HBS Ruth Mulan Chu Chao Center
East Drive Boston, MA 02163
Project Profile

LEED-NC v3
Pending LEED Gold
December 2017

The Ruth Mulan Chu Chao Center (Chao Center) serves as a "Gateway" building to the HBS Executive Education precinct and provides sustainable dining, meeting, learning, and office spaces meeting HBS's emerging needs. The resulting design supports the necessities of the Executive Education program and features state-of-the-art practices in technology and sustainability. Comprising approximately 87,000 GSF across three stories, the building delivers a central Hub for Executive Education participants and the larger Harvard community to collaborate, learn, dine together, and build relationships. The project makes meaningful physical and symbolic connections with the historic HBS campus, completes the Executive Education Quad, and creates spaces that reflect the contemporary mission of the Executive Education programs and HBS.

Photo Copyright: Goody Clancy, 2016

The project team applied an integrated approach to sustainable design, which incorporated environmental strategies that influenced all aspects of the building's design. The site and landscape were designed to create a comfortable outdoor environment and reduce the use of potable water for irrigation. The energy efficient lighting system creates well-lit places for students and staff while also reducing energy consumption. The high efficiency HVAC system provides comfort, high indoor air quality, user controls, and energy conservation, while the plumbing design strategy conserves potable water use. The project design will achieve LEED Gold certification in December 2017.

LEED® Facts

Harvard Business School
Chao Center

Location	Boston, MA
Rating System	LEED-NC v3
Certification Achieved	Gold
Total Points Awarded	69/110

Sustainable Sites	23/26
Water Efficiency	5/10
Energy and Atmosphere	20/35
Materials and Resources	2/14
Indoor Environmental Quality	9/15
Innovation and Design	6/6
Regional Priority	4/4

Project Metrics

36% percent indoor water savings compared to an Energy Policy Act of 1992 baseline

57% percent of site area that is vegetated open space

37% percent reduction in total building energy costs compared to ANSI/ASHRAE/IESNA Standard 90.1-2007

54% percent reduction in annual potable water used for landscape irrigation

100% percent of workspaces have individual lighting controls

36% percent decrease in the volume of stormwater runoff from a 2-year 24-hour design storm

Project Overview

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Indoor Environmental Quality

The high indoor environmental quality of the Chao Center was a significant focus of the project. The selection of low-VOC building and finish materials as well as appropriate construction measures helped ensure a high level of indoor air quality and occupant health throughout the building. All main entryways have floor mats to help reduce contaminants brought in from the outdoors.

Other strategies to enhance the indoor environmental quality included:

- High efficiency low-mercury lighting with appropriate light levels
- Increase amount of outdoor air ventilation
- Lighting controls for individual and multi-occupant spaces
- Compliance with ASHRAE 55-2004 standard for thermal comfort
- Developing and implementing an indoor air quality management plan during construction
- Daylight and views to the outdoors for office, admin, and public gathering spaces

Project Team

Owner	Harvard Business School
Project Manager	CSL Consulting
Architect	Goody Clancy
Landscape Architect	Reed Hilderbrand Associates, Inc.
MEP Engineer	Vanderweil Engineers
Civil Engineer	Nitsch Engineering
Contractor	Lee Kennedy Company
Commissioning Authority	BR+A (Building Systems) 3iVE (Building Envelope)
Lighting Designer and Sustainability Consultant	Atelier Ten

Photo Copyright: Goody Clancy, 2016

Photo Copyright: Goody Clancy, 2016

Landscape and Site

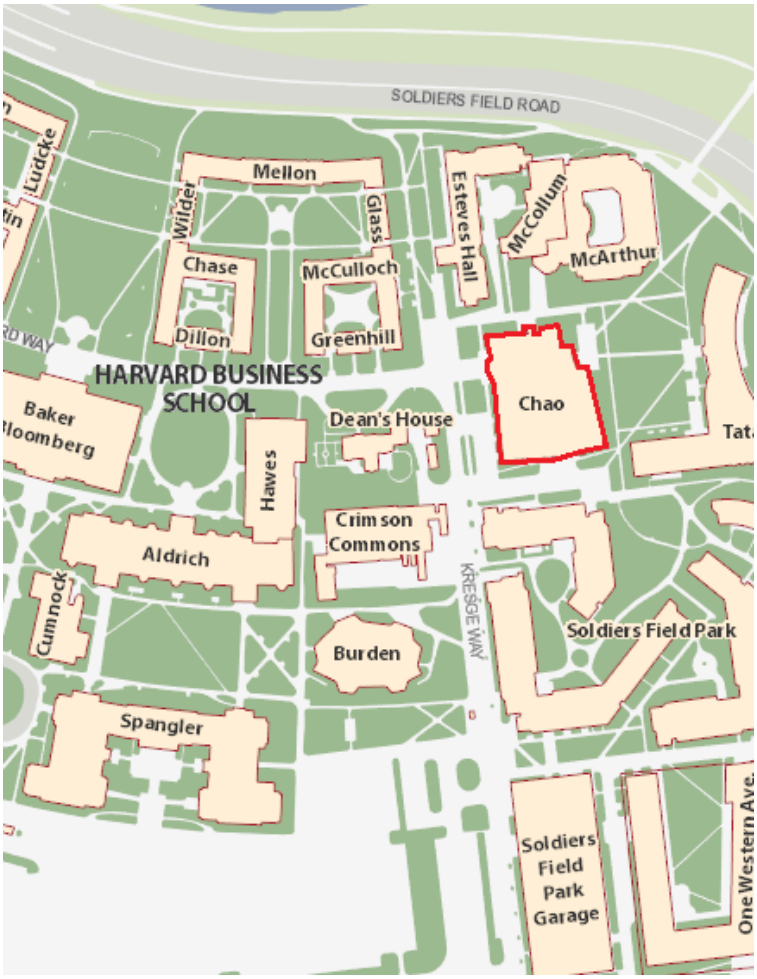
The Chao Center landscape and site were designed to provide a gathering space for the Harvard Business School campus and the surrounding community. The design is centered on reducing potable water use for irrigation, mitigating the urban heat island effect, and creating a comfortable outdoor environment.

Irrigation is controlled by the Rain Bird Maxicom system, which monitors day-to-day weather patterns via the weather station on campus and provides irrigation when needed. The rain sensor system helps reduce outdoor potable water use by 54%.

The project's site design strategy includes a mixture of hardscape and vast vegetated areas. The project also includes a green roof, which helps mitigate urban heat island effect and reduces stormwater runoff.

The Chao Center is conveniently situated in a highly transit-served area. The building is located less than a quarter mile from two bus stops, connecting the Business School to both Cambridge and Boston.

Further more, the Chao Center has been built in close proximity to a shared fuel-efficient vehicle which occupants may utilize in addition to providing access to 25 bicycle racks. The building is also equipped with shower and changing rooms.



Plumbing Systems and Potable Water Use Reduction

1.28 GPF Toilet: Copyright Sloan, 2012

0.125 GPF Urinal: Sloan, 2012

Decreasing the demand for potable water is the first step towards sustainable water management. Sinks, toilets, urinals, and irrigation systems that are designed to use less water than typical fixtures and systems are widely available and when combined with conscientious occupant use patterns and controls, can result in a large reduction in water use.

Some of the water conservation strategies incorporated in the project include:

- Low-flow plumbing fixtures (urinals: 0.125 GPF; toilets: 1.28 GPF; lavatory faucets: 0.5 GPM; pantry sinks: 1.5 GPM)
- Water efficient irrigation system

These strategies are predicted to lead to a 36% reduction in water use, compared to the EPAct 1992 baseline and plumbing code.

Energy Efficiency

ECM 1: Highly Insulated Envelope System with High Performance Glazing

ECM 2: Occupancy, Vacancy, and Daylight Sensors

ECM 3: ENERGY STAR Kitchen Equipment and Water-cooled Refrigeration Systems

ECM 4: Air Handling Unit Energy Recovery

ECM 5: Efficient Light Fixtures

ECM 6: Active Chilled Beams and Radiant Heating in Select Spaces

ECM 7: Demand Control Ventilation

ECM 8: Make-up Air Unit for Kitchen Exhaust

ECM 9: Roof-mounted Photovoltaic and Solar Thermal Hot Water Systems

The Chao Center project design includes a highly insulated envelope system with high performance glazing, which both help to decrease heating energy-usage. Cooling is provided by the existing HBS central chilled water system to new air handling units and terminal cooling equipment and includes demand control ventilation. Heating hot water is sourced from a steam plant in addition to utilizing a solar thermal hot water system for domestic hot water. The first, second, and third floors of the building are conditioned via central air handling units with energy recovery located in the penthouse mechanical room. Select spaces are also served by active chilled beams and radiant heating systems. The basement and kitchen are conditioned via a new air handling unit with the addition of a dedicated make-up air unit, bringing in tempered outside make-up air for the kitchen exhaust hoods. Furthermore, the kitchen is equipped with ENERGY STAR kitchen equipment and water-cooled refrigeration systems, resulting in additional energy savings.

Lighting is provided by a mixture of energy efficient LED and fluorescent fixtures. The lighting system consists of a Lutron networked lighting control system to serve the public spaces and the large dining venues as well as local stand alone sensors for individual rooms. Occupancy and vacancy sensors are used for automatic off control with photo sensors used along the perimeter of the building for daylight harvesting. The newly installed roof-mounted photovoltaic (PV) array provides 81.122 MWh per year, offsetting the total energy costs of the lighting system by 8%.

Photo Copyright: Goody Clancy, 2016

Photo Copyright: Goody Clancy, 2016

Products and Materials

The material selection process was driven by the goal of creating a healthy working environment that will improve occupant productivity and well-being. Materials were also selected for their high recycled content, and whenever possible, local extraction and manufacture. Local materials can be environmentally preferable because they reduce transportation energy and support local economies. These sustainable choices allowed the project to have a positive impact on both building occupants and the building industry. Implementing these strategies also allowed the following thresholds to be met:

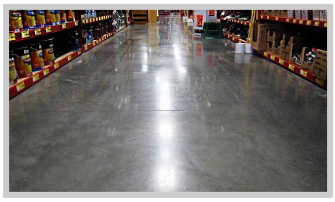
- **20%** recycled content value as a percentage of total materials cost
- **85%** of the wood used is FSC certified
- **100%** of adhesives, sealants, flooring systems, composite wood, paints and coatings are low-emitting

Ceiling Suspension System
Armstrong
Prelude Plus XL
✓ 23% post-consumer recycled content
✓ 7% pre-consumer recycled content

Rubber Flooring Adhesive
Johnsonite
965 Adhesive
✓ VOC content: 0 g/L

Interior Hardwood
Columbia Forest Products
White Maple
✓ 100% FSC certified
✓ No added urea-formaldehyde

Interior Flat Paint
N536 Ultra Spec
Benjamin Moore
✓ VOC content: 0 g/L

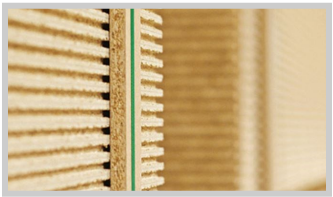


Concrete Curing Agent
Curecrete Chemical
Ashford Formula
✓ VOC content: 0 g/L

Waterproofing Sealer
9235
Laticrete
✓ VOC content: 2.39 g/L

Indoor Carpet
Illuminated Linen
Bentley Price Street
✓ Meets CRI Green Label Plus

Mineral-Based Tile Flooring
CT-1B Modern Dimensions
Dal-Tile
✓ FloorScore Certified



Particle Board
Uniboard
NuGreen
✓ No added urea-formaldehyde

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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If printing is required, please print double sided and recycle when finished. Thank you!

HARVARD RECYCLES

Project Scorecard

SUSTAINABLE SITES	23 OF 26
SSp1 Construction Activity Pollution Prevention	Y
SSc1 Site Selection	1 / 1
SSc2 Development Density and Community Connectivity	5 / 5
SSc3 Brownfield Redevelopment	1 / 1
SSc4.1Alternative Transportation-Public Transportation Access	6 / 6
SSc4.2Alternative Transportation-Bicycle Storage and Changing Room	1 / 1
SSc4.3Alternative Transportation-Low-Emitting and Fuel-Efficient V	3 / 3
SSc4.4Alternative Transportation-Parking Capacity	2 / 2
SSc5.1Site Development-Protect or Restore Habitat	0 / 1
SSc5.2Site Development-Maximize Open Space	1 / 1
SSc6.1Stormwater Design-Quantity Control	1 / 1
SSc6.2Stormwater Design-Quality Control	1 / 1
SSc7.1Heat Island Effect, Non-Roof	0 / 1
SSc7.2Heat Island Effect-Roof	1 / 1
SSc8 Light Pollution Reduction	0 / 1

WATER EFFICIENCY	5 OF 10
WEp1 Water Use Reduction-20% Reduction	Y
WEc1 Water Efficient Landscaping	2 / 4
WEc2 Innovative Wastewater Technologies	0 / 2
WEc3 Water Use Reduction	3 / 4

ENERGY AND ATMOSPHERE	20 OF 35
EAp1 Fundamental Commissioning of the Building Energy Systems	N
EAp2 Minimum Energy Performance	Y
EAp3 Fundamental Refrigerant Mgmt	Y
EAc1 Optimize Energy Performance	13 / 19
EAc2 On-Site Renewable Energy	4 / 7
EAc3 Enhanced Commissioning	0 / 2
EAc4 Enhanced Refrigerant Mgmt	0 / 2
EAc5 Measurement and Verification	3 / 3
EAc6 Green Power	0 / 2

MATERIALS AND RESOURCES	2 OF 14
MRp1 Storage and Collection of Recyclables	Y
MRc1.1Building Reuse-Maintain Existing Walls, Floors and Roof	0 / 3
MRc1.2Building Reuse - Maintain 50% of Interior Non-Structural Ele	0 / 1
MRc2 Construction Waste Mgmt	2 / 2
MRc3 Materials Reuse	0 / 2
MRc4 Recycled Content	0 / 2

MATERIALS AND RESOURCES	CONTINUED
MRc5 Regional Materials	0 / 2
MRc6 Rapidly Renewable Materials	0 / 1
MRc7 Certified Wood	0 / 1

INDOOR ENVIRONMENTAL QUALITY	9 OF 15
IEQp1 Minimum IAQ Performance	Y
IEQp2 Environmental Tobacco Smoke (ETS) Control	Y
IEQc1 Outdoor Air Delivery Monitoring	0 / 1
IEQc2 Increased Ventilation	1 / 1
IEQc3.1Construction IAQ Mgmt Plan-During Construction	1 / 1
IEQc3.2Construction IAQ Mgmt Plan-Before Occupancy	0 / 1
IEQc4.1Low-Emitting Materials-Adhesives and Sealants	1 / 1
IEQc4.2Low-Emitting Materials-Paints and Coatings	1 / 1
IEQc4.3Low-Emitting Materials-Flooring Systems	1 / 1
IEQc4.4Low-Emitting Materials-Composite Wood and Agrifiber Products	0 / 1
IEQc5 Indoor Chemical and Pollutant Source Control	1 / 1
IEQc6.1Controllability of Systems-Lighting	1 / 1
IEQc6.2Controllability of Systems-Thermal Comfort	0 / 1
IEQc7.1Thermal Comfort-Design	1 / 1
IEQc7.2Thermal Comfort-Verification	1 / 1
IEQc8.1Daylight and Views-Daylight	0 / 1
IEQc8.2Daylight and Views-Views	0 / 1

INNOVATION IN DESIGN	6 OF 6
IDc1.1 Occupant Education Program	1 / 1
IDc1.1 Innovation in Design	0 / 1
IDc1.2 Low Mercury Lighting (per LEED EB:O+M v2009)	1 / 1
IDc1.2 Innovation in Design	0 / 1
IDc1.3 Innovation in Design-Green Cleaning Policy/Program	1 / 1
IDc1.3 Innovation in Design	0 / 1
IDc1.4 Exemplary Performance: SD-Maximize Open Space	1 / 1
IDc1.4 Innovation in Design	0 / 1
IDc1.5 Innovation in Design	0 / 1
IDc1.5 Innovation in Design	1 / 1
IDc2 LEED® Accredited Professional	1 / 1

REGIONAL PRIORITY CREDITS	4 OF 4
SSc3 Brownfield Redevelopment	1 / 1
SSc6.1Stormwater Design-Quantity Control	1 / 1
SSc7.2Heat Island Effect-Roof	1 / 1
EAc2 On-Site Renewable Energy	1 / 1

TOTAL	69 OF 110

Project Highlights: Photovoltaic and Solar Hot Water Systems

One of the Chao Center's key sustainability features is the installation of a photovoltaic (PV) array. The rooftop system is designed to generate an estimated 81.122 MWh per year, which is the equivalent to $10,984 in utility cost savings. The PV system is predicted to offset 8% of the Chao Center's annual energy cost and reduces greenhouse gas emissions by 25.635 MTCDE per year.

Another one of the Chao Center's key sustainability features is the utilization of a solar thermal hot water system shared with Esteves Hall. The solar thermal system uses energy provided by the sun and transfers this energy to create domestic hot water through the use of 28 'direct flow' style evacuated tube collectors. The hot water system is installed on Baker Hall, but the collection tank is located in a central vault, thus allowing both buildings to utilize this hot water. In total, the system can store up to 1,560 gallons of solar thermal hot water. It is estimated the system will generate enough energy to lower steam usage by 2701.2 Therms annually, which is equivalent to a reducing GHG emissions by 14.366 MTCDE. This system is an excellent way to lower energy consumed for domestic hot water.

More Information

- Harvard Business School: http://www.hbs.edu/Pages/default.aspx
- HBS Sustainability: http://www.hbs.edu/about/campus-and-culture/Pages/commitment-to-sustainability.aspx
- Harvard—Green Building Resource: http://www.energyandfacilities.harvard.edu/green-building-resource
- Harvard—Green Building Services: http://www.energyandfacilities.harvard.edu/project-technical-support/capital-projects/sustainable-design-support-services