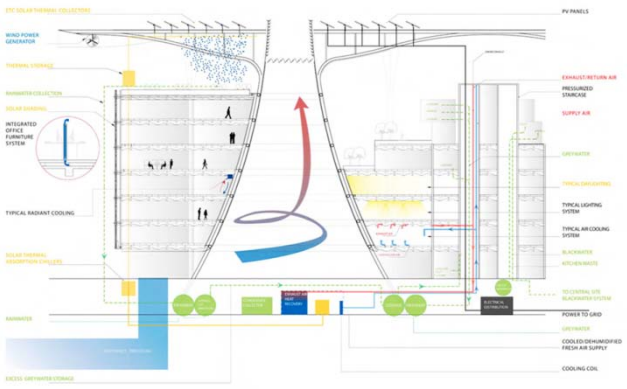
ARCH 5550 • Zero+DESIGN

Envisioning the Sustainable Campus

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

Rendering of Masdar HQ. Copyrights: Adrian Smith+ Gordon Gill



Section drawing noting the different sustainability strategies.

Exercise 5: Integrated Zero+ Design
Holistic Integration and Performance Analysis

Due Dates

Due Fri. May 6, 1:30 PM, Formal presentation; Rapson Hall Courtyard

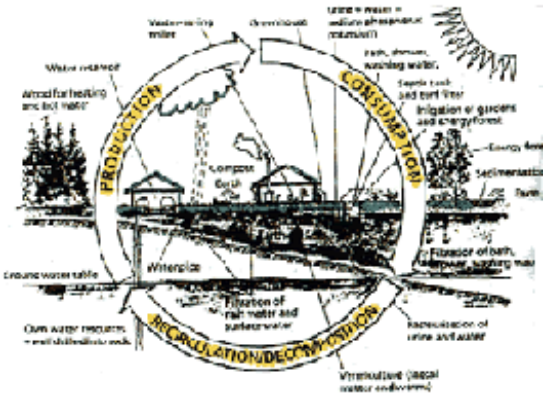
Exercise 5.0 Grade weighting: 30% total grade (300 points); team grade

OBJECTIVES

- To learn to integrate various sustainable strategies and systems across boundaries of building and site.
- To learn to assess building performance metrics including energy use, potable water use, grey water reclamation and wastewater treatment, rainwater harvesting and infiltration systems and solid waste reclamation and disposal strategies.
- To learn to measure the impacts associated with energy and water usage at both the local site and source scales.
- To gain an understanding of the cooling effects of evaporation and transpiration on buildings and to how to evaluate their potential in reducing cooling loads.
- To gain an understanding of the inter-relationships of energy, water, carbon emissions and waste.
- To conclude development of your project design towards net-zero and zero+ performance goals.

STEP A: SUSTAINABLE STRATEGY INTEGRATION

Identify the linkages and synergies of the proposed sustainable strategies for your project.



1. Make a list of all strategies proposed for your project and your performance goals (e.g., Net-zero energy use, Net-zero water use, Net-zero carbon footprint, Zero waste during construction and operation, etc.)
2. After reviewing your performance goals, create an integration matrix or diagram of the sustainable strategies that address each of your performance goals.
   • *Note: Identify the relative strengths of the relationships between the strategies and all of the performance goals.*
3. Consider the strategies that address only one performance goal and evaluate whether they can be modified in some way to address multiple goals?

   • *Present: graphic analysis of the proposed strategies for both building and site. Identify the inter-relationships and associated performance goals.*

STEP B: HOLISTIC SYSTEMS INTEGRATION

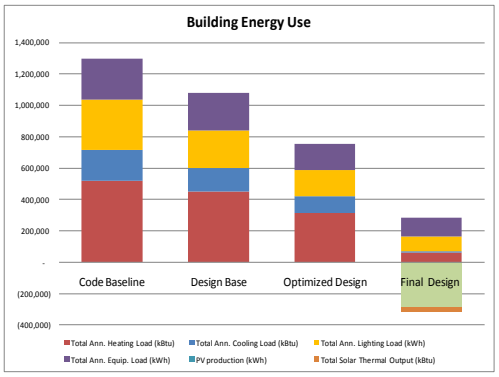
As a team, continue analyzing the performance goals for your project and the associated strategies proposed to mitigate impacts (less bad) and optimize benefits (more good). Identify the systems that are affected by the proposed strategies and consider the following:

1. Simplify. Can the systems be made less complex?
2. Synergize. Can the systems be revised to accomplish more functions or eliminate redundancies?
   • *Note: You may want to reexamine your precedent research and other case studies.*
3. Optimize. How can the systems be made more robust, more effective or less costly? …and how can they provide more benefits to the surrounding community.
   • *Note: You may want to consider analyzing the "recyclemania" data for other but similar building types as well, e.g. Dining Hall data could be used to predict waste and recycling for the dining portion of your project.*
4. Minimize. How can waste be eliminated through creative reclamation of energy or materials or diversion of waste by-products to provide resources to some other facility*?... i.e., How can Waste=Food.*
5. Combine. Can multiple systems be combined or can functions be shared in some way?.
   • *Present: Diagrams or drawings communicating the proposed systems integration approach for your project.*

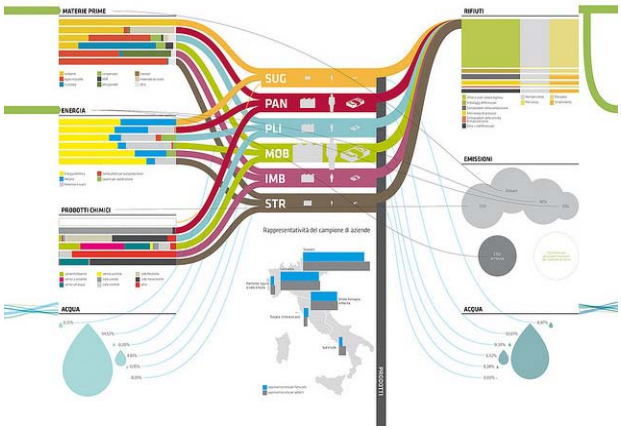
STEP C: PERFORMANCE ANALYSIS: ENERGY, WATER, RUNOFF AND WASTE

Complete your analysis of the energy and water usage performance of your proposed design compared to the baseline. Complete your final assessment of impacts including both at the local site and source usage characteristics. Complete the following:

1. Energy Performance: Calculate your estimated energy consumption by use (i.e., heating, cooling, lighting, domestic hot water, equipment and other) compared to the baseline for your project. Identify the specific energy conservation and renewable energy strategies proposed to achieve this result. Show the resulting EUI in KBtu/SF/Yr and the total utility cost in $/Yr if known.
   • *Note:* If your estimates are based on precedent research of relevant case studies, indicate the specific project name, location and site your sources. You may also want to include some graphic documentation for the case studies.



2. Calculate your estimated potable water consumption compared to the baseline for your project. Identify the specific water conservation and reclamation strategies proposed to achieve this result. Show the resulting WUI in G/SF/Yr and the total utility cost in $/Yr if known.
   • *Note:* See note under C.1. Above.
3. Calculate your estimated reclaimed solid waste and disposal requirements compared to the baseline for your project. Identify the specific waste management and reclamation strategies proposed to achieve this result.
   • *Note:* See note under C.1. Above.



4. Using the Zero+ Calculator provided for the course, calculate the total estimated off-site energy generation requirements in KBtu/SF/Yr and the associated carbon emissions in Tons/Yr. as compared to the Baseline for your project.
   • *Note: Include both on-site energy use and energy associated with water delivery and waste water treatment in your energy and carbon calculations. Also include carbon emissions from burning of solid waste sent to the HERC plant.*

5. Update the water balance, energy and waste usage studies (e.g., sankey diagrams) completed *in Exercise 4 Steps B,C and D. Create a similar combined (integrated) energy, water and waste performance flow diagram for your proposed design compared to the Baseline for your project.*
   • Optional: Include Carbon Emissions associated with energy, water, waste as calculated in C.4. above.
   • Present: Integrated Energy, Waste and Water balance model: Proposed Design vs. Baseline. Include any other graphic diagrams, section drawings or charts that help to illustrate your overall sustainable approach to waste, energy and water use and reuse.

STEP D: WRITTEN FINDINGS AND CONCLUSIONS

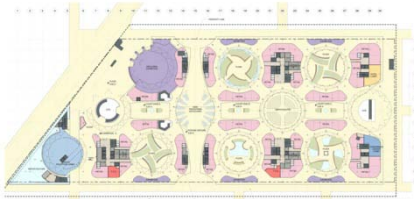
Develop a brief written summary of the findings and conclusions of your analysis and your design explorations. Please include the following in your presentation:

i. Design Intentions, Concepts, and Strategies: Summarize the critical design intentions, concepts, and strategies related to your Zero+ Design Proposal.
ii. Performance: State clearly how well your final design meets your ZERO+ performance goals (e.g., energy, water, waste, etc.) using written and/or graphic means.
iii. Optional - Carbon Emissions: State clearly how well your final design performs in terms of annual carbon emissions including energy use, water delivery and waste disposal - use written and/or graphic means.
iv. Life Cycle Cost Analysis: To be added later.
v. Ecological Impacts/Benefits Summary: Summarize the Zero+ (Eco-effective) benefits of your final design to the community and surrounding eco-systems.
vi. Strengths and Weaknesses and Lessons: List the major strengths and weaknesses of your design proposal? Lessons?

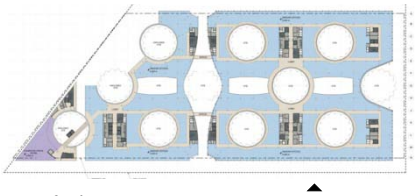
STEP E: FINAL INTEGRATED DESIGN: 1/16" Plans, Sections, Exterior Elevations Physical site and building massing model and other Drawings as appropriate

Due: Friday, April 22, 1:30 p.m. Rapson Room 71; Informal Review

Communicate your conceptual design proposal illustrating the building programmatic spatial layout, vertical floor –to-floor relationships, and exterior finish and appearance. Keep in mind that these drawings and model are considered to be equivalent to Schematic Design phase drawings intended to convey your final design ideas and approach.



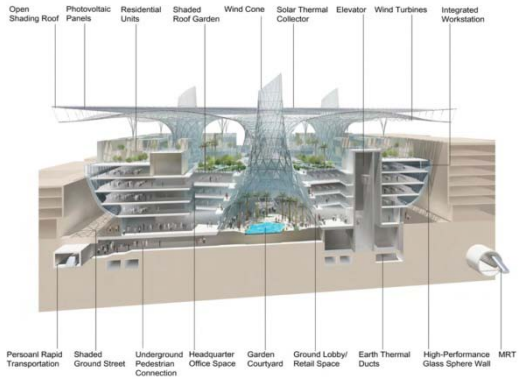
Typical Upper Level Plan 1/16" Scale N



Roof Plan 1/16" Scale N

For your formal review on *Friday, May 6,* please include the following:

1. Site/Building Floor Plans: Develop annotated floor plans for your first floor at 1"=16' scale to illustrate your site layout and ground floor design concept. Develop a typical upper level floor plate and Roof Plan. Identify the key water, energy and waste aspects of your site and building. Include a scale and North arrow and identify section cut locations.
2. Section Drawings: Develop annotated section drawing(s) for your proposed design at 1"=16' scale to illustrate your key energy, water and waste strategies as well as the vertical arrangement of your proposed design concept. Identify any passive integration strategies such as daylighting and natural ventilation, as well as key energy and water systems, such as rainwater harvesting, green roofs, renewable energy systems, etc.
3. Building Elevations: Develop at least two annotated exterior elevation drawings (one should be of the south exposure) for your proposed design at 1"=16' scale to illustrate your exterior cladding and fenestration layout and strategies as well as the aesthetic appearance of your proposed design concept. Identify any passive integration strategies such as shading systems, high performance glazing and wall integrated renewable energy systems, etc.
4. Physical Massing Model: Develop a physical model of your final design project at 1/16" scale (or other appropriate scale).
5. Other Drawings and renderings as necessary to fully communicate design intentions.



Section 1/16" Scale

GRADING CRITERIA - Exercise Five: *30% total of ARCH 5550 grade (300 pts)*

- Clarity and accuracy of quantitative analysis tables, charts, graphs and diagrams
- Craft and quality of annotated conceptual design drawings
- Craft and quality of physical model
- Clarity and accuracy of written summaries and conclusions drawn