or political materials, advertisements, emails, products, promotions that in any way suggests approval or endorsement of Harvard University.

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PROJECT SCORECARD

SUSTAINABLE SITES

- SS01 Construction Activity Pollution Prevention 1 / 1
- SS02 Site Selection 1 / 1
- SS03 Development Density and Community Connectivity 5 / 5
- SS04 Brownfield Redevelopment 1 / 1
- SS05.1 Alternative Transportation-Public Transportation Access 0 / 6
- SS05.2 Alternative Transportation-Bicycle Storage and Changing Room 0 / 1
- SS05.3 Alternative Transportation-Low-Emitting and Fuel-Effective V 0 / 3
- SS05.4 Alternative Transportation-Parking Capacity 2 / 3
- SC01 Site Development Protect of Restore Habitat 0 / 1
- SC02 Site Development Maximize Open Space 1 / 1
- SS06.1 Stormwater Design-Quantity Control 1 / 1
- SS06.2 Stormwater Design-Quality Control 0 / 1
- SC01 Heat Island Effect-Non-Roof 0 / 1
- SC02 Heat Island Effect-Roof 0 / 1
- SC03 Light Pollution Reduction 0 / 1

WATER EFFICIENCY

- WEP1 Water Use Reduction-20% Reduction Y
- WEC1 Water Efficient Landscaping 4 / 4
- WEC2 Innovative Wastewater Technologies 0 / 2
- WEC3 Water Use Reduction 4 / 4

ENERGY AND ATMOSPHERE

- EA01 Fundamental Commissioning of the Building Energy Systems Y
- EA02 Minimum Energy Performance Y
- EA03 Fundamental Refrigerant Mgmt Y
- EA04 Optimize Energy Performance 15 / 17
- EA05 On-Site Renewable Energy 0 / 7
- EA06 Enhanced Commissioning 2 / 2
- EA07 Enhanced Refrigerant Mgmt 2 / 2
- EA08 Measurement and Verification 3 / 3
- EA09 Green Power 0 / 2

MATERIALS AND RESOURCES

- MR01 Storage and Collection of Recyclables Y
- MR02 Building Reuse-Maintain Existing Walls, Floors and Roof 2 / 3
- MR03 Building Reuse-Maintain 50% of Interior Non-Structural Ele 0 / 1
- MR04 Construction Waste Mgmt 2 / 2
- MR05 Materilas Reuse 0 / 2
- MR06 Recycled Content 0 / 2

MATERIALS AND RESOURCES CONTINUED

- MC04 Regional Materials 0 / 2
- MC06 Rapidly Renewable Materials 0 / 1
- MC07 Certified Wood 0 / 1

INDOOR ENVIRONMENTAL QUALITY

- IE01 IAQ Performance 0 / 5
- IE02 Tobacco Smoke (ETS) Control Y
- IE03 Outdoor Air Delivery Monitoring Y
- IE04 Increased Ventilation 0 / 1
- IE05.1 Construction IAQ Mgmt Plan During Construction 2 / 3
- IE05.2 Construction IAQ Mgmt Plan Post-Build Occupancy 0 / 1
- IE05.3 Low-Emitting Materials-Adhesives and Sealants 0 / 1
- IE05.4 Low-Emitting Materials-Paints and Coatings 1 / 1
- IE05.5 Low-Emitting Materials-Flooring Systems 0 / 1
- IE05.6 Low-Emitting Materials-Composite Wood and Agglomerated Products 0 / 1
- IE05.7 Indoor Chemical and Pollutant Source Control 0 / 1
- IE05.8 Controllability of Systems-Lighting 1 / 1
- IE05.9 Controllability of Systems-Thermal Comfort 1 / 1
- IE07.1 Thermal Comfort Design 0 / 1
- IE07.2 Thermal Comfort Verification 0 / 1
- IE08.1 Daylight and View-Daylight 0 / 1
- IE08.2 Daylight and View-Vi 1 / 1

INNOVATION IN DESIGN

- ID01 Innovation in Design 0 / 5
- ID02 Innovation in Design 1 / 2
- ID03 Innovation in Design 0 / 1
- ID04 Innovation in Design 0 / 1
- ID05 Innovation in Design 0 / 1
- ID06 Innovation in Design 0 / 1
- ID07 Innovation in Design 0 / 1
- ID08 Innovation in Design 0 / 1
- ID09 Innovation in Design 0 / 1
- ID10 Innovation in Design 0 / 1
- ID11 Innovation in Design 0 / 1
- ID12 Innovation in Design 0 / 1
- ID13 Innovation in Design 0 / 1
- ID14 Innovation in Design 0 / 1
- ID15 Innovation in Design 0 / 1
- ID16 LEED® Accredited Professional 0 / 1

REGIONAL PRIORITY CREDITS

- SC01 Brownfield Redevelopment 1 / 1
- SC02 Stormwater Design-Quality Control 0 / 1
- SC03 Building Reuse-Maintain Existing Walls, Floors and Roof 2 / 3

TOTAL

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More Information

- Harvard Faculty of Arts and Sciences: http://www.fas.harvard.edu/home/
- Leverett House - leveret.harvard.edu

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