A. General Information

Studio Guidelines:

The Department of Architecture at UMass Amherst has a vibrant and engaging studio culture that emphasizes mutual respect, professionalism, and shared responsibilities among students, faculty, administrators and practitioners. For more information about the policy, please visit: https://www.umass.edu/architecture/content/umass-amherst-studio-culture-policy.

Please read this document and be familiar with the guidelines.
B. Course Description

*What is this course about?*

This graduate design studio is intended to develop students’ skills in designing high-performance, carbon-neutral, resilient buildings. The course is structured to allow students to incorporate sustainable design strategies, and to investigate methods for improving energy efficiency and meeting net-zero energy goals. The studio will focus on a redevelopment project in East Boston, Massachusetts, where students will be designing a new Resiliency Research and Education Center. This mixed-use building is envisioned as the region’s dedicated multidisciplinary research center for resilience and sustainability issues, as well as education and community outreach activities. The studio has been selected to participate in the Architecture2030 Challenge Curriculum Project, therefore, we will be collaborating with this organization throughout the semester. The students will learn about the advances in technology, sustainable and high-performance building systems, building simulations and energy modeling, high-performance building envelopes, as well as novel ways to represent their ideas and design.

Students will address these following questions:

- What are the appropriate design strategies for high-performance mixed-use buildings?
- How to integrate passive sustainable design strategies and advanced building technologies/renewable energy systems to design carbon-neutral buildings?
- What are the appropriate design strategies for revitalization of urban environments?

Early weeks of the studio will focus on site analysis and programming. Students will be expected to develop concepts and visual representations of their designs, and proceed with schematic design during the middle part of the semester. Mid-term review will be scheduled to provide feedback and direction for next stages of the design. The last part of the semester will focus on design development, energy modeling, and preparation of the documentation for final review.

C. Course Objectives

*What can I expect to learn by studying this course?*

- Research methodologies
- Site analysis
- The role of precedents and case studies
- Programming
- Design of mixed-use buildings (research centers and educational buildings)
- Emerging building technologies
- Advanced building systems and new construction materials
- Digital design skills and software programs, especially focusing on building performance analysis and energy modeling
- Development of design communication skills through written, verbal, 2D and 3D formats.
D. Learning Activities

What opportunities does the course provide for me to learn? What will I be expected to do?

The primary activity of the studio will be to examine sustainable and resilient design strategies for mixed-use research and education building, as well as methods for urban revitalization. There will be opportunities for individual work and for team collaborations. Studio time will be used to share research and analysis, and to work with instructor and peers to continue and advance individual and team designs. Work will be reviewed and discussed in individual desk critiques, informal pin-up sessions and more formal final reviews in the studio.

Class discussions, readings and written responses will supplement the studio work.

E. Assessment

How will my learning in this course be assessed?

Assessments will be based on the ability to define and creatively resolve design situations and to expand the project into the technical aspects and prepare design documentation. Grades will also be a reflection of the level of intensity of performance, which is expected to be at the professional entry level in the field of architecture.

Assignments: Assignments will generally be due every two to three weeks and grades will be given for each assignment. It is important that assignments be handed in on time. Late work will result in deducted points. In the case of outstanding circumstances, please email the instructor before the assignment deadline.

Participation: Participation is required and will be individually noted throughout the semester. Attendance is mandatory except when announced by the instructor. After three (unexcused) absences a letter grade is deducted for each additional absence. Please email the instructor promptly to explain any absences.

Mid-term Review: Mid-term review will be scheduled to discuss design concept, progress and further design steps. Students will be expected to clearly communicate their design concepts via digital or physical models, perspectives, plans, elevations, sections, site plans and other necessary design information.

Final Review: Final review will be scheduled to review design development and documentation. Students will be expected to produce high-quality presentation material describing their designs using multiple digital and analog media. Students will be expected to clearly communicate their designs, and include site analysis, plans, sections, elevations, section, physical and digital models, material selection, and systems.

Grade Distribution:

- Assignments: 20%
• Participation: 10%
• Mid-term Review: 20%
• Final Review: 50%.

*Please review the Department of Architecture Student Guidelines for detailed grading criteria.

F. Instructional Materials

What materials will I need for this course?

Reading

Recommended texts:


Equipment and Materials

Basic drawing, modeling, drafting, model making supplies and equipment are required for this studio. Laptops and other equipment for digital design process are also required.

Please use caution when using and manipulating ALL materials. Read health and safety literature supplied with purchases. Aerosol sprays and solvents may not be used in the studio. Exercise caution when cutting materials with sharp blades!

Department of Architecture Lecture Series

Students are required to attend Department of Architecture Lecture Series. Please visit Department’s website for full schedule, dates and times of lectures.

G. Documentation of Work

BE SURE TO DOCUMENT YOUR WORK FOR YOUR PORTFOLIO.

YOUR ORIGINAL PROCESS AND FINAL WORK WILL BE COLLECTED DURING AND AT THE END OF THE SEMESTER AND WILL BE ARCHIVED FOR THE ACCREDITATION PROCESS. IN ADDITION, AT THE END OF THE SEMESTER EACH STUDENT MUST SUBMIT A CD WITH HIGH RESOLUTION DOCUMENTATION OF ALL WORK INCLUDING SCANS OR DIGITAL COPIES OF ALL 2D AND 3D DIGITAL DOCUMENTS. THIS WORK MUST BE NEATLY ORGANIZED AND LABELED ACCORDING TO ASSIGNMENT AND DATE.
**H. Course Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
</tr>
</thead>
</table>
| 1: 1/23 to 1/27 | Introductions  
Project introduction  
Assignment 1: Case studies  
(sustainable and net-zero energy buildings) | Desk critiques                                       |
| 2: 1/30 to 2/3  | Assignment 1 due on 1/30                                                | Assignment 2: Site analysis,  
program analysis, code analysis,  
concept development                                      |
| 3: 2/6 to 2/10  | Desk critiques                                                         | Desk critiques                                       |
| 4: 2/13 to 2/17 | Desk critiques                                                         | Desk critiques                                       |
| 5: 2/20 to 2/24 | No class (Presidents' Day Holiday)                                     | Assignment 2 due on 2/22  
Assignment 3: Schematic design documents (plans, sections,  
elevations, perspectives for Mid-term Review) |
| 6: 2/27 to 3/3  | Desk critiques and schematic design documentation                     | Desk critiques and schematic design  
documentation                                           |
| 7: 3/6 to 3/10  | Desk critiques and schematic design documentation                     | Desk critiques and schematic design  
documentation                                           |
| 8: 3/13 to 3/17 | Spring break                                                          | Spring break                                          |
| 9: 3/20 to 3/24 | Preparation for Mid-term review                                       | Mid-term Review  
(Assignment 3 due on 3/22)                             |
| 10: 3/27 to 3/31 | Assignment 4: Energy modeling for schematic design/design development | Desk critiques                                       |
| 11: 4/3 to 4/7  | Desk critiques                                                         | Desk critiques                                       |
| 12: 4/10 to 4/14 | Desk critiques                                                         | Assignment 4 due on 4/12  
Assignment 5: Design development documentation (plans, sections,  
elevations, perspectives, plans indicating building systems, written  
documentation, models) |
| 13: 4/17 to 4/21 | No class (Patriot's Day Holiday), class meets on Tuesday, 4/18         | Desk critiques and design development                |
| 14: 4/24 to 4/28 | Desk critiques and design development                                 | Desk critiques and design development                |
| 15: 5/1 to 5/5  | Preparation for Final review (Last day of classes)                     | Final review                                          |

*schedule subject to change*
University of Massachusetts Amherst
Department of Architecture

ARCH-DES 601-1 / Graduate Design Studio IV / Spring 2017

Project Overview: Resiliency Research and Education Center, East Boston

The purpose of this project is to investigate sustainable and resilient design strategies for carbon-neutral buildings, as well as revitalization of urban environments. Students will be designing a new, mixed-use building, dedicated to interdisciplinary resiliency and sustainability research, as well as educational and community outreach activities. Students will be taking into account environmentally conscious design, energy-efficiency strategies, passive and active design methods, advanced building systems and renewable energy sources.

The building site is located in East Boston, surrounded by Marginal St. on the north side, Piers Park on the east, Bremen St. on the west and the Boston Main Channel on the south.

Students will be expected to perform site analysis, program and building code analysis at the beginning of the course. Then, a design concept should be developed, taking into account programmatic elements and passive sustainable design strategies.

During the schematic design, students will identify spatial arrangement and organization of the program, structural grid, building envelope, treatment of the site, as well as MEP building systems and their integration with architecture. Students will be expected to produce plans, sections, elevations, physical and digital models, diagrams, and will be expected to use simulation tools. Following feedback and critique from the instructor, students will develop energy model of their design (using eQuest or other energy modeling software). Students will develop two energy models—baseline building and alternative design, which should investigate the effects of energy-efficient design strategies (improved thermal performance of building envelope, daylight strategies, and energy efficient HVAC systems). Based on the results, students will engage in design development, and will also investigate methods for meeting net-zero energy goals through implementation of renewable energy systems. Students will also develop strategies for improving the site, such as introducing urban farming, park and an extension of East Boston Greenway.

During the design development stage, students will be expected to develop detailed plans, sections, elevations, physical and digital models, technical details, and diagrams that convey their design solutions, spatial organization, building envelope treatment, and MEP systems. Students should incorporate results of the energy modeling to improve building performance. Students should demonstrate approach and strategies for integrating the building within the site, as well as urban revitalization techniques.
Building site.
Program

<table>
<thead>
<tr>
<th>Program element</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building</strong></td>
<td></td>
</tr>
<tr>
<td>Lobby</td>
<td>1,000 SF</td>
</tr>
<tr>
<td>Café</td>
<td>3,000 SF</td>
</tr>
<tr>
<td>Auditorium</td>
<td>6,500 SF</td>
</tr>
<tr>
<td>Research laboratories</td>
<td></td>
</tr>
<tr>
<td>Collaborative laboratory</td>
<td>3,000 SF</td>
</tr>
<tr>
<td>Environmental science (12 laboratories: 2,000 SF each)</td>
<td>24,000 SF</td>
</tr>
<tr>
<td>Building science laboratory</td>
<td>6,000 SF</td>
</tr>
<tr>
<td>Fabrication laboratory</td>
<td>6,000 SF</td>
</tr>
<tr>
<td>Testing laboratory</td>
<td>6,000 SF</td>
</tr>
<tr>
<td>Flexible laboratory</td>
<td>4,000 SF</td>
</tr>
<tr>
<td>Offices</td>
<td></td>
</tr>
<tr>
<td>Administrative offices (10 offices, 100 SF each)</td>
<td>1,000 SF</td>
</tr>
<tr>
<td>Research offices (30 offices, 100 SF each)</td>
<td>3,000 SF</td>
</tr>
<tr>
<td>Collaborative/open plan office space</td>
<td>8,000 SF</td>
</tr>
<tr>
<td>Conference rooms</td>
<td></td>
</tr>
<tr>
<td>Small conference rooms (5, 200 SF each)</td>
<td>1,000 SF</td>
</tr>
<tr>
<td>Large conference rooms (2, 500 SF each)</td>
<td>1,000 SF</td>
</tr>
<tr>
<td>Classrooms (15 classrooms, 500 SF each)</td>
<td>7,500 SF</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>3,000 SF</td>
</tr>
<tr>
<td>Mechanical and service</td>
<td>10,000 SF</td>
</tr>
<tr>
<td>Bike parking</td>
<td>1,000 SF</td>
</tr>
<tr>
<td>Parking</td>
<td>5,000 SF</td>
</tr>
<tr>
<td><strong>Total (Building)</strong></td>
<td>100,000 SF</td>
</tr>
<tr>
<td><strong>Site</strong></td>
<td></td>
</tr>
<tr>
<td>Outdoor research space</td>
<td>10,000 SF</td>
</tr>
<tr>
<td>Urban farm</td>
<td>30,000 SF</td>
</tr>
<tr>
<td>Extension of East Boston Greenway</td>
<td>50,000 SF</td>
</tr>
<tr>
<td>Park</td>
<td>50,000 SF</td>
</tr>
<tr>
<td><strong>Total (Site improvements)</strong></td>
<td>160,000 SF</td>
</tr>
</tbody>
</table>
Assignment 1: Case Studies and Precedents

Case Studies

1. Students should perform research and identify three case studies (net-zero energy or extremely low energy research laboratory/educational buildings) and prepare documentation that illustrates characteristics of these buildings.

Analysis

1. Students analyze case study buildings, and identify following aspects:
   a. Building name, location, project team and year of completion
   b. Sustainable design strategies
   c. Response to site, climate, transportation and contextual aspects
   d. Building systems
   e. Daylighting strategies
   f. Building envelope treatment
   g. Employed renewable energy sources
   h. Water use
   i. Availability of actual building performance data
   j. Energy Usage Intensity (EUI)

The deliverable will be three boards, showing the results of the precedent analysis. Students should keep in mind that we will be digitally projecting, and select the size of the boards accordingly. Assignment is due on Monday, January 30.
Assignment 2: Site analysis and program development

Site analysis

1. Students should analyze project site and surrounding area, taking into account topography, orientation, climate, landscape, roads and transportation, site context and surrounding buildings.

2. Students should prepare a site plan that shows surrounding area, property lines, site topography, roads, and landscaping. Students should also create diagrams that show results of site analysis (solar position, prevailing winds, pedestrian access and movement, location of green areas/landscape, climate information, contextual aspects).

3. Students, as a team, should work on a physical model of the site. The model should include surrounding buildings, topography, waterfront and landscape. The building site can be left out, so that individual building models that will be built later during conceptual/schematic design can fit.

Program development and design concepts

1. Students should analyze building codes for Boston (2009 International Codes), taking into account building function. Particular attention should be given to egress requirements, fire protection, and ADA requirements.

2. Students should begin analyzing the given building program (for all parts of the building), and start developing bubble diagrams that indicate relationships between different spaces in the program. Students should also analyze sizes and square footage of different spaces, and begin to translate those into volumetric spaces and building massing.

3. Students should develop two basic design concepts for their building, based on the programming exercise and volumetric study, as well site analysis. Particular attention should be paid to orientation and layout of the building, solar exposure, organization of different spaces in the building, movement through the building (horizontal and vertical), potential for natural ventilation and overall form. Students should also develop strategies for site design.

4. Students should use digital and physical models to explore the building form and massing.
University of Massachusetts Amherst
Department of Architecture

ARCH-DES 601-1 / Graduate Design Studio IV / Spring 2017

Assignment 3: Schematic design

Students should begin schematic design of their project, which will continue until the Mid-term review. For the Mid-term review, students should complete the following requirements:

1. Site plan with the building massing shown, as well as schematic design of the site
2. Programming diagram, axon or section showing different spaces in the building
3. Digital model of your building and physical model that is able to fit on your site model
4. Diagrams showing sustainable design strategies (daylight, natural ventilation, renewable energy sources, water reuse and recycling if applicable, materials, etc.)
5. Floor plans for each level, which should show building core, elevators and stairs, spatial organization and program, building envelope treatment, and furniture
6. Building elevations (all four)
7. Building sections (at least two)
8. Perspectives of exterior and interior views.

The deliverable will be a minimum of three boards (24x48 in), showing the schematic design, as well as physical massing model that is able to fit on the site model. Mid-term review is scheduled for Wednesday, March 22.
Assignment 4: Energy modeling

Students should simulate and analyze energy usage of their designed buildings by using eQuest energy modeling software program. Students should:

1. Complete the simulations for the building as currently designed.
2. Then, students should identify energy efficiency measures that can be implemented to reduce the energy consumption of the building, and then students should run the simulations for the alternative design. The energy efficiency measures can include changes to building footprint, improved R-value of the walls, window-to-wall ratio, application of shading devices, improved R-value of the roof, selection of high-efficiency HVAC systems, reductions in lighting loads, modified occupancy schedules, etc.
3. Students should calculate annual energy usage for both scenarios, and should compare the results. Students should also determine Energy Usage Intensity (EUI) for their building, which is annual energy usage per area, and the units are kBtu/SF.
4. Students should prepare a report that outlines modelling strategies, inputs, results and conclusions.

The deliverable will be a report, showing the results for both design scenarios. The report should be uploaded to Udrive by April 12th. Also, students should prepare one board that summarizes energy modeling procedures, inputs and results, and present in class on Wednesday, April 12th.
Assignment 5: Design development and final review requirements

Students should continue developing their designs and prepare the following design documentation for the final review:

- Site plan indicating location of the site, transportation routes (public and vehicular), topography, urban context, waterfront, and any other information relevant to the site. The site plan should also show building massing, as well outdoor research space, extension of Greenway, urban farm and other landscaping elements
- Site analysis diagrams/concept diagrams
- Overall axonometric view (exploded axon or regular view) showing different programmatic elements (public space, research labs, offices, classrooms) and vertical circulation
- Floor plans for each level, showing building core, elevators and stairs, structural system, spatial organization, building envelope, and furniture layout
- Building elevations (all four)
- Two overall building sections
- Enlarged detailed section(s), plan and partial elevation of building facade
- Plans/diagrams showing different building systems (structural system, mechanical system, building envelope)
- Diagrams showing sustainable design strategies, results of energy modeling, and methods for achieving net-zero energy
- Diagrams showing material choices
- Perspectives of exterior and interior views
- Any other information relevant to the project.

Students should also prepare physical massing model that is able to fit within the site model.

On each board, please include your name, as well as course number and instructor's name.

Students should submit all boards (digital format) and photos of the physical models to Udrive by May 8th. Size of the board will be determined.

On Mon, May 1st, we will have desk crits in class and students should have “almost” final boards ready for instructor's review. Final review will be on Mon, May 8th, from 1 to 4 PM.
Resiliency Research & Education Center

Project Overview
Graduate Design Studio IV
Department of Architecture
University of Massachusetts Amherst
Studio Introductions

Professor: Dr. Ajla Aksamija, LEED AP BD+C, CDT

Erica Shannon
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Nisha Borgohain

Reyhane Bassamtabar

Sabrina Afrin
safrin@umass.edu | (413) 230 8760
Objective: to investigate sustainable and resilient design strategies for carbon-neutral buildings, impact of climate change, and revitalization of urban environments.

Project: a new, mixed-use building, dedicated to interdisciplinary resiliency and sustainability research, educational and community outreach activities. Students addressed environmentally conscious design, energy-efficiency strategies, passive and active design methods, advanced building systems, methods for reaching net-zero energy goals and renewable energy sources.
Site: East Boston
Architecture 2030 Curriculum Project

2030 Challenge Targets

Baseline: CBECs 2003

- 2006: -50%
- 2010: -60%
- 2015: -70%
- 2020: -80%
- 2025: -90%
- 2030: -100%

Zero Net Carbon
Process

Precedents → Code and site analysis → Schematic design → Energy modeling → Net-zero strategies → Design development

- Precedent analysis
- Sustainable and resilient buildings
- Net-zero energy buildings

- Building code analysis
- Site analysis
- Program analysis
- Concept development

- Building volume and massing
- Structure
- Spatial organization
- Passive design strategies
- Building envelope
- Site treatment

- Initial model for schematic design
- Determination of energy usage intensity (EUI)
- Second model with maximized energy saving potentials
- Established minimum EUI

- Methods for reaching net-zero goals
- Calculations for PV integrated system
- Identification of other renewable systems

- Modified building design based on energy modeling
- Detailed facade design
- Materials
- Site and landscaping
EAST BOSTON
Transportation Analysis

PUBLIC TRANSPORTATION
THE BLUE LINE RUNS DIRECTLY INTO EAST BOSTON, WITH MAVERICK STATION BEING IN CLOSE PROXIMITY TO SITE
THE GREEN LINE ALSO RUNS INTO EAST BOSTON, BRINGING PASSENGERS DIRECTLY TO LOGAN AIRPORT
OTHER MBTA ROUTES IN BOSTON INCLUDE:
RED LINE
GREEN LINE
ORANGE LINE

PEDESTRIAN + BIKE TRAVEL
EAST BOSTON GREENWAY, LOCATED NEXT TO SITE, CONTAINS SEVERAL BIKE + PEDESTRIAN PATHS THAT INTERCONNECT THROUGHOUT EAST BOSTON
BIKES ON THE MBTA BICYCLES ARE ALLOWED ON THE BLUE, GREEN, RED, ORANGE LINES AS WELL AS ON THE COMMUTER RAIL AND THE FERRY, WITH SOME EXCEPTIONS DURING BUSY HOURS

BOSTON LOGAN INTERNATIONAL AIRPORT
OPENED IN THE 1920S, THE AIRPORT ACCELSURATED 2,254 ACRES OF EAST BOSTON. IT GREATLY IMPACTED THE SURROUNDING NEIGHBORHOODS. MANY FAMILIES WERE FORCED TO LEAVE THEIR HOMES OR ADJUST TO A BUSIER AND MORE CONGESTED AREA

MBTA FERRY TRANSPORTATION
THE FERRY CONNECTS TO EAST BOSTON Via LOGAN AIRPORT BOAT FERRY DOCK, WITH A FERRY SHUTTLESERVING PASSENGERS FROM THE DOCK TO LOGAN INTERNATIONAL AIRPORT TERMINAL.

'BIG DIG' HIGHWAY SYSTEM
BOSTON'S NEW HIGHWAY SYSTEM WAS OPENED IN 2001. FOLLOWING THE CONSTRUCTION KNOWN AS THE 'BIG DIG', THE NEW HIGHWAY SYSTEM CONNECTED I-93 TO EAST BOSTON, EXPANDED I-93 TO MORE AREAS OF BOSTON

Congestion Near Site
Demographics

- Median age: 31.8
- Race & Ethnicity: 52%
- Educational attainment: 85.9%
- Language: 37.7%
- Place of birth: 28.4%
- Veteran status: 3.3%
- Male-Female Ratio: 50% - 75%
- Population Density: 1,000 - 2,999
- Unpopulated tracts

Maps and data visualizations showing median household income, 0 to 17 years, children, gender distribution, and population density for Boston Census Tracts 2010.
Climate Analysis

Temperature Data
Source: Logan Int'l Airport, Boston MA
Program

Building program
Lobby 1,000 SF, Café 3,000 SF
Auditorium 6,500 SF
Research laboratories
  Collaborative laboratory 3,000 SF
  Environmental science (12 laboratories: 2,000 SF each)
  Building science laboratory 6,000 SF
  Fabrication laboratory 6,000 SF
  Testing laboratory 6,000 SF
  Flexible laboratory 4,000 SF
Offices
  Administrative offices (10 offices, 100 SF each)
  Research offices (30 offices, 100 SF each)
  Collaborative/open plan office space 8,000 SF
Conference rooms
  Small conference rooms (5, 200 SF each)
  Large conference rooms (2, 500 SF each)
Classrooms (15 classrooms, 500 SF each)
Bathrooms 3,000 SF
Mechanical and service 10,000 SF
Bike parking 1,000 SF
Parking 5,000 SF.
Total (Building): 100,000 SF

Site program
Outdoor research space 10,000 SF
Urban farm 30,000 SF
Extension of East Boston Greenway 50,000 SF
Park 50,000 SF
Total (Site): 160,000 SF
PROJECT OVERVIEW

Located on the East Boston waterfront, the Resiliency Research and Education Center divides research and educational functions into two rectilinear masses, confined by a central public atrium wing. The majority of the building's form is oriented along the east-west axis, maximizing northern and southern exposures while minimizing the east and west. Long and narrow volumes with central circulation provide ample opportunities for passive ventilation, while maximizing natural views and daylight. All roofs are angled true south to maximize renewable solar power via PV arrays.

The building's mass timber frame structure naturally sequesters carbon, and provides a viable alternative to traditional concrete and steel construction. The research and education wings are both lifted one story off of the ground to provide resiliency against future sea level rise, and create a direct pedestrian connection between the East Boston Greenway and adjacent Piers Park. Together, the three forms rise and unfold to embrace the East Boston waterfront.
ENERGY MODELING RESULTS

01 - BASELINE DESIGN
Annual Electric Consumption = 3,054,272.00 Kwh
Annual Gas Consumption = 1,884.100 Kwh
Total Building Area = 119,450 S.F.
Total Energy Use Intensity (EU) = 49.09 Kwh / S.F.
Total Energy Reduction from Baseline = N/A

02 - OPTIMIZED DESIGN
Annual Electric Consumption = 2,754,904.67 Kwh
Annual Gas Consumption = 1,557.600 Kwh
Total Building Area = 119,450 S.F.
Total Energy Use Intensity (EU) = 39.02 Kwh / S.F.
Total Energy Reduction from Baseline = 22.18%

03 - OPTIMIZED ALTERNATE MASING
Annual Electric Consumption = 2,613,326.52 Kwh
Annual Gas Consumption = 1,718,800 Kwh
Total Building Area = 119,846 S.F.
Total Energy Use Intensity (EU) = 36.18 Kwh / S.F.
Total Energy Reduction from Baseline = 21.62%
First Floor Plan:

Structural Diagram:

Passive Strategies:

Baseline Simulation:

Building Section A