Wasatch Experience
Implementation Summary

Complete this worksheet after you have modified your course, delivered it, and assessed it. Attach a syllabus/course outline, Activity Sheets for new activities, summary of your assessment, and essential copies of teaching materials to help the mentor team evaluate your achievement of workshop goals.

Course Name: ____ CVEEN 5550– Sustainable Materials __________________

Instructor Name: ___Pedro Romero_______________________________

List your course, lesson, or activity learning goals that highlight new sustainability elements.

COURSE DESCRIPTION: This course presents the concepts necessary to evaluate, select, and design materials in civil engineering applications to be energy-, cost-, and eco-efficient while durable and high performing.

Explain the new sustainability element(s) you incorporated into your course and how they related to the learning goals above (at course, lesson, or activity level). Describe how you see these elements relating to sustainability.

By the end of semester, students will be able to predict criticality/exhaustion of a resource (e.g., crude oil), identify different phases in the life of a structure or product, perform simple life-cycle assessment to estimate the total energy- and carbon-footprint of a structure, calculate material indices and select the best materials (with optimum mechanical, durability, and eco-performance) for a project, design efficient cross sections for structural members, calculate the effective properties of composite materials, and explain various techniques for designing green concrete materials. The course is developed to emphasize active learning through interactive classroom discussions, computer simulations, and laboratory exercises.
Provide a concise listing of sustainability lessons and activities and show their location in the course schedule. For selected activities attach a completed Activity Sheet.

**Assessment Mechanisms**

- 2 Exams
- 8 Homework
- 3 Field Reports
- 1 Final Exam
- 1 Case Study Presentation
- 1 Participation
- 1 Material Research Paper

**Typical Exam question:**
Two materials are considered for guard rails: wood and aluminum. For simplicity, the performance of the guard rail will be analyzed as a simply supported beam loaded at the midpoint. The distance between posts is 6 m. The original guard rail is made out of corrugated stainless steel with a cross sectional area of 0.0005 m$^2$ and a moment of inertia in the direction of loading approximately equal to 741 x 10$^3$ mm$^4$.

Determine the dimensions (height and depth) of an aluminum guardrail so that the deflection of the rail when loaded remains the same. For simplicity, assume a prismatic shape with an aspect ratio (h to d) of 9 for aluminum loaded along the tallest dimension. Show all calculations

**Typical Homework Problem**
A Portland cement concrete mix has been designed based on the following mass ratios based on aggregate SSD conditions.

Water : Cement : Fine Aggregate : Coarse Aggregate → 0.51 : 1.00 : 2.55 : 3.10 The final product also has 5% air entrainment

Determine the total mass of each component of this mix for 1 m$^3$ of concrete. Then determine the total embodied energy and CO$_2$ emissions of this concrete mix.

**Field Report Instructions**
Determine the material quantities (i.e., bill of materials) for the first and second levels of the business circle parking structure. This includes concrete and steel reinforcement for the foundation, the wall, and the floor slab. Disregard any excavated material or any other architectural material. Based on the quantities calculate the embodied energy and the CO$_2$ equivalent for the materials phase only (i.e., disregard transportation). Again since this is a parking structure, it is reasonable to assume that the impact of other phases should be small in comparison.

**Case Study Instructions**
The case study is meant for you to research a specific item of the local infrastructure and perform an eco-audit in comparison to an alternative; in other words part of your evaluation should include relative comparisons. You will need to define the boundary of your analysis (both temporal and spatial) as appropriate and break down the item into five different processes or phases and five different effects related to the 5 pillars of sustainability.

**Research Paper Instructions**

Research Paper Assignment is meant for you to research a specific material use in civil infrastructure and describe its advantages from a sustainability point of view. The idea is for you to become familiar with a state-of-the-art approach to a given material. In essence it should be a look at emerging technology.

What motivated you to change your course?

Sustainability is at the core of what the profession does, yet there was no course specifically addressing material sustainability. This is not only a change in a course but rather a option in the curriculum.

Explain how you approached the modification of your course.

Develop a new course and teach it as a Special Topics. Then based on students comments and self assessment modify the course. Teach it as a primary technical elective in the Civil Engineering program

Did you achieve your proposed desired modification of the course? Why or why not?

Assessments are still being performed. Throughout the course there were several aspects that were identified in need of change. Some more realistic than others and will be evaluated during Fall 15.

Describe the process you took to develop the sustainability teaching materials. What did you find particularly helpful? What did you do that was not particularly helpful?

Look at different books available. Contact colleagues that teach a similar course. Discuss with other faculty members. All were helpful at one point or another.

Did the students achieve the sustainability learning goals of the course, lesson, and/or activity?

Yes
What will you do differently in the future to continue to enhance the sustainability content and/or delivery of this course and others?

Try to incorporate the materials used in other courses so that the students see a connection between this course and other courses.

In retrospect, in what ways could the Wasatch Experience have improved your ability to elevate your teaching of sustainability content?

It provided with contacts across campus that help delivering the course as well as give suggestions.