

Sustainable Design Throughout the Curriculum Using Case Studies

Steve Lambert
NSERC – General Motors of Canada
Chair in Collaborative Design

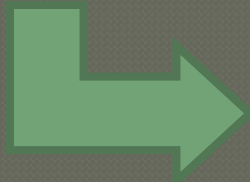
UNIVERSITY OF
Waterloo



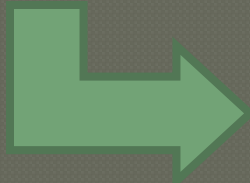
Mudd Design Workshop VII
“Sustaining Sustainable Design”
Claremont, California
28-30 May, 2009

steve@uwaterloo.ca – www.design.uwaterloo.ca

“Sustaining Sustainable Design”



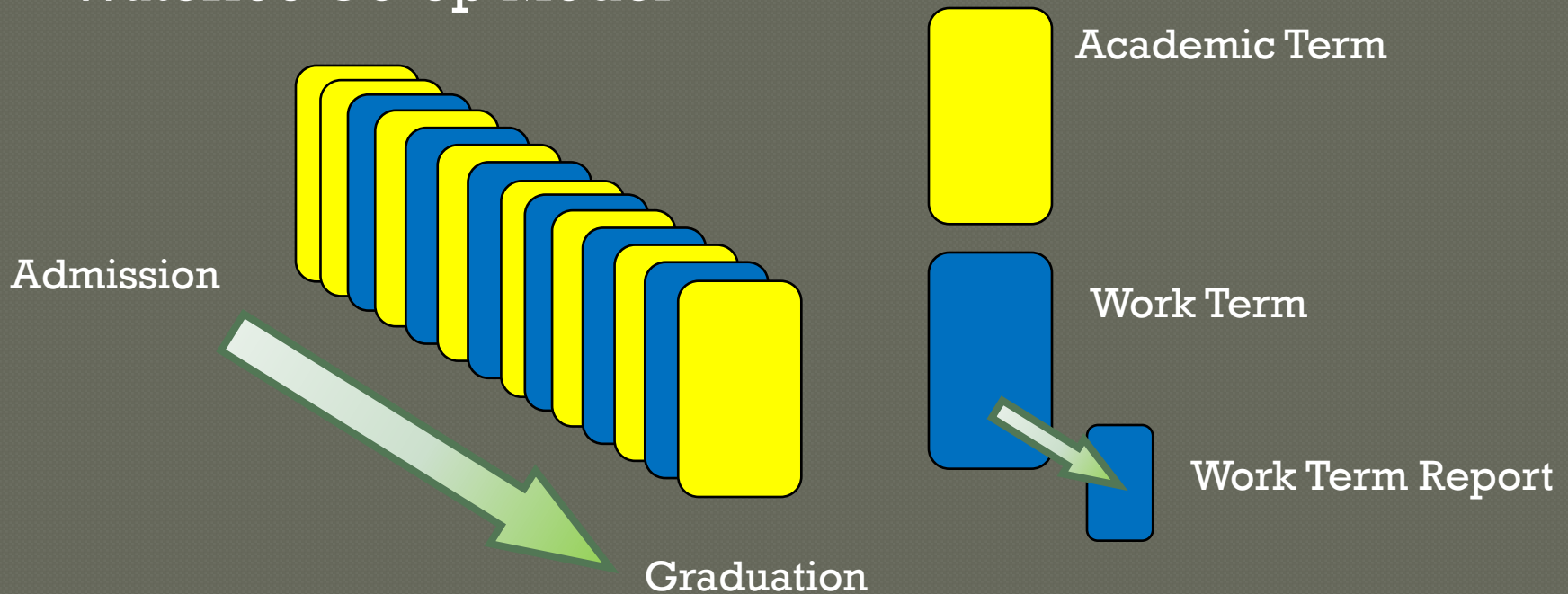
Sustaining a change in the
curriculum



Changing the academic culture

Learning from Experience

Waterloo Co-op Model




Waterloo Chair in Design Engineering

- NSERC – General Motors of Canada Chair In Collaborative Design
 - Title Sponsor: General Motors of Canada Limited (GMCL)
 - Development and implementation of design cases Faculty wide
- Prime innovation is use of work term reports as case material
- Waterloo Engineering students generate approximately **4000 work term reports** each year

Capturing Experience: What is a Case?

- A mechanism to capture and deliver a real experience
- An account of a real situation or experience that is published (released) and used for educational purposes
 - Facilitates case method teaching and learning
 - Promotes active rather than passive learning
- Commonly used in the teaching of business, law, medicine and engineering (ethics, failure analysis)

 **WATERLOO CASES IN DESIGN ENGINEERING**


WCDE-00022-01
Revision 080516

ELORA HOME HEATING

S. Lambert

Introduction

In August 1999, Steve Lambert, a Professor in the Department of Mechanical and Mechatronics Engineering at the University of Waterloo, purchased a stone house in Elora, Ontario, Canada. Figure 1 illustrates the front (west) and side (north) views of the house as it looked when it was purchased. The stone exterior is obscured by the ivy growing up the sides of the house. The house was not well insulated, and heated using a forced-air natural gas furnace. This furnace has a rating of $81,600 \text{ Btu/hr}$ ($102,000 \text{ Btu/hr}$ natural gas input). The house was purchased with the intention of significantly updating the interior, especially the insulation and windows, to significantly improve both comfort levels and energy efficiency.




(a) Front (west) view of original house. (b) Side (north) view of original house.
Figure 1. Photos of the original house.

The main house consists of two floors approximately 30 ft long by 25 ft wide, for a total gross living area of about 1500 ft^2 . It has a rough basement under half of the main house and a crawl space under the remaining half. Figure 2 provides a schematic of the layout. Dimensions of each wall surface are provided in Appendix A.

S. Lambert of the University of Waterloo prepared this design case for classroom use. The authors do not intend to illustrate either effective or ineffective handling of an engineering situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

Waterloo Cases in Design Engineering prohibits any form of reproduction, storage or transmission of this document without its written permission. This material is not covered under authorization of CopyRight or any reproduction rights organization. To order copies or request permission to reproduce material contact Waterloo Cases in Design Engineering c/o Department of Mechanical Engineering, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1.

Copyright © 2008, S. Lambert. Used by University of Waterloo with permission.

 **Waterloo**
ENGINEERING
USE OR REPRODUCE

WATERLOO CASES IN DESIGN ENGINEERING

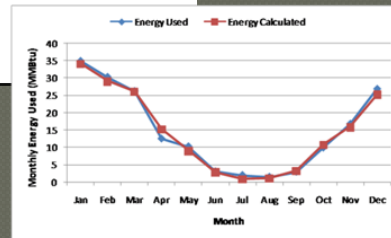
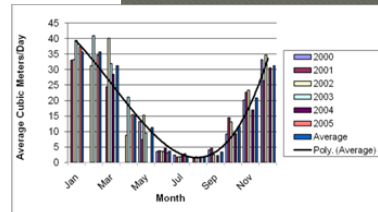
1

Work Reports → Design Cases

example: Elora Home Heating Retrofit

Work Term Report

1. Introduction
2. Background (Context)
3. Thermal Model
 - 3.1. Background Theory and Assumptions
 - 3.2. Model Verification
 - 3.3. Model Results for Renovated House
4. Selection of Heating System
 - 4.1. Heating Systems Considered
 - 4.2. Cost Comparisons
 - 4.3. Selection of Best Option
5. Conclusions
6. Recommendations



Case

Case Description

- Introduction
- Background Context
- General Problem Statement

Module 1

Thermal Model

- Background Theory for Model
- Model Verification
- Model Results
 - Heating Requirements

Module 2

Design Solution

- Heating Options Considered
- Cost Comparisons
- Recommendations

Module 3

Lessons Learned

- How to approach a problem
- How to improve on results

Cases from Work Term Reports

Work Reports Submitted
to WCDE Group



Work Report Selected
for Conversion to Case



Design Case



Provisional Release:

- Student
- Employer

Final Release:

- Student
- Employer

Work Report converted to case
by WCDE Staff: Case Writer

Intellectual Property (IP) owned by
student and company, as appropriate

Eventually provide option for
students to submit case directly

Copyright owned by student and
case writer, as appropriate

Sustaining Sustainable Design

- Not all students get exposed to sustainable design on co-op work terms
 - ***But some do***
- Not all professors have a sustaining interest in sustainable design
 - ***But some do***
- How to spread available experience and enthusiasm throughout the curriculum???
 - ***Virally, via case studies***

Summary

- We are introducing case studies as a mechanism to teach design throughout the curriculum
- To date, over 100 students have voluntarily submitted their reports for conversion
- This provides an exciting mechanism to leverage student experience to enrich the curriculum for everyone