CP6836-C/ ARCH4447 **Urban Ecological Design**

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Time: Monday 18:05-20:55
Venue: Eco Urban Lab (3rd Floor Architecture West)

Abstract: The course engages the contemporary issues of urban ecology and its articulation to design in urban settings. The new commitment of the co-habitation of nature and built environment has drawn attentions of city planners, urban designers and architects. The discourses of urban sustainability have to move away from social sufficiency, ecological efficiency to systems compatibility by linking the urban forms and ecological flows in urban, industrial and natural systems. The new global and climate challenges require design and planning professionals to deal with how cities could be analyzed, designed, managed, evaluated, represented and changed for cutting-edge ecologically sustainable issues. Defined by two key categories *Forms* and *Flows*, or more specifically, *urban form* and *ecological flows*, the course covers trends, theories, methods, tools and case studies of ecologically sound urban design. The first session *Theory and Method* introduces foundational theories in urban design, urban ecology, ecological design, and engages contemporary debates in urban sustainability and ecological urbanism. The second session *Form: Landscape Systems and Urban Structure* deals with landscape ecological structure, global ecological effects of mega urban form, sustainable urban form, waterfront revitalization, brown field redevelopment, urban-nature edge space, the debates of landscape urbanism, downtown urban environment and the proposition of organized complexity in cities. The third session *Flows: Urban Metabolism* covers theories and issues that address the concept of urban metabolism: how water, material and energy flow in cities and its design dimension. The course concludes with a synthesis of design method for ecological urban systems, in which urban design is seen as an ecological intervention and modeling tools for synthesizing complex system issues. Students are expected to participate in lecture series, tutorials and seminars actively. The course this year aim for working on themes related to eco city design. By selecting one specific theme under the course framework, students will participate in research teamwork and work on individual term paper over the semester.

Learning objectives

Students will be exposed to the following theories, methods and tools:

- Theories of urban design, urban ecology and ecological design
  - A literature review of contemporary debates on urban sustainability and ecological urbanism
- Landscape ecology and planning

- Industrial ecology, life cycle assessment and energy performance of urban systems
- Foundation in urban hydrology
- Computing tools for urban design, urban simulation and performance-based analysis

The semester aim for developing a *resource book on Eco City Design* with contributions from student participants through group research projects and term papers. Students will pick up one specific topic related to Eco City Design based on a framework defined by the course.

Course Schedule

PART I - Theory and Method

1. 1/05 Introduction
   Urban design, urban ecology and ecological design
2. 1/12 Propositions in urban sustainability and ecological urbanism
   Ecological city-regions in global context
3. 1/19 Public holiday (MLK day)

PART II - Forms: Landscape Systems and Urban Structure

4. 1/26 Design performance tool 1: Mapping landscape systems
   (Additional tutorial time TBA)
5. 2/02 Landscape ecological planning
   Urban-nature edges and landscape urbanism
6. 2/09 Downtown urban environment and organized complexity
7. 2/16 **Seminar 1) Density, typology, performance**
8. **2/23 Students' project presentation (1)**

PART III: Flows: Urban Metabolism

9. 3/02 Water flow: Water sensitive urban design
10. 3/09 Design performance tool 2: Energy and Carbon
    (Additional tutorial time TBA)
11. 3/16 Spring Break
12. 3/23 Design performance tool 3: Wind in urban environment
    (Additional tutorial time TBA)
13. **3/30 Seminar 2) Urban energy systems and design**
14. 4/06 Energy and material flows
    Design for urban metabolism
15. **4/13 Students' project presentation (2)**
16. 4/20 A synthesis: ecological urban systems by design

4/27 Term paper submission

Criteria of Performance Evaluation

1. 20% class attendance and seminar participation
2. 20% design simulation tool tutorials

   (Each tutorial session comes with a quiz that is designed separately for graduate and undergraduate students)
3. 20% project presentation (group project)
4. 40% term paper (The submission requirements of the reading and term papers are described in the following session.)

Submission Requirements

1. The weekly readings are divided by **required** and **recommended** categories. Before attending the class, students are required to complete the required reading, which is carefully selected from the whole reading list. The recommended reading is mainly for the long-term interests as well as a source for the research project and individual term paper.
2. Research project is a group project, to be presented by power point or other suitable ways of presentation. The grouping and topics for individual group are to be determined by 1/23.
3. The following three-stage submission are required for all students:
   1) 2/02, the first draft proposal, up to 2 pages;
   2) 3/09, the second draft of the term paper, 4-6 pages;
   3) **4/27, 12PM**, final term paper (5000 words max for graduate students and 4000 words max for undergraduate students)
   (The submissions are to be done by both uploading soft copy to T-Square and handing in hard copy to Perry's office mailbox.)
4. Please note that research projects (power point) and term papers (word file, including the first draft proposal, the second draft and the final term paper) have to be uploaded to T- Square by the date of presentation or deadline. The file name should include your name, topic and date, e.g. john-ecodesign-030305.

Course Policy

In general, the following guidelines apply to this course:

1. Engage yourself in class activities so you can maximize your learning. Before coming to the class, please read all required materials and be prepared for discussion. Class participation grades will reflect your participation in these activities, not just your attendance.
2. If events prevent you from attending a class, please let me know in advance by e-mail.
3. Please follow the due date on your problem sets or assignments. Late work will not be accepted unless emergent events happen.
4. Academic honor code and student code of conduct**:**
   All students should be knowledgeable of the Georgia Institute of Technology Academic Honor Code. The Georgia Tech Academic Honor Code (http://www.catalog.gatech.edu/rules/18b.php) and Student Code of Conduct (http://www.catalog.gatech.edu/rules/19b.php) outline the Institute's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading these two documents fully and for living up to them. Among the Codes' provisions are expectations about unauthorized access, unauthorized collaboration, plagiarism, false claims of performance, grade alteration, falsification, forgery and distortion. You should be absolutely clear in indicating when you have used ideas or words that are not your own. You are permitted to discuss the written assignments in this course with your fellow classmates, but, except for group assignments, you should not collaborate on your submissions.
5. Students with disabilities:

Students with disabilities needing academic accommodation should provide documentation to the Access Disabled Assistance Program for Tech Students (http://www.adapts.gatech.edu/) and bring an ADAPTS accommodation letter to the instructor indicating the nature of accommodations required. This should be done within the first week of class or as soon as possible after a new disability condition arises. All effort will be made to provide reasonable accommodation.

Reading List

Urban Design, Urban Ecology and Ecological Design

(required)

- Lynch K, 1990, "Urban Design", in *City Sense and City Design: Writings and Projects of Kevin Lynch*, pp 511-534, edited by T. Banerjee and M. Southworth, MIT Press.
- Marzluff J M et al. eds., 2008, Introduction in *Urban Ecology: An International Perspective on the Interaction* between Humans and Nature, Springer.
- Steinitz C, 2002, CH 10 On Teaching Ecological Principles to Designers in *Ecology and Design: Frameworks for Learning*, Johnson B R, Hill K eds., Island Press.

(recommended)

- Alberti M, 2009, *Urban Ecology: Integrating Humans and Ecological Processes in Urban Ecosystems*, Springer
- Barnett J, 2011, Introduction: three city-design challenges, in *City Design: Modernist, Traditional, Green, and Systems Perspectives*, Routledge.
- Lynch K, 1990, *City Sense and City Design: Writings and Projects of Kevin Lynch*, edited by T. Banerjee and M. Southworth, MIT Press.
- McHarg I L, Steiner F R, 1998, *To Heal the Earth: Selected Writing of Ian L. McHarg*, Island Press. Washington D C.
- Steinitz C, 2008, On Scale and Complexity and the Needs for Spatial Analysis, Working Paper, Graduate School of Design, Harvard University.
- Thompson G, Steiner F R eds., 1997, *Ecological Design and Planning*, John Wiley & Sons, Inc.

Propositions in Urban Sustainability/ Ecological Urbanism

(required)

- Huber J, 2006, Ch.2 "TEI in Discourse Context" in *New Technologies and Environmental Innovation*, Edward Elgar, Northhampton, MA.
- Yang, P P J, 2009, Questioning urban sustainability: social sufficiency, ecological efficiency and ecosystems compatibility. In *Journal of Urbanism*, November 2009, Vol.
  2, Issue 3.

(recommended)

- Chermayeff S, Tzonis A, 1971, *Shape of Community: Realization of Human Potential*, Penguin Books.
- Cronon W, 1991, "Introduction: In Search of Nature" in *Uncommon Ground: Toward Reinventing Nature*, edited by Cronon, W. W. Norton & Company, New York & London.
- Economy E C, 2007, The Great Leap Backward? *Foreign Affairs*; *Yale Global On-line Magazine* (http://yaleglobal.yale.edu).
- Graedel T E, Allenby B R, 2010, Ch1-3 in *Industrial Ecology and Sustainable Engineering*, Prentice Hall.
- Huber J, 2006, *New Technologies and Environmental Innovation*, Edward Elgar, Northhampton, MA.
- Kellert S, 2005, *Building for Life: Designing and Understanding the Human-Nature Connection*, Island Press, Washington D C.

- Mostafavi M ed., 2010, *Ecological Urbanism*, Harvard Graduate School of Design
- Yang, P P J, 2010, *Ecological Urbanism: Scale, Flow and Design*, China Architecture and Building Press, Beijing.

Ecological city-regions in global contexts

(required)

- Easterling K, 1999, Part one in *Organizational Space: Landscapes, Highways and Houses in America*, MIT Press.
- Forman R R T, 2008, Ch1-5, in *Urban Regions: Ecology and Planning Beyond the City*, Cambridge University Press.
- Hall P, 2002, Ch.5 "The City in the Region: The Birth of Regional Planning; Edinburgh, New York, London 1900-1940" in *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century*, Blackwell.
- Yang, P P J, 2007, Review of *Enduring Innocence: Global Architecture and its Political Masquerades*, Author: Keller Easterling, MIT Press, 2005", *Journal of Architectural Education*, 02.

(recommended)

- Barnett J, 1995, Introduction and Part one in *The Fractured Metropolis: Improving the New City, Restoring the Old City, Reshaping the Region.* Icon Edition, New York.
- Bernick M, Cervero R, 1997, *Transit Villages in the 21st Century*, McGraw-Hill Inc., New York.
- Burdett R, Sudjic D, eds. 2007, the part 'Cities' in *The Endless City: The Urban Age Project by the London School of Economics and Deutsche Bank's Alfred Herrhausen Society*, Phaidon Press Ltd.
- Calthorpe P, 1993, *The Next American Metropolis: Ecology, Community, and The American Dream*, Princeton Architectural Press, New York.
- Calthorpe P, Fulton W, 2001, *The Regional City: Planning for the End of Sprawl*, Island Press.
- Cronon W, 1991, *Nature's Metropolis: Chicago and the Great West*, W. W. Norton & Company.
- Easterling, K. 2005, *Enduring Innocence: Global Architecture and its Political Masquerades*, MIT Press,
- European Commission, 1996, *European Sustainable Cities: Report by the Expert Group on the Urban Environment*.
- Forman R R T, 2008, *Urban Regions: Ecology and Planning Beyond the City*, Cambridge University Press.
- Hall P, Pain K, 2006, *The Polycentric Metropolis: learning from mega-city regions in Europe*, Earthscan, London ; Sterling, VA.
- Koolhaas, R. (2000) "PRD Pearl River Delta" in Mutations, Actar Press.
- Jenks, M, Dempsey N eds., 2005, *Future Forms and Design for Sustainable Cities*, Architectural Press.
- Jenks M, Burton E, Williams K, eds., 1996, *The Compact City: A Sustainable Urban Form?* E & FN SPON, London.
- Jenks M, Williams K, Burton E, eds., 1999, *Achieving Sustainable Urban Form*, E & FN SPON, New York.

- Jenks M, Burgess R, 2000, *Compact Cities: Sustainable Urban Form for Developing Countries*, E & FN SPON, London.
- Katz P, 1994, *The New Urbanism: Toward an Architecture of Community*, McGraw-Hill Inc.
- Meacher M, Ravetz J, 2000, *City-Region 2020: Integrated Planning for a Sustainable Environment*, Earthscan Publications Ltd.
- Rogers R, Burdett R, 2001, "Let's Cram More Into The City", in *Cities For The New Millennium*, edited by Echenique M. & Saint, A., Spon Press, London.
- Sanders W S ed., 2005, *Sprawl and Suburbia*, A Harvard Design Magazine Reader, University of Minnesota Press, Minneapolis.
- Simmonds R, 2001, *Global City Regions: Their Emerging Forms*, Routledge.
- Talen E, 2005, Ch.7 Regionalism in *New Urbanism and American Planning: The Conflict of Cultures*, Routledge.
- Warren R, 1998, *Urban Oasis: Guideways and Greenways in the Human Environment*, McGraw-Hill Inc., New York.
- Welter V M, 2002, *Biopolis: Patrick Geddes and the City of Life*, MIT Press.

Landscape ecological flow: design for ecologically sound landscape patterns

(required)

- Dramstad W E, Olson J D, Forman R T T, 1996, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, Harvard GSD & American Society of Landscape Architects, Island Press.
- Forman R T T, 1995, Part One: Landscapes and Regions, Part Two: Patches, Part Five: Changing Mosaics, in *Land Mosaics: The Ecology of Landscapes and Regions*, Cambridge University Press, London.

(recommended)

- Forman R T T, 1995, *Land Mosaics: The Ecology of Landscapes and Regions*, Cambridge University Press, London.
- Fabos J, Ahern J, eds., 1996, *Greenways: the beginning of an international movement.* Elsevier, New York, USA.
- Jeffrey M, Klopatek R, Gardner H eds., 1999, *Landscape ecological analysis: issues and applications.* Springer, New York, USA.
- Leitao A B, Miller J, Ahern J, McGarigal K, 2006, *Measuring Landscapes: A Planner's Handbook.* Island Press, Washington, USA.
- McHarg I, 1992, *Design with Nature*, John Wiley & Sons Inc., New York.

Urban-nature edges and landscape urbanism

(required)

- Corner J, 2006, Terra fluxus, in *The Landscape Urbanism Reader*, Waldheim C ed., Princeton Architectural Press.
- Czerniak J ed., 2001, *Case: Downsview Park Toronto*, Harvard University Graduate School of Design. Prestel Verlag Press.
- Waldheim C, 2006, Landscape as urbanism, in *The Landscape Urbanism Reader*, Waldheim C ed., Princeton Architectural Press.

- Yang P P J, 2013, Landscape ecology and its urbanism, in *Landscape Urbanism and its Discontents: Dissimulating the Sustainable City*, Andres Duany and Emily Talen eds., Island Press.

(recommended)

- Berger A, 2006, *Drosscape: Wasting Land in Urban America*, Princeton Architecture Press.
- Charles W ed, 2005, City Edge: Case Studies in Contemporary Urbanism, Architectural Press.
- Gastil R W, 2002, *Beyond the Edge: New York's New Waterfront*, Princeton Architectural Press.
- Hall P, 1993, "Waterfronts: A New Urban Frontier", in *Waterfronts: A New Frontier for Cities on Water*, Bruttomesso, R. ed., International Centre Cities on Water, Venice.
- Kirkwood N ed., 2001, *Manufactured Sites: Rethinking Post-industrial Landscape*, Spon Press.
- Marshall R ed., 2001, *Waterfronts in Post-Industrial Cities*, SPON Press, London.
- Meyer H, 1999, *City and Port: Urban Planning as a Cultural Venture in London, Barcelona, New York, and Rotterdam: Changing Relations Between Public Urban Space and Large-scale Infrastructure*, Utrecht: International Books.
- Mostafavi M, Najle C eds., 2003, *Landscape Urbanism: A Manual for the Machinic Landscape*, Architectural Association.
- Waldheim C ed., 2006, *The Landscape Urbanism Reader*, Princeton Architectural Press.

Downtown urban environment and orgaized complexity

(required)

- Allen S, 2009, "Part three: Cities" in Practice: Architecture Technique + Representation, Routledge.
- Jacobs J, 1962, "The kind of problem a city is" in *The Death and Life of Great American Cities*, originally published Random House.
- Loukaitou A, Banerjee T, 1998, *Urban Design Downtown: Poetics and Politics of Form*, University of California Press.
- Yang, Perry P. J., 2012, Complexity Question in Urban Systems Design, in *Journal of Architectural Engineering Technology*, editorial, Vol. 1, Issue 2.

(recommended)

- Appleyard D, 1976, *Planning a Pluralist City: Conflicting Realities in Ciudad Guayana*, MIT Press.
- Bacon E, 1969, "Putting Ideas to Work—Philadelphia" in *Design of Cities*, pp. 264-307, MIT Press.
- Carr S, Francis M, Rivlin L G, Stone A M, 1992, *Public Space*, Cambridge University Press.
- Cherry N, Nagle K, 2009?, *Grid/Street/Place: Essential Elements of Sustainable Urban Districts*, American Planning Association.
- Gehl J, Gemzoe L, 2001, *New city spaces*, Danish Architectural Press, Copenhagen.
- Gosling D, 2003, *The Evolution of American Urban Design*, Wiley-Academy.
- Jacobs A, 1993, *Great Streets*, MIT Press.

- Jacobs J, 1962, *The Death and Life of Great American Cities*, originally published Random House.
- Koolhaas R, Nouvel J, Portzampark C, Vasconi C, Duthilleul J, 1995, *Euralille: The Making of a New City Center*, Birkhauser, Berlin.
- Lang J, 2005, *Urban Design: A Typology of Procedures and Products*, Oxford: Elsevier/Architectural Press.
- Latham I, Swenarton M eds., 1999, *Brindleyplace: A Model for Urban Regeneration*, Rightangle Publishing.
- Lynch K, 1972, *What Time Is This Place*, MIT Press.
- Lynch K, 1972, *Managing the Sense of a Region*, MIT Press.
- Marshall R, 2003, *Emerging Urbanity: Global Urban Projects in the Asia Pacific Rim*, SPON Press, London.
- Powell K, 2000, *City Transformed: Urban Architecture at the Beginning of the 21st Century*, Laurence King Publishing, London.
- Redstone L G, 1976, *The New Downtowns: Rebuilding Business Districts*, McGraw-Hill Book Company.
- Rogers R, Gumuchdjian P, 1997, *Cities for a Small Planet*, Faber & Faber Limited, London.
- Sarkis H, Allard P, Hyde T, 2002, *Case: Le Corbusier's Venice Hospital and the Mat Building Revival* , Harvard Graduate School of Design.
- Terry Farrell & Partners, 1998, *Kowloon: Transport Super City*, PACE publishing Ltd., Hong Kong.
- Yang, P P J, 2005, "From Central Business District to New Downtown: Designing Future Sustainable Urban Forms in Singapore", in *Future Forms and Design for Sustainable Cities*, Jenks M & Dempsey N eds. Architectural Press.

Seminar 1) density, typology, performance and complexity

(required)

- Batty, M, 2009, Defining density, in *Environment and Planning B: Planning and Design*, **36** 571-572.
- Batty, M, 2008, How tall can we go? How compact can we get? in *Environment and Planning B: Planning and Design*, **35** 1-2.
- Martin L., & March L., 1972, Ch1-2 in *Urban Space and Structures*. London: Cambridge University Press.
- MVRDV, 2006, *FARMAX: Excursions on Density*, 010 Publishers.
- MVRDV, *The Vertical Village: Individual, Informal, Intense*, NAi Publishers.
- Sarkis H, Allard P, Hyde T, 2002, *Case: Le Corbusier's Venice Hospital and the Mat Building Revival*, Harvard Graduate School of Design.
- Steadman P., 2006, Allometry and built form: revisiting Ranko Bon's work with the Harvard Philomorphs, in *Construction Management and Economics*, **24** 755-765.
- Steemers, K., 2003, Energy and the city: density, buildings and transport, *Energy and Buildings* **35** 3-1.
- Walker B, Holling S C, Carpenter, S R, Kinzig, 2004, Resilience, Adaptability and Transformability in Social-Ecological Systems, in *Ecology and Society 9 (2): 5*.

(recommended)

- Batty M, 2005, *Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals*, MIT Press.
- Grimm, V., Revilla, E., Berger, U., Jeltsch, F., Mooij, W. M., Railsback, S. F., Thulke, H. H., Weiner, J., Wiegand, T., DeAngelis, D. L., 2005, Pattern-Oriented Modeling of Agent- Based Complex Systems: Lessons from Ecology. *Science* 310, 987.
- Holling C S, 2001, Understanding the Complexity of Economic, Ecological, and Social Systems, in *Ecosystems* (2001) 4: 390-405.

Water flow: water sensitive urban design

(required)

- France, R L, 2003, *Wetland Design: Principles and Practices for Landscape Architects and Land Use Planners*, W. W. Norton and Company.
- Novotny V, Ahern J, Brown P, 2010, Water Centric Sustainable Communities: Planning, Retrofitting and Building the Next Urban Environment, John Wily and Sons Inc. New Jersey.
- Yang, Perry P. J. 2013. Hydrological effects of urban form and landscape change, in *Planning stormwater resilient urban open spaces*, vol. 3, F.D. Moccia and M.F. Palestino eds. Clean, Napoli.

(recommended)

- Balmori D, Benoit G, 2007, Ch. 2 "Water" in *Land and Natural Development (LAND) Code: Guidelines for Sustainable Land Development*, John Wiley & Son Inc.
- Ferguson B K, 1998, *Introduction to Stormwater: Concept, Purpose and Design*, John Wiley & Son Inc.
- France R C, 2002, *Handbook of Water Sensitive Planning and Design: Integrative Studies in Water Management and Land Development*, CRC Press LLC.
- Hough M, 1995, Ch. 2 "Water" in *Cities and Natural Process*, Routledge, New York and London.
- Kloster T, Leybold T, Wilson C, 2002, Green Streets: Innovative Solutions for Stormwater and Stream Crossings, in *Urban Drainage*. Redistribution subject to ASCE license or copyright; http://www.ascelibrary.org.
- Marsh W M, 2005, Ch. 7-14 in *Landscape Planning: Environmental Applications*. 4th edition, John Wiley & Son Inc.
- Riley A L, 1998, *Restoring Streams in Cities; A Guide for Planners, Policy Makers, and Citizens*, Island Press, Washington D C.
- Spirn A W, 1984, Ch. 6 "Floods Droughts and Poisoned Water" in *The Granite Garden: Urban Nature and Human Design*, Basic Books, New York.
- Wynkoop S E, 2000, *Low Impact Development: An Integrated Design Approach*, Department of Environmental Resources, Prince George's County, Maryland.

Energy and material flows: design for urban metabolism

(required)

- Batty M, 2011, "Cities as flows, cities of flows", in *Environment and Planning B: Planning and Design*, Volume 38 195-196.
- Grubler A, Fisk D eds., 2013, "Introduction" in *Energizing Sustainable Cities: Assessing Urban Energy,* Earthscan Press.

- Baccini P, Brunner P H, 2012, "Introduction" in *Metabolism of the Anthroposphere: Analysis, Evaluation and Design*. The second edition, MIT Press, Cambridge.
- Koolhaas R, Obrist H U, 2012, *Project Japan: Metabolism Talks*, Taschen.
- Oswald F, Baccini P, 2003, *Netzstadt: Designing the Urban*. Birkhauser, Berlin.
- Yang, Perry P. J. 2014. Energy resilient urban planning, in *Geodesign: Integrating design and geospatial science in Europe*, Scholten H, Lee D and Dias E eds., Springer.

(recommended)

- Ashfold N A, Cote R P, 1997, "An Overview of the Special Issue", in *Journal of Cleaner Production* Vol. 5, No.1-2: i-iv.
- Brown, M. A., F. Southworth, and A. Sarzynski., 2009, The geography of metropolitan carbon footprints. *Policy and Society*, 27, 285–304
- Breuste J, Feldmann H, Uhlmann O, 1998, *Urban Ecology*, Springer-Verlag, Berlin.
- Droege P, 2006, *The Renewable City: A Comprehensive Guide to an Urban Revolution*, John Wiley & Son Inc.
- Chertow M R, 2000, "Industrial Symbiosis: Literature and Taxonomy", in *Annual Review of Energy and the Environment* 25: 313-37.
- Graedel T E, Allenby B R, 2010, *Industrial Ecology and Sustainable Engineering*. Prentice Hall.
- Grubler A, Fisk D eds., 2013, *Energizing Sustainable Cities: Assessing Urban Energy,* Earthscan Press.
- Guy S, Marvin S, Timothy M, 2001, *Urban Infrastructure in Transition*, Earthscan, London.
- Hough, M, 1995, "Climate: Making Connections" in *Cities and Natural Process*, Routledge, New York and London.
- Kennedy C, Pincetl S, Bunje P, 2010, The study of urban metabolism and its applications to urban planning and design, in *Environmental Pollution* 1-9.
- Thomas R, Fordham M, eds., 2003, Ch.6-7, In *Sustainable Urban Design: An Environmental Approach*. SPON Press, London.
- Yang, P P J, 2008, Tracking Sustainable Urban Forms and Material Flows in Singapore. In *World Cities and Urban Form: Fragmented, Polycentric, Sustainable?* edited by Mike Jenks, Daniel Kozak and Pattaranan Takkanon, Routledge.
- Yang P P J, Ong B L, 2004, "Applying Ecosystem Concepts to the Planning of Industrial Areas: A Case Study of Singapore's Jurong Island", in *Journal of Cleaner Production* (special issue on applications of industrial ecology), 12, 8-10, October 2004.

Seminar 2) low energy and renewable urban systems

(required)

- Bribian I Z, Uson A A, Scarpellini S, 2009, Life cycle assessment in buildings: State-of-the –art and simplified LCA methodology as a complement for building certification, Building and Environment, **44** 2510-2520.
- Nocera D G, 2006, On the future of global energy, Dadalus Fall 2006, the American Academy of Arts and Sciences.
- Ng E, 2009, Policies and technical guidelines for urban planning of high-density cities – air ventilation assessment (AVA) of Hong Kong, Building and Environment, **44** 1478-1488.

- Ratti C., Baker N., Steemers, K., 2005, Energy consumption and urban texture, Energy and Buildings **37** 762-776.
- Ratti C., Raydan D., Steemers K., 2003, Building form and environmental performance: archetypes, analysis and an arid climate, Energy and Buildings **35** 49-59.
- Steinberger J, Weisz H, 2013, "City wall and urban hinterlands: the importance of system boundaries", in *Energizing Sustainable Cities: Assessing Urban Energy,* Grubler A, Fisk D eds., Earthscan Press.
- Stremke S, Koh J, 2010, Ecological concepts and strategies with relevance to energy conscious spatial planning and design, *Environment and Planning B: Planning and Design*, **37** 518-532.

(recommended)

- Xu M, Weissburg M, Newell J P, Crittenden J, 2012, Developing a Science of Infrastructure Ecology for Sustainable Urban Systems, in *Environmental Science and Technology* **46** 7928-7929.

A synthesis: ecological urban systems by design

(required)

- Batty M, 2011, "Cities as flows, cities of flows", in *Environment and Planning B: Planning and Design*, Volume 38 195-19.
- World Architecture (WA), 2010, *Ecological Urbanism*, January Issue in *WA*, Tsinghua University, Beijing China.
- Yang P P J, 2014(?), Cities as flows: an energy perspective of urban form making, working paper in *Eco Urban Lab*, College of Architecture, Georgia Institute of Technology

(recommended)

- Allen, S. (2009) *Practice: Architecture Technique + Representation*, Expanded Second Edition. Routledge.
- Batty, M., 2013, The future cities agenda, in *Environment and Planning B: Planning and Design*, **40** 191-194.
- Batty, M., 2012, Smart cities, big data, in *Environment and Planning B: Planning and Design*, **39** 191-193.
- Castells M, 1989, "The Reconstruction of Social Meaning in the Space of Flows", in *The Informational City: Information Technology, Economic Restructuring, and The Urban- Regional Process*. Blackwell, Cambridge, USA.
- Yang P P J, 2006, Book review of Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing, *Environment and Planning B: Planning and Design*., Vol 33, 793-795.