ARCH 4150/5550 · Whole Building Analysis

Envisioning the Sustainable Campus

towards zero: integrating carbon, energy, water and ecological impacts

Exercise 5: Design recommendations based on Shoebox Analysis evaluation and presentation of results

Exercise 5 Due Date
Thurs. Nov. 23, 2011, 4:00 PM
Upload to Exercise 5 assignment drop box on course Moodle site

Phase Grade weighting: 10% total grade (100 points); individual grade

OBJECTIVES

- To learn to understand and evaluate water impacts and utilization with regards to both building and site
- To grasp the intricate relationships and linkages between water and energy flows
- To learn various methods for calculating water use in buildings and performing site water balance analysis
- To formulate a cohesive integrated water design strategy based on your findings and conclusions

Introduction

For this exercise you will perform various calculations and analyses relating to water usage in your building and stormwater utilization vs. runoff from your site. These will include 1) calculation of the water usage in your building along with the effects of possible water conservation strategies and 2) performing site water balance analysis of your project site including various strategies that would reduce potable water consumption, increase infiltration and reduce runoff from the site. Several tools will be available for these tasks including:

1. **VE-Toolkits** – Water Water Review: analyzes the occupancy and fixture type selections to establish a proposed and baseline case for comparison. The output provides overall water consumption, a 'water scarcity' global metric, and identifies what water use reduction measures are the biggest drivers to achieving higher and higher percentages of savings. LEED: Water: incorporates the LEED calculation methodology to determine the percentage water use reduction. Also demonstrates the potential impact of rainwater harvesting, grey water, and black water reuse.

2. **VE-Gaia (Navagator) –** Water appliance analysis & evaluation of potential wastewater recycling technologies and resulting efficiencies. Follow the step-by-step instructions provided in the Navigator labeled "VE Gaia/Water."

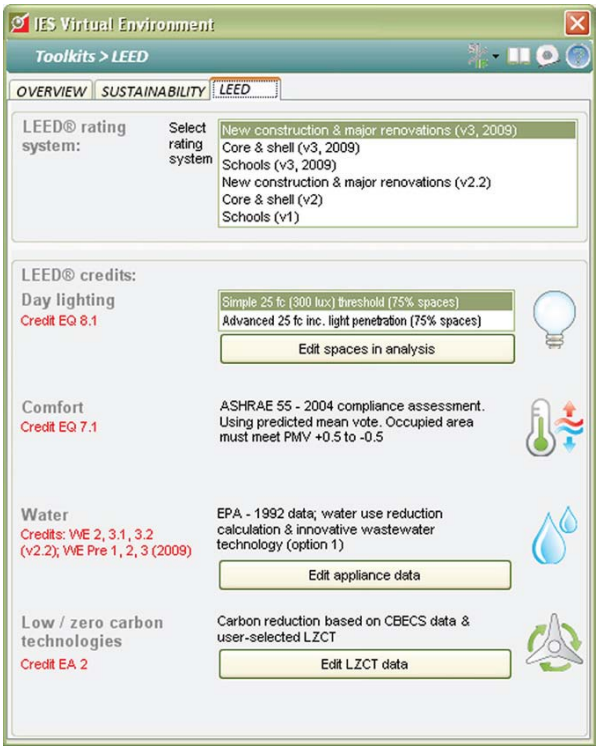


Figure 1: LEED Summary Report including water efficiency evaluation using IES VE – Toolkits.

3. **Urban Water Model –** a tool (better defined as a model) that is capable of estimating within a reasonable margin of error (5-10%) the water use and flows related to people, landscapes, and systems, based on empirical data, of a given set of design strategies. Read the instructional tutorials provided (e.g., Architect RandD Awards v2.pdf.)

4. **Green Values™ National Stormwater Management Calculator –** an online green infrastructure evaluation tool that compares green infrastructure (commonly referred to as Low Impact Development) performance, costs, and benefits to conventional stormwater practices. The tool provides a quantified analysis of LID environmental benefits including reduced runoff volume and maintenance savings, in addition to carbon sequestration, reduced energy use, and groundwater recharge. (Review: Green Values Methodolgy .pdf file provided.)

5. **Sankey diagrams** can be used to graphically illustrate water cycle flows and utilization in terms of volume (gallons or Acre Feet) annually and provide visual comparisons between the baseline and proposed design including water conservation, harvesting, reclamation, infiltration or other strategies. Adobe Illustrator is the preferred tool for creating these types of diagrams.)

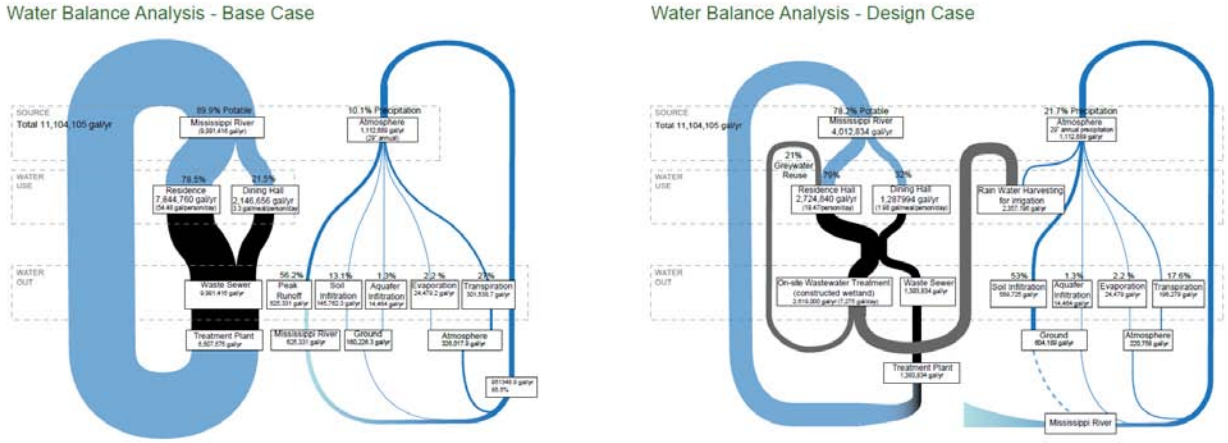


Figure 2. Sankey Water Balance Comparative Diagram

You will be asked to work in tandem with your team-mate(s) in completion of this assignment but your submission will be your own work and you will be graded individually. Each individual will perform at least two of the analysis described below using at least one of the tools listed above. The final deliverables are described in Step 3 below. The following analyses are to be performed by each team of 2 or three individuals (minimum 2 per person):

1. Project LEED Water evaluation (VE-Tools)
2. Water usage, harvesting and reclamation Summary Report - VE- Gaia Water Review (see at right.)
3. Water Cycle Comparison (Urban Water Model or Green Values National Stormwater Calculator recommended)
4. LID
5. Water Balance Analysis (Sankey Diagram recommended based on analysis by Tool of your Choice)

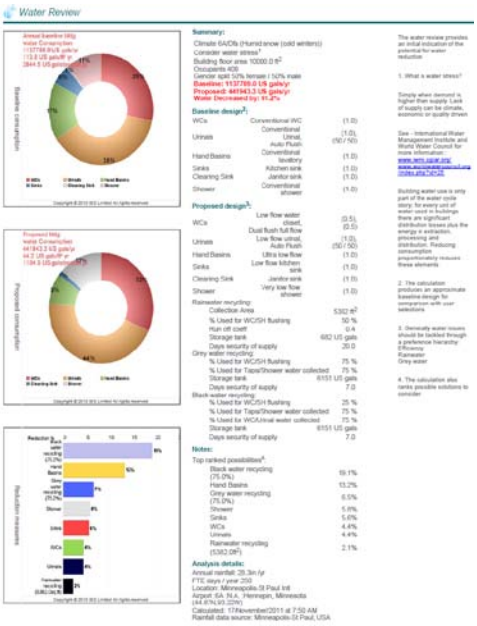


Figure 3: Water review Summary Report using IES VE - Gaia.

Exercise Five: SITE AND WATER ANALYSIS

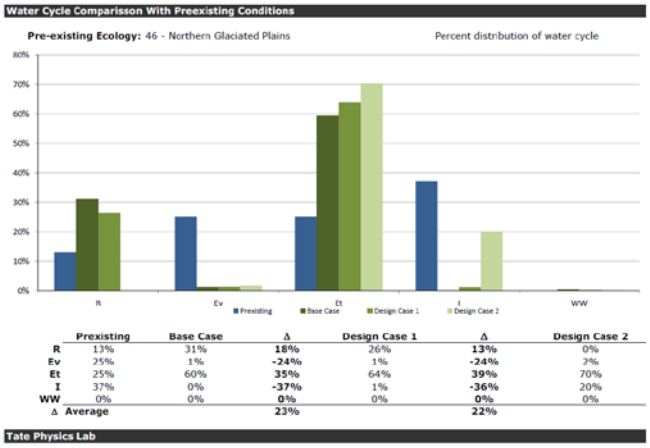
STEP 1: *Gather information and make assignments.* Together with your teammates, you should do the following:

a) Gather and review your baseline and proposed design building and site information, e.g., no. of occupants, water appliances and fixture requirements, roof area, other potential cachement areas, site area, existing non-permeable (paved) surfaces, turf (lawn) area, types of vegetation and associated planted areas, quantity, location and types of trees, etc.

b) Discuss the opportunities for and preferred mix of Green Infrastructure BMPs or LID strategies (green roof, rainwater gardens, constructed wetland, permeable paving. swales, additional trees and plantings, etc.)

c) Discuss the opportunities for and preferred mix of water conservation measures (plumbing fixtures, irrigation strategies, rainwater harvesting opportunities.

d) Discuss the opportunities for and preferred mix of innovative water reclamation and treatment measures (e.g., grey water reuse, black water treatment and reuse, living machine, etc.)



	Prexisting	Base Case	Δ	Design Case 1	Δ	Design Case 2
R	13%	31%	18%	26%	13%	0%
Ev	25%	1%	-24%	1%	-24%	2%
Et	25%	60%	35%	64%	39%	70%
I	37%	0%	-37%	1%	-36%	20%
WW	0%	0%	0%	0%	0%	0%
Δ Average			23%		22%	

Tate Physics Lab

Figure 4: Water Cycle Comparative Analysis using Urban Water Model tool.

e) Decide on the types of water and site studies and analyses to be done and the preferred tools. Make individual assignments (i.e., minimum 2 per person.)

STEP 2: *Complete the Analysis.* Do the following:

a) Review all tutorials, instructions and other documentation provided for the tool(s) you are using. Make several practice attempts to learn to use the tools properly. Investigate any results that do not make sense or errors.

b) From the data gathered and choices made in Step one, complete the studies assigned to you and create the necessary reports and graphics (see deliverables in Step 3.)

STEP 3: Evaluation of results and required deliverables. Do the Following:

a) Create Site plan drawings for your baseline and proposed design case or multiple cases. Your drawings should indicate location and quantity of roof area, permeable site areas and green infrastructure components, non-permeable areas such as sidewalks and roads.

b) Create the most appropriate reports and charts for the types of studies you are responsible for. Be sure that all charts are clearly labeled and all axis include laebs and units if appropriate. Include legends as appropriate.

c) Summary of Findings and Conclusions: Together with your teammate(s) review the results and identify the most important findings and conclusions from your combined analysis work. State which strategies you investigated that had the most significant benefits and rank the strategies

studied in terms of your best guess at Life Cycle Cost advantage to the owner. Each individual should include the summary of Findings and Conclusions with their submission.

d) Upload your presentation files to the ***Exercise 5 Drop Box*** on the course Moodle Website by Wed. Nov. 23 at 4pm.

GRADING CRITERIA - Exercise 4: 100 possible points (10% total of grade) based on the following criteria:

- Completeness of deliverables submitted
- Depth of analysis and complexity of project and reasonableness of conclusions
- Clarity and accuracy of quantitative analysis charts and graphics
- Quality and craft of drawings and charts