Fall 2017

Sustainable Landscape Technologies and Systems Design

11:550:442

3 credits, Lecture/Lab: Wednesday: 10:55-1:55

Department of Landscape Architecture

Rutgers, The State University of New Jersey, School of Environmental and Biological Sciences

***Fulfills Architectural Design Requirement*

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Course Description

New advancements in sustainable landscape technologies are located within the history, theory and practice of systems design. Systems design methodologies such as biomimicry, resiliency, closed-loop systems, and regenerative design have led to practice and product developments that improve sustainability performance. Lecture content and lab design studies will explore how new technologies and (often ancient) building methods can improve landscape performance in the areas of soil, water, carbon (materials), energy production/conservation, and communications (social factors).

A fundamental premise of sustainability in Landscape Architecture is the creation of a new design relationship between human and biological systems. Either inspired by the functioning of natural systems or designed as solutions to problems in the interface between human and natural systems, sustainable technologies are often characterized by their direct relationships with natural systems. These relationships range from mimicry, to modeling, restoration, regeneration and mitigation.

The overarching aim of this course is to create an understanding of the process of technological development as it relates how natural systems may operate both as model and as context for intervention by Landscape Architectural projects. A range of current sustainable technologies used in Landscape Architectural practice will be presented and engaged by experimental lab practices that locate components within larger site design and landscape systems.

Students who participate in this class will learn about the role of technology in the design and construction of landscape architectural projects. The course will begin at the larger scale of site design, considering design choices that prepare a site to function efficiently. Preliminary analytical design concepts such as siting of features, integration with existing site systems, design for energy/climate and reuse of site materials set the stage for sustainable site design. These concepts lead to the integration of specific sustainable practices and technologies in areas such as:

- **Communications**: participatory design, eco-revelatory design, maintenance, networked measurement, monitoring technologies and responsive or communicative systems such as QR code signs and interactive park features.
- **Systems**: Interdisciplinary design, biomimicry, restorative/regenerative design, and design for diverse biological communities.
- **Soils**: growing media, structural media, soil building, remediation, soils as filters
- **Water**: site water treatment for reuse, bioremediation, design for infiltration, cisterns/rain barrels and rainwater harvest, green roofs for rainwater harvest/detention, low flow irrigation, natural pools
- **Carbon**: materials and energy: site generated/harvested, reuse, recycled materials, and sustainably supplied materials such as FSC Lumber, design for deconstruction
- **Energy**: Solar technology, sites as energy generators, passive solar, heat exchangers, geothermal wells, digesters, green roof-insulation for heat retention and cooling

Course Objectives:

- Students will learn how to use nature as model for sustainable design.
- Exploration, understanding and incorporation of practical design methodologies and processes for technological development will develop the student's individual way of designing.
- Design oriented understandings of existing systems, technologies, and new processes will focus the students work on creative revision, iterative design and systems, the invention of new solutions and the identification of topics for further design research.
- Students will become able to integrate existing and proposed component technologies within overall site design and development practices.

Course Methodologies

<u>Reading</u>: Weekly readings are assigned to familiarize the student with scholarship and practical information on the subjects of the course. The readings chosen for the course are wide ranging in theme and difficulty. The student is expected and encouraged to engage with the reading and incorporate it into the following writing and lab practices. On the schedule readings correspond with the Lecture and Lab located below, readings should be completed before each Wednesday Lecture.

<u>Writing</u>: Writing assignments correspond with each of the seven sections of the course: Drawing, Systems, Soil, Water, Carbon, Energy and Communications. Written pieces may take a variety of forms relevant to the process of technological development (design and engineering). Examples include reports on readings or research and synthesis of multiple readings (literature review), project or process descriptions (verbal specifications or schematics), and speculative reflection pieces (creative process).

Laboratory/Experimental Practices: These practices ground the study and investigation in physical design, including concept and technical drawings, concept and functional models, and built works. The lab practices lead to and culminate in the final project, which combines practices of research, writing, design, making and building.

Course Outline and Schedule

Wednesday, September 6

Lecture/Lab - Discussion: Introduction to Course

Review of Syllabus

Discussion of Course Methodologies: Reading, Writing and Experiment.

Group Discussion of Terms: World Commission on Environment and Development (Brundtland Commission, 1987) Definition . United Nations Sustainable Development Goals (2015).

Sustainability + Landscape + Technology + Systems + Design

Create working definitions that will be revisited throughout semester

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Readings:

"Representation and landscape: drawing and making in the landscape medium", James Corner

Envisioning Information, Edward R. Tufte, "Escaping Flatland", pp. 12-36.

Wednesday, September 13

Lecture/Discussion: Drawing as primary design technology

Design Thinking and Methodologies

Primary design technology is drawing.

Drawing In the design professions is usually associated with careful planning, thoughtful detailing and rigorous documentation needed to ensure quality in construction. But drawing is also a primary act, with still vibrant roots in the direct experience and physical record of physical impressions. The coordinated physical, mental and emotional processes that emerge as drawing are at once related to direct experience, a manipulation of material and the creation of a record. These three translations, from experience to manipulation and recording form the emotional and technological basis for design. The energy that flows into the perceiver as sensory data to become transformed by cumulative experience flows out materially through the pencil, through design work to ultimately be the energetic hand that guides the backhoe, the hammer and the trowel.

Drawing is explored from drawing in/on the land, to marking with materials, to the abstraction of drawing an image on a ground, from literally 'the ground' to more recent surfaces from stone, clay, papyrus, linen, paper.

Drawing modes are explored from representations of impressions that lead to more concrete analytical types of observation, such as mapping and diagramming. From problem identification comes schematic and functional diagramming. The role of digital drawing, including Building Information Modeling systems will be presented as drawing technologies.

Drawing in the design and construction process: Concept Sketch, Schematic Drawing, Modeling (and building); Drawing as first technology – Sketch; Drawing to Modeling – CAD; Modeling to Building – Rhino; Changes to drawing as technology evolves – BIM, Revit, GIS.

Lab: Concept Sketch to Schematic Diagram to Model

Lab Description: Concept sketch explores perception, goals and ideas about design problem. Schematic Diagram begins to define components, chart relationships and suggest connections. The conceptual function model starts to spatialize relationships, describing requirements of connections, and show boundaries/interfaces.

Readings:

Technologies of Landscape, David E. Nye, Introduction

The Nature of Design, David W. Orr. Part 1 The Problem of Ecological Design:1. Introduction: The Design of Culture and the Culture of Design and 2. Human Ecology as a Problem of Ecological Design, pp. 3-32.

Eco-revelatory Design, Landscape Journal Special Issue Introduction.

Wednesday, September 20

*Writing/Drawing/Modeling work on **Drawing** due.*

Lecture: "Ecorevelatory" Design and communication about sustainability

Practices: communications

Concepts: Eco-Revelatory Design, Complex systems, Resiliency

Lab: Research and create report/poster of Ecorevelatory Design examples from LA practice

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Readings:

> Resilience Thinking: Sustaining Ecosystems and People in a Changing World, Brian Walker and David Salt. Chapter 1 Living in a Complex World: An Introduction to Resilience Thinking, 1-14

Wednesday, September 27

Guest Lecture: Ecological Design, a Systems Approach

Readings:

> Thinking in Systems, A Primer, Donella H. Meadows, Introduction: the Systems Lens, p. 1-7 and Chapter 1: the Basics.
>
> Design With Nature, Ian McHarg. Introduction pp. vii-viii, Nature in the Metropolis pp. 55-66, Process as Values pp. 103-117, Process and Form pp. 163-174, The City: Process and Form pp. 175-186, The City: Health and Pathology 187-195.
>
> Optional (Fundamental Systems Theory Text): General System Theory, Ludwig von Bertalanffy. Introduction p 3-29, Chapter 5 The Organism Considered as Physical System, p 120-138, Chapter 6 The Model of Open System, Chapter 7 Some Aspects of System Theory in Biology

Lab: Diagram or model long term feedback communications between human and biological systems

Wednesday, October 4

Writing/Drawing/Modeling work on ***Communications*** *due.*

Lecture

> Systems and Wholes
>
> Site relative to Region: local materials, labor, and transportation

Site and its components

Lab: Use commonly found items to construct a model of a hypothetical system, exploring the relations between inputs, processes, outputs and wastes.

Lab Description: Examples of systems that could be modeled: building/landscape stormwater green infrastructure system, Hydrological Cycle, Carbon Cycle

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Readings:

Resilience Thinking: Sustaining Ecosystems and People in a Changing World, Brian Walker and David Salt., Chapter 4 In the Loop: Phases, Cycles, and Scales – Adaptive Cycles and How Systems Change 74-95.

Permaculture: Principles and Pathways Beyond Sustainability, David Holmgren. Preface and Introduction

Biomimicry: Innovation Inspired by Nature, Janine Benyus. Chap. 1 Echoing Nature: Why Biomimicry Now? 1-10

Wednesday, October 11

Lecture

Systems and Wholes Continued

Site Design and Construction as a Systems Process

Introduction to closed loop processes in design and construction

Lab: Revisit system model: Revision

Lab Description: Practice revision, deconstruction, rebuilding of model using abstracted processes of erosion, wear, use, disuse, disrepair, etc. – Working with physical processes to understand system shocks and disturbances over time, and potential resiliency increasing human interventions.

Readings: The Upcycle, William McDonough and Michael Braungart. Introduction and Chapter 1 Life Upcycles, pp. 1-50.

Wednesday, October 18

Lecture: Wholes to parts: Sustainable Technologies Separated

Soil, Water, Carbon, Energy, Communication

Lab: Model Relationships between components

Lab description: How are things connected, what holds them together and pulls them apart – the interconnections between elements in a system determine its functioning – explore the types of relationships in different sustainable and non-sustainable systems

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Readings:

The Upcycle, William McDonough and Michael Braungart, Soil not Oil pp. 121-141.

Construction for Landscape Architecture, Robert Holden and Jamie Liversedge, “Earthworks and topsoil in relation to structures” pp. 100-113.

Wednesday, October 25

*Writing/Drawing/Modeling on **Systems** Due.*

Lecture: Soil and other media: structural basis for life (and construction)

Practices: soil

Technologies/Concepts: Soil Mixtures for building, For growing, For structure beneath paving, Adobe, Cob, Soil mixtures, Soil mixtures for filtration – soil is an example of a complex, yet underestimated material that can contribute to long-term effectiveness of sustainable interventions in site design/development generally.

Lab: Build soil mixes for different purposes

Readings:

A Safe and Sustainable World, Nancy Jack Todd, Chapter3, “Food from our Fishponds” p 34-50.

Construction for Landscape Architecture, Robert Holden and Jamie Liversedge, “Dealing with Water” pp. 164-179.

Wednesday, November 1

Writing/Drawing/Modeling work on ***Soils*** *due.*

Lecture: the Hydrological Cycle and its impact on design

Practices: water

Concepts: Capture, Filtration, Conveyance – water management is key to future sustainability and resiliency of human/natural systems. From management of sea-level rise to control of stormwater runoff, water issues impact all site development.

Technologies: Rain Barrels, bioremediation cells, Sand Filters, Created Wetlands, Channels, Swales, Runnels

Lab:

Model or diagram the hydrological cycle.

Readings:

Green Infrastructure: Linking Landscapes and Communities, Mark A. Benedict and Edward T. McMahon. Chapter 1 Why Green Infrastructure pp. 1-22, Chapter 5 The Basics of Network Design 109-148, Chapter 6 The Implementation Quilt: Matching Available Resources to Network Needs 149-196.

Wednesday, November 8

Lecture: Green Infrastructure and Water in the Landscape

Practices: water

Concepts: Explore in depth Green Infrastructures as techniques for improving the breadth of water management issues in Landscape Architecture.

Technologies: Cisterns, basins, infiltration beds, soil modifications, swale irrigation, low flow irrigation

Lab: Model/build a stormwater capture, filtration and reuse system.

Readings:

Biomimicry: Innovation Inspired by Nature, Janine Benyus , Chapter 4, How Will We Make Things: Fitting Form to Function: Weaving Fibers Like a Spider.

Manufactured Sites: Integrating Technology and Design in Reclaimed Landscapes by Kirkwood 3-11, Chapter 5 Phytoremediation: Integrating Art and Engineering through Planting by Steven Rock, 52-60.

Wednesday, November 15

Writing/Drawing/Modeling work on ***Water*** *due.*

Introduce Final Project:

Options: 1. Choose a design problem, and invent a technological solution based on the processes learned. 2. Analyze and improve upon a sustainable landscape technology. 3. Model a technology using alternate materials 4. Propose a project based on course material.

Lecture: Carbon Cycle and sequestration.

Practices: carbon

Concepts: Biophysical cycles, Sequestration, Sustainable materials

Technologies: Plant/soil for sequestration, rapidly renewable materials, biodegradable materials, erosion control materials, shoreline stabilization – soft/hard engineering hybrids

Lab: Diagram opportunities for carbon sequestration on a hypothetical site

Readings:

Ecological Design and Planning, George F. Thompson and Frederick R. Steiner, eds. Chapter 8 Signature-Based Landscape Design by Joan Hirschman Woodward 200-225.

Wednesday, November 22

No Class (Wednesday observes Friday Classes – Thanksgiving)

<u>Wednesday, November 29</u>

<u>Lecture: Carbon, Life Cycle Analysis and the Materials of design</u>

Practices: carbon

Concepts: Sustainable materials, Life cycle, Life cycle extension

Technologies/practices: Reuse of materials, recycling, recycled content materials, durability, deconstruction, design for disassembly

<u>Lab: Model or diagram the life cycle of a "sustainable" material, from extraction to deconstruction and reuse.</u>

Readings:

> Biomimicry: Innovation Inspired by Nature, Janine Benyus, Chapter 3, How Will We Harness Energy? Light into Life: Gathering Energy Like a Leaf 59-94
>
> A Safe and Sustainable World, Nancy Jack Todd, Chapter 4, "Energy from the Sun, the Wind, and Conservation" pp. 51-62.
>
> Traditional Construction for a Sustainable Future, Carole, Ryan, "Climate, Site and Thermal Performance", pp. 209 – 250.

<u>Wednesday, December 6</u>

*Writing/Drawing/Modeling work on **Carbon** due.*

<u>Lecture: Microclimate, passive solar</u>

Practices: energy

Technologies: Solar collection, solar devices, geothermal wells

<u>Lab: Model site arrangement for microclimate and Work on Final Project</u>

Readings:

The Nature of Economies, Jane Jacobs. Chapter 4 The Nature of Self-Refueling, 65-83.

Wednesday, December 13

Lecture: Site and Energy

Technologies: Site as Energy Collector , Passive solar, Thermal mass, Biomass production integration into landscape projects

Present Final Projects to Class

Begin to compile Portfolio of Class Work

Portfolio:

Chronological compilation of written work, drawings, and laboratory/experimental practices (pdf document) due on the Last day of Exams.

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Basis for Grading

Weekly Lab Practices: 20%

Bi-weekly writing/drawing/modeling exercises (7% each): 50%

Final Project: 30%

Required Text

The required texts for this course will be posted to the course Sakai site.

Supplies

Basic drafting supplies and model making materials will be required.

Work Spaces

Work will be conducted in multiple locations, including room 148, the computer lab, the students' studio spaces and outside locations on and off-campus. Transportation will be provided and/or arranged.

Use of Facilities

Studio cannot be taught without reliable facilities. But your use of the facilities is dependent upon responsible use with particular regard to the clearly established rules about their use as specified in the student handbook:

http://landarch.rutgers.edu/current_students/student%20handbook/StudentHandbook_web_SectI.pdf

These rules cover access to studio and vandalism, table assignments, personalization of work space, smoking and drinking, use of the lockers, access to the reference collection, and basic rules governing the use of the computer lab. Failure to observe rules may result in loss of access. Access to the fabrication lab is granted after successfully passing the safety instructions. Access is monitored and can be revoked if students use tools they are not qualified for or if students do not clean after themselves.

Equipment

The student handbook also includes a section governing the use of equipment http://landarch.rutgers.edu/current_students/student%20handbook/StudentHandbook_web_SectII.pdf This section includes rules specifying use department equipment including of projection equipment, department cameras, and drafting equipment.

Submitted drawings, models, photographs, or written papers for any project assigned in Landscape Architecture courses are considered the property of the Department. The formatting of all digital submission must follow the department guidelines because they will be retained in its archives for exhibition and accreditation purposes.

All projects will be graded and returned to the student at a location designated by the instructor. Should your drawings be retained by the Department, you will be given the opportunity to obtain a print or photographic record of your work. Department files are OFF LIMITS to students.

Attendance

The Department of Landscape Architecture requires attendance in all of its classes. The individual student's development as a landscape architect is largely dependent upon two aspects of education. First is the exposure to and assimilation of a body of information which relates to the field. Second is the application of this knowledge through studio projects and problem-solving skills developed through critiques, reviews and interactions during each project.

The Rutgers Landscape Architecture curriculum is designed to develop both areas. Attendance and participation in all lectures and studios are essential if the student is to achieve his/her maximum potential. Unless a more strict policy is in place by the individual instructor, more than three unexcused absences will result in a step reduction in your semester grade. Each additional three absences will result in another step reduction. Since the common lecture is part of the studio, missing that would count as an additional absence.

A minimum level of participation is defined as being in attendance for the entire duration of a class session. It is the student's responsibility to be in attendance at all required classes and all personal plans should be made in accordance with the schedule. Students on academic probation have NO ALLOWABLE UNEXCUSED ABSENCES. Your attendance at juries or special seminars scheduled in your design course is mandatory for the entire duration of the session.

Work Becomes Department Property

Submitted drawings, models, photographs, or written papers for any project assigned in Landscape Architecture courses are considered the property of the Department and may be retained in its archives for exhibition and accreditation purposes.

All projects will be graded and returned to the student at a location designated by the instructor. Should your drawings be retained by the Department, you will be given the opportunity to obtain a print or photographic record of your work. Department files are **OFF LIMITS** to students.

Due Dates

Except for circumstances truly beyond the student's control, all assignments are due at the dates and times specified throughout the semester. Projects that are incomplete on the due date should still be submitted on the date it is due to receive at least partial credit. Any work submitted late will be penalized a letter grade for each day past due. Working beyond a due date is both unrealistic in a professional setting and unfair to your classmates in this course.

Academic Progress

The student bears full responsibility for missed information and their own academic progress in the course. The student shall consult with the professor and other students to gather missed information and to maintain pace with the class and on group projects.

Academic Integrity Policy

The intentional copying of another student's file or portion of the file and presenting it as your own work is in direct violation of the University Integrity Policy:

- Plagiarism: Plagiarism is the representation of the words or ideas of another as one's own in any academic work.

- Facilitating Violations of Academic Integrity: It is a violation of academic integrity for a student to aid others in violating academic integrity. A student who knowingly or negligently facilitates a violation of academic integrity is as culpable as the student who receives the impermissible aid, even if the former student does not benefit from the violation.

As a result, any copying and/or "sharing" of exercise, assignments and projects will be treated as Level 2 violations and subject to the sanctions as outlined in the Integrity Policy:

1. A failing grade on the assignment.
2. A failing grade for the course.
3. Disciplinary warning or probation.

Repeat violations will be treated as separable Level Three violations and referred to the AIF of the school for adjudication. Please refer to the complete Integrity Policy at:
http://academicintegrity.rutgers.edu/integrity.shtml.

Assignment of Grades

While the assignment of grades is ultimately the purview of the instructor, the department uses the following guideline for understanding appropriate grading in its courses:

A – Outstanding –This not only means fulfilling the requirements, but impressing and going beyond the initial expectations of the project. The student has demonstrated a superior grasp of the subject matter coupled with a high degree of creative or logical expression, and strong ability to present these ideas in an organized and analytical manner.

B – Very Good – The student has demonstrated a solid grasp of the material with an ability to organize and examine the material in an organized, critical, and constructive manner. The projects and in-class performance reveal a solid understanding of the issues and related theories or literature.

C – Acceptable –The student has shown a moderate ability to grasp concepts and theories for the class, producing work that , while basically adequate, is not in any way exceptional. This performance in class display a basic familiarity with the relevant literature and techniques.

D – Unacceptable – The work demonstrates a minimal understanding of the fundamental nature of the material or the assignment with a performance that does not adequately examine the course material critically or constructively. Students cannot graduate from the Landscape Architecture program with 2 D's in required 550 classes.

F – Failure – The student has demonstrated a lack of understanding or familiarity with course concepts and materials. Their performance has been inadequate. Failure is often the result of limited effort and poor attendance which may indicate that the student is not in the proper field of study.