HARVARD
Faculty of Arts and Sciences

GREEN
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Nocera Lab
12 Oxford Street, Cambridge, MA
Project Profile

LEED CI v3.0
GOLD

Laboratories are typically regarded as an energy intensive building typology. Many of these buildings have extended occupancy periods, energy intensive equipment and machinery, and in some cases, strict air quality code requirements (high air changes per hour). These factors contribute to a high average energy use intensity value (National Average EUI of 370 kBtu/SF/year). Additionally, some laboratories consume significant amounts of water through process and HVAC equipment use. Nevertheless, there are many strategies that can be employed to make laboratories more energy and water efficient as well as healthy and productive spaces with minimal environmental impact. The Nocera Lab is a great example of the successful implementation of these strategies.

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The Nocera Lab project consisted of the renovation of the existing Corey Laboratories located on the third floor of the James Bryant Conant Laboratory and the adjacent bridge space. Additionally, a new laser lab was added to the basement of the adjacent Edward Mallinckrodt Chemical Laboratory for a total of 12,304 gross square feet of renovation work. The renovation included a new lab space, instrumentation facility, chemical storage room, glove box room, cold room, seminar room, write up spaces, and a kitchenette facility. The Laser Lab renovation included the addition of four laser benches, a small prep lab, and a small office. The project's goals were to create high performance lab spaces that optimize the indoor environment, reduce resource consumption, and reduce the overall impact on the environment.

The project team was committed to sustainability from the onset and followed the Harvard Green Building Standards to make more informed decisions. These standards led to the inclusion of a number of progressive design strategies to meet aggressive energy targets and reduce water use without significant additional cost. The project achieved LEED-CI v3 Gold certification in August 2014.

LEED® Facts

Harvard University
Nocera Lab

Location	Cambridge, MA
Rating System	LEED-CI v3
Certification Anticipated	Gold
Total Points Anticipated	75/110
Sustainable Sites	17/21
Water Efficiency	11/11
Energy and Atmosphere	20/37
Materials and Resources	7/14
Indoor Environmental Quality	11/17
Innovation and Design	6/6
Regional Priority	3/4

Project Metrics

43% reduction in water use below code maximum

100% of the eligible equipment and appliances by rated power are ENERGY STAR certified

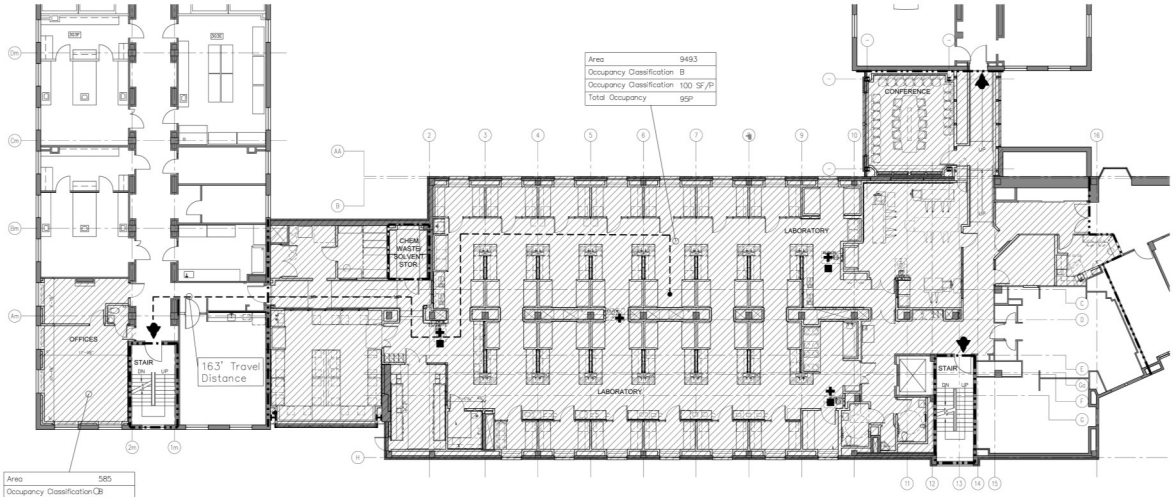
100% of individual and shared multi-occupant spaces have lighting controls

14% reduction in lighting power density

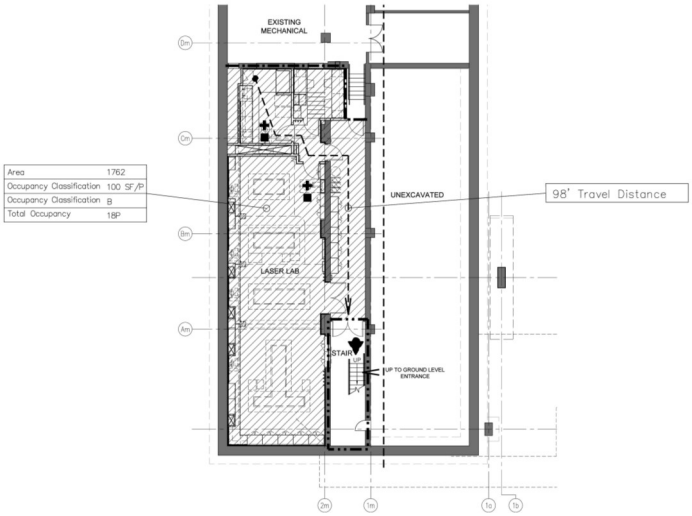
56% of offices have thermal comfort controls

100% of the project's adhesives, sealants, and flooring systems are low-emitting

PROJECT HIGHLIGHTS



1 THIRD FLOOR LAB PLAN - CONANT
3/32" = 1'-0"



2 BASEMENT LASER LAB PLAN - MALLINCKRODT
3/32" = 1'-0"

Key Sustainability Features:

- Revitalizing an existing space
- Energy efficient HVAC systems
- Extensive energy efficient lighting and daylighting design strategy with occupancy sensors, efficient fixtures, and controls
- Comprehensive water conservation measures including low-flow plumbing fixtures and water efficient lab process equipment
- Healthy, productive, creative lab spaces

Photo: copyright Ellenzweig, 2013

PROJECT TEAM

Owner	Harvard University
Project Manager	Harvard FAS Capital Project Management
Architect	Ellenzweig Associates
MEP Engineer	BR + A
Contractor	JBM General Contract
Commissioning Authority	Harvard Green Building Services
Sustainability Consultant	Harvard Green Building Services

ENERGY EFFICIENCY AND INDOOR ENVIRONMENTAL QUALITY

MECHANICAL SYSTEMS

ECM 1: Variable-Frequency Drives (VFD)

ECM 2: Occupancy sensors for HVAC setbacks

ECM 3: HVAC controls incorporated into BAS

ECM 4: Fume hoods with VAV capabilities

ECM 5: Heat recovery of exhaust air streams

The HVAC system serving the Conant building had to be modified to accommodate the increased demands from the Nocera Lab renovation project. The capacity of the existing 35,000 CFM, constant volume air handling unit (AHU) was increased and new hood exhaust fans were installed on the roof in the new mechanical penthouse. HVAC improvements to the space also included the modification of an existing AHU currently serving other areas in the building into a dedicated unit only serving the Nocera Lab. A new 7,500 CFM AHU unit was provided to support the laser lab. New fan coil units (FCU) with hot and chilled water coils will condition perimeter areas and offices. Most of the FCUs process 100% re-circulated air, with make-up air ducted directly to the offices.

Controls and variable-frequency drives (VFD) were also included in the HVAC system design to further improve efficiency. The VFDs are capable of modulating load based on occupancy patterns and demands and can significantly reduce energy use. These improvements will allow the existing AHU to operate as a variable air volume (VAV) system. The supply variable volume terminal units will track the fume hood variable volume terminal units via the building automation system (BAS) in order to maintain laboratory pressurization.

Photo: copyright Harvard Green Building Services, 2013

The HVAC system controls were also upgraded as part of the project and were connected to the base building's automation control system. Carbon dioxide (CO_2) monitoring controls were installed in the conference rooms to control the fan coil units serving the spaces and maintain a high indoor air quality. If the CO_2 level in the room is greater than 700ppm or the occupancy sensor senses an occupant in the room or the room temperature is greater than +/- 5° F from the setpoint, then the Occupied Mode will be activated and the FCU will run for a minimum of 60 minutes. If the CO_2 level is less than 500ppm, the room temperature is not greater than +/- 5°F from the setpoint, and the occupancy sensor does not detect any occupants, then the system will enter Unoccupied Mode and the FCU will be shut off. Other energy reduction strategies include:

- Separate metering for exhaust to allow for accurate assessment of energy consumption patterns and demand
- Improved building envelope glazing
- Real-time CFM displays at main points of entry into the lab space to encourage the closure of fume hood sashes, and consequently, reduce ventilation rates and energy demand
- High efficiency elevator equipment

Even though the capacity of the HVAC system was increased, the system upgrades are expected to significantly reduce the average demand for ventilation, exhaust, and overall energy use.

ENERGY EFFICIENCY AND INDOOR ENVIRONMENTAL QUALITY

LIGHTING AND ELECTRICAL SYSTEMS

The Nocera Lab space is expected to be occupied for extended periods throughout the year, therefore, it is crucial that the energy reduction strategies also focus on reducing lighting energy. The lighting system was designed to not only reduce energy use, but also to improve in the indoor environmental quality of the space and provide optimal lighting. Some of the strategies employed include:

- Reduce lighting power density by 14% below the ASHRAE 90.1 baseline standard
- High performance T8 lamp fixtures for office spaces (35 foot candles)
- High performance T8 lamp fixtures and recessed linear fluorescent parabolic down lights for the lab spaces (75 foot candles)
- Ceiling mounted occupancy and daylighting sensors capable of managing lighting setbacks for perimeter write up spaces, offices, and conference room
- Lighting controls with multiple lighting levels to provide adequate illumination for a higher indoor environmental quality
- LED exit signs

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PLUMBING SYSTEMS AND POTABLE WATER USE REDUCTION

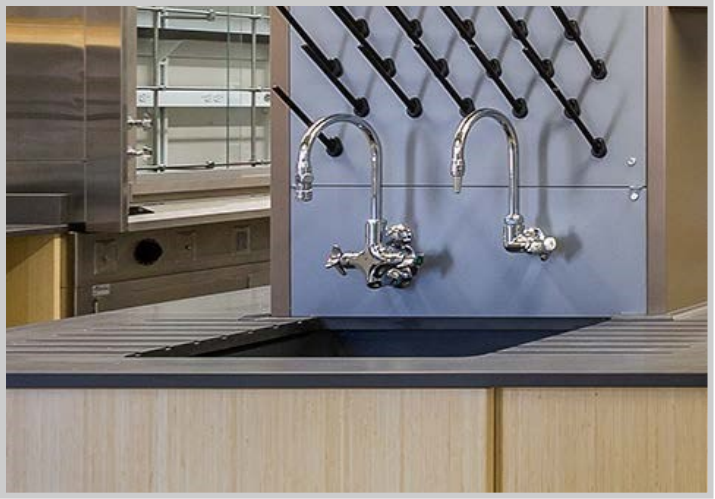

Photo: copyright Ellenzweig, 2012

The plumbing system for the Nocera Lab was also designed to reduce resource consumption, specifically potable and process water use. Potable water use was reduced by incorporating low-flow fixtures in the space. In the bathrooms, 0.5 gpm lavatory faucet aerators and WaterSense labeled toilets were installed, while the labs spaces included low-flow lab sink faucets. These plumbing fixtures reduced water use in the space by over 40% when compared to the baseline plumbing fixtures required by code.

In order to further reduce water consumption, water efficient process equipment was installed in the lab. Typical process equipment applies “once-through” cooling, which discharges the water after it is used to cool the system, which is a major source of water consumption. For the Nocera Lab, a closed loop glycol cooling system replaced the once-through domestic water system in the main lab. Recirculating the cooling fluid significantly reduces water consumption and makes the process equipment more efficient and sustainable.

PRODUCTS AND MATERIALS AND INDOOR ENVIRONMENTAL QUALITY

Plyboopure Bamboo Plywood

- 100% FSC certified wood
- 100% rapidly renewable

Dal-Tile Ceramic Tile

- 33.7% pre-consumer recycled content
- Floorscore certified
- Low VOC content

Sherwin-Williams Latex Primer

- No VOCs

One of the overall project goals was to ensure that all materials and products installed provide as little impact to the environment as possible. In order to achieve this, the project team selected materials with high percentages of recycled content, materials that were harvested and manufactured within 500 miles of the site, and wood products that were certified by the Forest Stewardship Council (FSC). During the construction phase of the project, a construction waste management program was implemented to sort and redirect construction and demolition debris. 86% of the debris was diverted from a landfill.

Material selection also played a significant role in maintaining a high indoor environmental quality in the lab spaces. Adhesives, sealants, and flooring systems with low or no VOC content were installed in the project. During the construction phase, additional measures were taken to ensure a healthy environment for the future building occupants. The project team developed and implemented a comprehensive indoor air quality (IAQ) management plan. Some of the strategies included:

- Filtration media used on HVAC equipment during construction was replaced prior to the building being occupied
- Contaminant source control
- Regular cleaning and housekeeping, including ventilation equipment
- Pre-occupancy flush-out

KEY HIGHLIGHTS

13% of the materials contain recycled content

65% of the materials were manufactured within 500 miles of the project site

76% of the new wood is Forest Stewardship Council (FSC) certified

86% of waste materials were diverted from landfills

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.

PROCESS AND LESSONS LEARNED

One of the challenges faced by the project team was finding a balance between reducing the laboratory's energy use while maintaining a safe lab environment. This required that all energy conservation measures be evaluated for potential safety concerns for the building occupants. The team had to develop creative solutions to maximize the use of daylight and fresh air, while maintaining rigorous safety standards. Achieving this sustainable balance required applying an integrative design approach early in the design process, with input and feedback from all project team members. Green building design charrettes were among the tools and strategies used to address sustainability guidelines early in the design process.

Rigorous analysis was also a critical component in the energy conservation measure selection process. Harvard's Life Cycle Costing calculator was used as a design tool to determine the 20 year life cycle impact of potential energy conservation measures. The Nocera Lab project used life cycle costing to evaluate and vet the exhaust heat recovery system, LED lighting, and daylighting strategies for the interior lab spaces.

The project team also developed strategies for operations and maintenance as well as for occupant engagement for when the space became occupied. Engaging future users and the building operations staff during the design phases would ensure that the finished space would meet their needs. Some of the strategies implemented included:

- Provide metering and feedback for occupants to encourage sustainable habits
- Provide submetering to enable potential competitions amongst other research groups at Harvard
- Develop signage highlighting and instructing occupants of the use of equipment within their space
- Provide training for both building management and occupants on the proper operation of the project's HVAC, electrical, and water systems

The Nocera Lab project is a clear example of how Harvard's Green Building Standards and an integrative design process can lead to a high performance space that not only reduces resource consumption, but also creates a healthy and high quality space conducive to research, collaboration, and innovation.

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MORE INFORMATION

- Harvard Faculty of Arts and Sciences: http://www.fas.harvard.edu/home/
- Nocera Lab: nocera.harvard.edu/Home
- Harvard - Green Building Resource: http://www.energyandfacilities.harvard.edu/green-building-resource
- Follow Green Building Services: http://www.facebook.com/HarvardGBS or @Harvard_GBS