

## SYLLABUS

Columbia University  
School of Architecture, Planning and Preservation  
Fall 2012

### SUSTAINABLE DESIGN

Course number: A4684.001

Time: Fridays, 1100h-1300h

Room: Avery 600

Instructor: Davidson Norris, Principal - Davidson Norris Architect & Carpenter Norris Consulting  
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#### 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 readings and text books will also be posted, with many selections available on course reserves in the Avery Architectural Library.

There are no exams or papers. Students will be given weekly homework assignments which are part of a semester long sketch design problem. The first homework assignment focuses on sustainability case studies. Each subsequent homework assignment is applied to the design problem. The design problem will require successive application of sustainable techniques and technologies, described in the weekly lectures, to the design of a very simple site and building - the Bio-Dwelling. These assignments will be submitted before class each week and 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. Lastly, students will be asked to present one article during the semester. The article should address a specific issue discussed in class (from the building perspective), showing the relevance of this issue within current events. Article presentation guidelines and a signup sheet will be posted on Courseworks during the first week of class.

#### Assignments

1. Development and presentation of case studies highlighting sustainable design.
2. Sketch design of different bio-climatic features of the Bio-Dwelling. While the program for the Bio-Dwelling 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).
3. Presentation of current events article.

Each homework assignment must be uploaded to Courseworks before class begins (11:00AM) on the day which it is due. One full letter grade will be deducted from any assignment which is uploaded after 11:00AM on the day

that it is due. Students unsatisfied with their performance on homework assignments will be given an opportunity to revise and resubmit assignments at the end of the semester. All assignments should be uploaded to Courseworks in PDF format.

### Grading

Attendance: 15%

Article presentation: 5%

Homework assignments: 60%

Final presentation: 20%

### Course Books

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 struggling with the complexities of understanding and balancing sustainable strategies, techniques and technologies, it is helpful in this course and should be a core holding in your sustainable library going forward. For students who are not conversant in architectural drawing techniques, the book *Architectural Graphics* by Francis D.K. Ching is recommended.

The following books can be used when developing the sketch design problem and for learning more about specific topics covered in class. These books have been placed on course reserve at the Avery Architectural Library.

### Course Reserve Books

1. Fitch, J and Bobenhausen, W., *American Building and the Environmental Forces that Shape It*. Oxford, 1999.
2. Heschong, Lisa, *Thermal Delight in Architecture*. MIT Press, 1979.
3. Brown, GZ and DeKay, M., *Sun, Wind and Light, Architectural Design Strategies*. John Wiley and Sons, Inc., 2001.
4. Givoni, Baruch, *Climate Considerations in Building and Urban Design*. Van Nostrand Reinhold, 1998.
5. Herzog, Thomas, ed., *Solar Energy in Architecture and Urban Planning*. Prestel, 1998.
6. International Energy Agency, *Daylight in Buildings. A Source Book on Daylighting Systems and Components*. IEA, 2000.
7. Konya, A., *Design for Hot Climates*. Architectural Press, 1980.
8. Lechner, N., *Heating, Cooling and Lighting. Sustainable Methods for Architects*. 3<sup>rd</sup> edition, Wiley.
9. Lyle, John, *Regenerative Design for Sustainable Development*. Wiley, 1994.
10. Moore, Fuller. *Concepts and Practices of Architectural Daylighting*. Van Nostrand Reinhold, 1991.
11. Moore, Fuller. *Environmental Control Systems: Heating Cooling, Lighting*. McGraw Hill, 1993.
12. Olgyay, V., *Design with Climate. Bioclimatic Approach to Architectural Regionalism*. Princeton University Press, 1963
13. Olgyay, A., & Olgyay, V. *Solar Control and Shading Devices*. Princeton University Press, 1957.
14. Pallasmaa, J., *The Eyes of the Skin: Architecture and the Senses*. Wiley, 2005.
15. Tuluca, Adrian, *Energy Efficient Design and Construction for Commercial Buildings*. McGraw Hill, 1997.
16. Yeang, K., *The Skyscraper Bioclimatically Considered*. Academy Editions, 1996.
17. Yeang, K., *Designing with Nature, the Ecological Basis for Architectural Design*. McGraw Hill, 1995.
18. Van der Rym, Sim, Cowan, S., *Ecological Design*. Island Press, 1996.
19. Wines, James, *Green Architecture*. Taschen, 2001.

## Class Schedule

### 09.07

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

~ The Reichstag by Sir Norman Foster

~ The Rondaval by Setswana tribesmen

Assignment: C1\_Case Study

### 09.14

#### 2. Bioclimatic Building Design - Site

~ Landscape types

~ Site and solar access

~ Topography and microclimate

~ Vegetation and microclimate

~ Topography and air movement

Assignment: C2\_Sustainable Site Design

### 09.21

#### 3. Bioclimatic Building Design - Water

~ Water conservation practices

~ Building water harvesting

~ Water retention and green roofs

~ Site water harvesting

~ Alternate waste treatment systems

Assignment: C3\_Site Waste and Water Problem

### 09.28

#### 4. Bioclimatic Building Design - Thermal comfort

~ PMV tool

~ Heat exchange and metabolism

~ Thermal comfort

~ The sun/earth dance

~ Climate types and characteristics

~ Climate types and sustainable strategies

Assignment: C4\_The Thermally Comfortable Worker

### 10.05

#### 5. Bioclimatic Building Design - Architectural strategies

~ Climate Consultant

~ Wind and vegetation / ventilation and protection

~ Sun and vegetation / shade

~ Sun and building albedo/form/orientation

~ Window area and orientation

~ Envelope and insulation

~ Heat migration and thermal mass

~ Internal loads

Assignment C5\_Climate Consultant

### 10.12

#### 6. Bioclimatic Building Design - Passive solar heating

- ~ Direct gain
- ~ Trombe wall
- ~ Sunspace
- ~ Hybrids

Assignment: C6\_Bio-Dwelling Concept Plan

### 10.19

#### 7. Bioclimatic Building Design - Passive solar cooling

- ~ Shading
- ~ Mass cooling
- ~ Ventilation

Assignment: C7\_Bio-Dwelling Heating and Cooling

### 10.26

#### 8. Bioclimatic Building Design - Daylight

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

Assignment: C8\_Bio-Dwelling Daylighting

### 11.02

#### 9. Bioclimatic Building Design - Natural ventilation

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

Assignment: C9\_Bio-Dwelling Natural Ventilation

### 11.09

#### 10. Bioclimatic Building Design - Indoor environment

- ~ Site issues
- ~ Ventilation
- ~ Material Selection
- ~ Maintenance

Assignment: C10\_Design Integration (Mid-term submission of design problem)

### 11.16

#### 11. Bioclimatic Building Design - Advanced systems

- ~ Heat recovery
- ~ Photovoltaics
- ~ Wind energy
- ~ Fuel cells

No Assignment

11.23

NO CLASS . THANKSGIVING HOLIDAY

11.30

12. Bioclimatic Building Design - Mechanical systems

~ The mechanical engineer's perspective

No Assignment

12.07

NO CLASS . REVIEW WEEK

12.14

13. Final Review

9:00h-17:00h

Presentation should include a sustainability narrative, site plan, building plan and section(s), sustainable systems diagram and 3 dimensional model (computer or architectural). The review will begin at 9:00h and end at 19:00h. If this time conflicts with another final review, please see me at least one week in advance.