- Successful Integration of Life Cycle Assessment in to Civil Engineering Course -

CIVL 498C Life Cycle Analysis of UBC Buildings

This article is to announce the success of the pilot course CIVL 498C – Life Cycle Analysis of UBC Buildings – in the Civil Engineering Department at UBC this past 2008/2009 winter session. The significance of this course is that it is the first ever at UBC to be dedicated to teaching the science-based environmental impact assessment method of Life Cycle Analysis (LCA). Through learning about LCA and applying it in practical applications, fourth year Civil Engineering students were given their first opportunity to take a unique look at buildings from a quantified environmental impacts perspective. This perspective is becoming ever more important in today's society as concerns over our activity's impacts on the environment increase. Significant environmental impacts are created by the building sector simply because current standard decision making processes do not take environmental impacts into account. The knowledge and skills gained by students completing the course will help them begin to integrate practical decision making processes that contribute to decoupling the building sector from environmental degradation, through being capable of;

- Completing a Life Cycle Assessment (LCA) study in accordance with ISO 14040 and 14044 guidelines
- Understanding, interpreting and scrutinizing LCA studies
- Conducting material takeoffs from architectural and structural building drawings using OnCenter's OnScreen Takeoff software
- Conducting a whole building LCA study using the Athena Sustainable Materials Institute's Environmental Impact Estimator software

The main deliverable for the course required each student to submit a cradle-to-gate LCA study on the structure and envelope of an assigned academic or residence UBC building (Table 1).

Table 1 UBC Buildings studied in CIVL 498C 2008/2009.

Academic Buildings	Residence Buildings
• Geography • Hennings • HR MacMillan • Buchanan • Civil and Mechanical Engineering (CEME) • Forest Sciences Center (FSC) • Aquatic Ecosystems Research Laboratory (AERL)	• Vanier • Totem • Walter H. Gage • Fairview • Thunderbird • Marine Drive

Combining the use of structural and architectural drawings with site visits, students created profiles for the various assemblies and materials of their assigned buildings. This process also included performing take-offs using OnScreen TakeOff version 3.6.2.25. These profiles were then used to generate whole-building LCA models with the Environmental Impact Estimator (Impact Estimator or IE) software, version 4.0.51. This version of the Impact Estimator used the Athena Life Cycle Inventory (LCI) Database version 4.6 to complete the LCI portion of the LCA, and the Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI) version 2.2 to complete the Life Cycle Impact Assessment (LCIA) portion of the study.

Students in the course we were fortunate to get the chance test out the latest version of the IE software (version 4.0.51), however, the downside of this was that it is still under development, thus only preliminary results are currently available. An example of the outcomes is seen in Table 2, where average impact profiles were generated for the respective building types studied.

Table 2 Preliminary LCIA results of UBC buildings studied in CIVL 498C 2008/2009.*

Impact Category	Academic Avg	Residence Avg
Primary Energy Consumption (MJ)	237.5	306.8
Weighted Resource Use (kg)	148.0	202.39
Global Warming Potential (kg CO_2 eq)	20.0	25.7
Acidification Potential (kg H^+ eq)	6.8	9.1
Human Health Respiratory Effects (kg $PM_{2.5}$ eq)	5.9x10-2	7.5x10-2
Eutrophication Potential (kg N eq)	5.1x10-4	6.4x10-4
Ozone Depletion Potential (kg CFC-11 eq)	5.1x10-8	7.0x10-8
Smog Potential (kg NO_x)	9.2x10-2	1.3x10-1

*Although these results are not expected to change significantly, it must kept in mind that these are the preliminary and not the final results of the LCA studies conducted.

Each of the UBC building LCA's completed includes a Bill of Materials, Life Cycle Inventory (LCI), Life Cycle Impact Assessment (LCIA). Once the final build of the Impact Estimator version 4 is released, the LCA results will be updated and the studies resulting from the CIVL 498C course will be made available on the Social Ecological Economic Development Studies (SEEDS) program website (http://www.sustain.ubc.ca/seedslibrary/).

The main outcomes of the students efforts in CIVL 498C are the establishment of material inventories and environmental impact references for buildings at UBC. An ideal application of these references are in the assessment of potential future performance upgrades to the structures and envelopes of the studied buildings. When the studies completed by the students are considered in conjunction further applications include the possibility of carrying out environmental performance comparisons across UBC buildings over time and between different materials, structural types and building functions. Furthermore, as demonstrated through these potential applications, these LCAs can be seen as an essential part of the formation of a powerful tool to help inform the decision making process of policy makers in establishing quantified sustainable development guidelines for future UBC construction, renovation and demolition projects.

Since the completion of the course, invitations to present its' successes have seen presentations given at the Athena Sustainable Materials Institute's office in Ottawa, Recollective Consulting's office in Vancouver and the Integrated Design Workshop for the UBC Renew Biological Sciences Complex project. In addition to these, I will presenting the successes of the course at the LCA IX in Boston this coming late-September.

CIVL 498C 2008/2009 class photo.

In response to the overwhelming success of the pilot course with the students, academic community

and private industry, we are proposing to continue to offer CIVL 498C in the Civil Engineering Department at UBC and are currently exploring funding options.

I would like to thank the Civil Department, UBC Sustainability Office, UBC Social Ecological Economic Development Studies (SEEDS), OnCenter Software and the Athena Sustainable Material Institute for their generous contributions which made this course possible. I would also like to express my sincere appreciation to the biggest contributors of the course's success, the students, as their level of enthusiasm and dedication to the course and it's subject matter was truly inpirational.

Please feel to contact me if you would like to have more information on CIVL 498C,

Cheers,

Rob Sianchuk, B.Sc.
M.A.Sc. Candidate