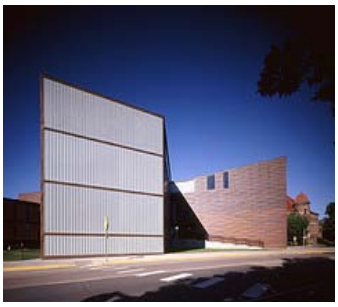
ARCH 5550 • LA 5405

Optimizing the Building/Landscape Interface

Envisioning the Sustainable Campus

Integrating carbon, energy, and water management strategies toward zero- and net-positive design






"The ruins of the unsustainable are the 21st century's frontier." - Bruce Sterling (2009)

"Now there is one outstandingly important fact regarding Spaceship Earth, and that is that no instruction book came with it."
- R. Buckminister Fuller, Operating Manual for Spaceship Earth (1963)

Exercise One: Establishing the Performance Baseline

Due: May 31, 2011, Informal Review, Room 71 @3:00 PM
Grade weighting: 30% total grade (30 points); team grade

OBJECTIVES

- To establish site and systems boundaries for your project.
- To gain an understanding of the site characteristics that will shape the design for your project towards Zero+ goals for performance and eco-effective design and to create a site inventory of your site.
- To identify the performance metrics, tools and related design targets for your project.
- To establish a complete description of the existing context, project characteristics and performance to be used as a baseline for measurement of the expected improvements of the final proposed solution.
- To identify case examples and precedents which demonstrate exemplary integration of energy, water, runoff and waste optimization strategies that are particularly relevant to your project.
- To begin to establish an holistic approach to integrated building and landscape design moving towards net-zero and zero+ performance goals.

INTRODUCTION

The Zero+ Campus Project's goal is creating the instruction book for Spaceship Earth, aka the U of MN Campus, and the first step is to determine the operating parameters for the built environment.

Universities, as research institutions and as long-term owners of property, have the opportunity—and responsibility—to explore new forms of sustainable practice. This project will link several building performance metrics (e.g., energy use, water consumption, rain water runoff and harvesting, etc.) and will seek to explore how the University of Minnesota campuses can become a model of environmental stewardship. We will begin to apply methods for evaluation and modeling of performance of rain water, biodiversity, shade and ground cover, as well as energy use of integrated buildings and landscapes – environmental factors not typically considered in the creation of the traditional performance models. Combined, these environmental factors play a significant role in the actualized performance of the

campus, and also contribute to the beauty of place. This exercise aims to create a detailed description of building and site conditions, context and performance within a selected project site and identified systems boundaries. This baseline will be used to demonstrate the potential improvement in performance that can be achieved through application of specific integrated sustainable strategies during the course of continued investigations. You will also identify recent building and landscape projects where site and building performance goals are well integrated resulting in net-zero or zero+ performance.

Defining environmental performance of landscapes and buildings is complex and difficult to measure. The choice of performance criteria is both culturally and scientifically indeterminate – like in quantum mechanics, the act of observation changes what you are measuring. There is a danger in trying to quantify the ephemeral in losing sight of bigger contextual issues informing the practice of design – if you have a hammer, everything becomes a nail - so it is important to find the right tools to use as designer. Performance Baseline in the context of our course can be defined as:

- Quantification of physical existing conditions including resource fluxes and inputs to the site/building. This approach required producing a site inventory that includes performance criteria for both the technical and ecological conditions – we have a wide range of data about specific buildings on campus including energy use, water use, occupancy, and more.

- Minimum performance criteria defined by building/zoning code (or discipline specific 'standards'), covering everything from energy use, water use, rain water runoff, percentage of impervious cover, number of parking spaces, the solar reflectance index (albedo/emissivity) of roofing or paving, biodiversity and habitat quality, site lighting, deflection and stiffness of structures, amount of insulation, air exchanges/hour, rate of air infiltration, and lots of other technical bits that get assimilated into the design process.

- Other criteria such as: life cycle analysis of embedded energy and greenhouse gas emissions, toxicity, and other environmental footprints for materials, systems, or operating practices.

- Performance baselines are not rating systems such as LEED or the Sustainable Sites Initiative, but are the foundation for these tools.

A performance baseline isn't just a snapshot of what's happening at just one moment, but a statistical look at long-term trends with multiple data points for resource fluxes. Many performance criteria are shifting in response to intentional inputs and practices, and to environmental/cultural shifts. Code-based performance standards can also include moving targets (like the Architecture 2030 challenge) to incrementally achieve better performance over time. The key to defining a valid performance baseline is that it can be applied to similar projects in across the same climate zone.

Most performance criteria need to be analyzed within a system of linkages, feedbacks, benefits and impacts. Improving the performance of one criteria may have a negative impact on other equally important metrics. Increasing the amount of glazing in a building can improve the daylighting of the interior, but also increases the heat loss in winter. Identifying such reciprocal benefits and impacts takes practice, and having a holistic understanding of the built environment which this course will help you develop.

METHODOLOGY

STEP A: IDENTIFY SITE AND SYSTEMS BOUNDARIES AND ANALYZE CONTEXT AND EXISTING CONDITIONS

1. **What are the Site and Systems boundaries of your project?** As a team, establish the critical objectives of your design investigation. Based on your preliminary review of the targeted project area and established objectives, choose a physical area and define the specific systems to be the focus of your proposed design interventions.
   You might consider:
   - *Groundwater systems*
   - *Potable and wastewater systems*
   - *Soil and nutrient cycling systems*
   - *Plant – evapo-transpiration systems*
   - *Etc.*
   - *Building structural and envelope systems*
   - *Electrical power systems*
   - *HVAC Systems*
   - *Lighting systems*

2. **What are the site characteristics that will shape your project towards Zero+ Goals for performance?**
   You might consider:
   - *Climate, Site, and Ecological Context*
   - *Critical Landscape elements and features*
   - *Traffic and Circulation patterns*
   - *Historical and cultural considerations*
   - *Available solar energy and Energy Use patterns*
   - *Etc.*
   - *Soils and Pre-settlement Vegetation*
   - *Occupancy and Building Typology*
   - *Habitat considerations*
   - *Rainfall and Water Use patterns*
   - *University standard practices*

STEP B: CREATE PERFORMANCE BASELINE

3. **What are the pertinent performance characteristics?** Collect and analyze data to determine the current and historic performance of your chosen systems, and determine the impacts of typical University standard practices. You might consider:
   - *Rainfall, Rainwater runoff and probable infiltration rates.*
   - *Water use characteristics for both building and irrigation.*
   - *Energy Use by fuel type and use (e.g. heating, cooling, lighting and equipment, etc.)*

4. **As you go through this process, seek to identify patterns and feedback systems**

Working with patterns, linkages, feedback systems, and other design parameters will be a reoccurring theme for this course.

STEP C: RESEARCH PRECEDENTS

5. **Integrated Energy and Water/ Building and Site Precedent study:** Assign at least2 precedent research tasks to each individual in your team. You might consider:
   - *Integrated Energy and Water Strategies*
   - *Net-Zero performance Goals*
   - *Integrated Building and Site design*
   - *Living Walls, arbors and trellises*
   - *Intelligent Skin concepts*
   - *Other innovative Approaches*
   - *Performance analysis methods*
   - *Innovative use of modeling tools*
   - *Energy and water performance data*
   - *Eco-services systems approach*
   - *Renewable Energy integration*

DELIVERABLES DUE: TUESDAY 5/31

All exercises will result in a written report that is to be formatted using the Zero+ Campus Project report ***Adobe InDesign*** template. Your team will be asked to present your findings as PDFs to the entire class and selected guests on the due dates. You are asked to use a consistent graphic format for all project boards and reports, please see the "Report and Board Templates" provided on the Moodle website. Please include the following information in your report:

- Create a Site Plan drawing at 1"=40' or other appropriate scale for pin-up during presentation that includes site boundaries, systems descriptions and key elements of your site inventory. Include drawing tile, North Arrow and Graphical Scale indicator.
- Your report should include a complete site inventory. Layer the following information or create additional graphics:
  - climate, precipitation, wind, pervious/impervious surfaces/infiltration zones, utilities, vegetation, drainage/topography/slopes, buildings, and more.
  - Systems descriptions, capacities, boundaries and related information
  - Analysis/quantification of the performance of these systems (include various pertinent metrics such as % impervious, estimated runoff amounts, urban heat island impacts, etc.
- Project case studies/precedents that measure your performance criteria with graphic representation and written narratives of the opportunities/constraints represented by these examples
- The performance parameters that quantify the range of criteria/inputs/outputs at a resolution appropriate to the UMN Campus
- Written report/graphics of the modeling/simulation of the baseline conditions
- Refined graphics and information from Charrette 1 (Thursday 5/26)
- Any other pertinent information

GRADING CRITERIA - Exercise 1: *30% total of grade (30 pts)*

- Depth and appropriateness of site analysis and research and relevance to project
- Clarity and accuracy of quantitative analysis charts, graphs and annotated drawings
- Clarity and accuracy of conclusions drawn