

Columbia University  
School of Architecture, Planning and Preservation  
SUSTAINABLE DESIGN (GSAPP)

Course number: ARCH A4684\_001

Time: Friday, 11:00 – 13:00

Room (verify): Ware Lounge (6th floor Avery)

Instructor: Davidson Norris - Davidson Norris Architect & Carpenter Norris Consulting

Contact: T: 212.431.6821 Email: dn192@columbia.edu

#### NOTE:

This course is offered for students who are interested in the DESIGN implications of Sustainable Design. If you are more interested in the broader non-design implications of sustainability in the built environment, consider taking A4684\_002: Sustainable Design (Earth Institute).

#### DESCRIPTION:

Sustainable Design recognizes that the architect's primary challenge is the poetic integration and inspired balancing of multiple technical, and sometimes conflicting, sustainable options. To address this, the course introduces the student to the core technical principles that govern sustainable design and, in parallel, requires their inspired and poetic application to the design of a small and sustainable dwelling.

In a series of weekly lectures the instructor will present core principles and practices of sustainable design. See below for specifics. Lecture outlines, including graphics, will be posted before each class on Courseworks. A bibliography of back-up readings will also be posted, with many selections available on reserve in the Library.

There are no exams or papers. To begin, homework assignments will focus on a number of case studies followed by a semester long sketch design problem. The design problem will require the successive application of sustainable techniques and technologies, described in the weekly lectures, to the design of a very simple site and building – a classroom block for a High School for Environmental Science (HSES). The instructor will review and comment on each stage of the student's design development. The final integrated sustainable design will be presented for review at the end of the semester. The site will be Central Park in NYC. While the program for the HSES will be identical, the student will have the option of developing it in one of 4 different climate types (cool, temperate, hot/wet or hot/dry). In all climate cases the site and context (urban) will be the same – Central Park in New York City.

#### CLASS ASSIGNMENTS & FINAL PROJECT:

1. Development and presentation of case studies highlighting sustainable design.
2. Weekly sketch design application of that week's sustainable strategy to your HSES design.
3. Final project: HSES presentation.

#### TEXTBOOKS

While there are no required texts books for the course I highly recommend that you purchase Sun, Wind & Light, Architectural Design Strategies, 2nd edition, Brown, G. and DeKay, M.,

Wiley. Written by architects for architects, it outlines sustainable strategies, techniques and technologies, provides helpful sizing graphs and charts, and offers many excellent examples of their architectural application. It is the basis for much of my instruction and should be a foundation document in your sustainable design library going forward.

## SOFTWARE

Over the course of the semester, we will rely on a number of softwares, all of them freely downloadable or accessible on the internet:

PMV Tool – no longer available on web. We will distribute.

Climate Consultant (

[http://apps1.eere.energy.gov/buildings/tools\\_directory/software.cfm/ID=123/pagename=alpha\\_list](http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=123/pagename=alpha_list))

Facade Design Tool (<http://www.commercialwindows.org/fdt.php>.)

SEFAIRA (<http://sefaira.com>.)

Sefaira will become your primary building energy optimization and analysis tool. It allows you to test preliminary sustainable design strategies using a simple SketchUp model with the Sefaira plug-in on your own computer. Once settled you can then upload the model to Sefaira's servers for more fine grained parametric analysis.

## CLASS SCHEDULE

### 09.05 1. Sustainable Design: Two Case Studies

- The Reichstag by Sir Norman Foster
- The Rondaval by Setswana tribesmen

### 09.12 2. Sustainable Building Design - Site

- Landscape types
- Site and solar access
- Topography and microclimate
- Vegetation and microclimate
- Topography and air movement

Assignment: case study

### 09.19 3. Sustainable Building Design – Thermal comfort

- Heat exchange and metabolism
- Thermal comfort
- The sun/earth dance
- Climate types and characteristics
- Climate types and sustainable strategies

Assignment: site analysis

### 09.26 4. Sustainable Building Design - Water

- Water conservation practices
- Building water harvesting
- Water retention and green roofs

- Site water harvesting
- Alternate waste treatment systems

Assignment: site water and waste sketch problem

#### 10.03 5. Sustainable Building Design – Architectural strategies

- Wind and vegetation / ventilation and protection
- Sun and vegetation / shade
- Sun and building albedo
- Sun and building form / orientation
- Window area and orientation
- Envelope and insulation
- Heat migration and thermal mass
- Internal loads

Assignment: building location and orientation

#### 10.10 6. Sustainable Building Design – Passive heating

- Passive solar heating
- Direct gain
- Trombe wall
- Sunspace
- Hybrids

Assignment: passive solar heating

#### 10.17 7. Sustainable Building Design

- Passive solar cooling
- Shading
- Mass cooling
- Ventilation

Assignment: passive solar cooling

#### 10.24 8. Sustainable Building Design – Natural ventilation

- Ventilation
- Wind pressure
- Stack effect
- Ventilation and window placement and area
- Ventilation and building form and orientation
- Wind catchers and vent towers

Assignment: natural ventilation

#### 10.31 9. Sustainable Building Design - Indoor environment

- Site issues
- Ventilation
- Material Selection
- Maintenance

Assignment: design integration

#### 11.07 10. Sustainable Building Design - daylight

- Daylighting
- Daylight spectrum, reflection and transmission
- Visual system and visual comfort
- Daylight penetration
- Glazing and transmission
- Daylight and building form

Assignment: daylighting

#### 11.14 11. Sustainable Building Design – advanced systems

- Heat recovery
- Photovoltaics
- Wind energy
- Fuel cells

Assignment: advanced systems

#### 11.21 12. Sustainable Building Design – mechanical systems

- The mechanical engineer's perspective

#### 11.28 T H A N K S G I V I N G

#### 12.05 No class

#### 12.12 13. Review Norris/Others

Presentation (sustainable narrative, site plan, plan and section(s), sustainable systems diagram, 3d model (computer or architectural))