

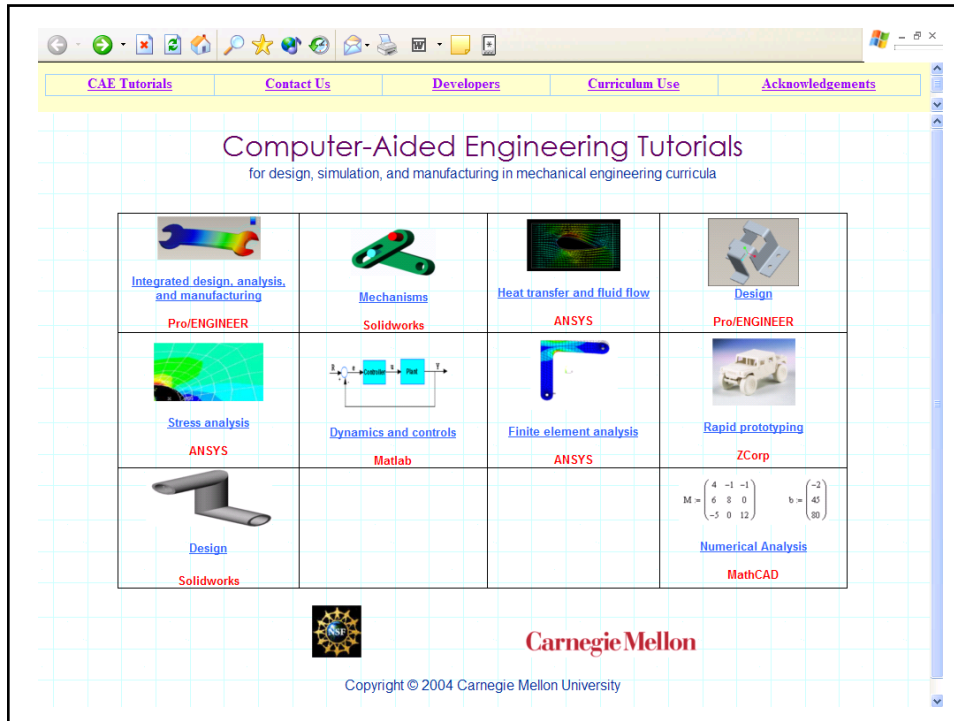
Developing CAE Skills Through Web-Based Course Modules Across the ME Curriculum

Jonathan Wickert and Jack Beuth
Department of Mechanical Engineering
Carnegie Mellon University

Carnegie Mellon

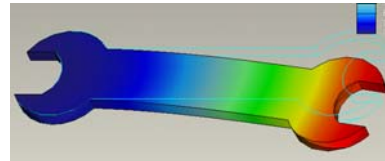
Web-Based CAE Course Modules

- ❑ CAE tools in mechanical engineering practice and education
 - ❑ First year students are unaware of the extent to which mechanical engineers use computer-based tools
 - ❑ Steep learning curve associated with software interfaces
 - ❑ Don't want to spend lecture time on "picks and clicks," or detract from traditional technical content
 - ❑ Web-based modules are an option to preserve classroom time for fundamentals and analytical skills
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First Year Experience in Computer-Aided Design, Analysis, and Manufacture

- Used in "Introduction to Mechanical Engineering"
- Pro/Engineer's design, analysis, and manufacturing software
- Re-sets student perceptions of mechanical engineering



Part Modeling in Pro/Engineer Wildfire - Microsoft Internet Explorer

Address: http://www.me.cmu.edu/academics/courses/NSF_Edu_Proj/Fresh_CAE_Intro/modelingframe.htm

Fundamentals of Mechanical Engineering CAE Project

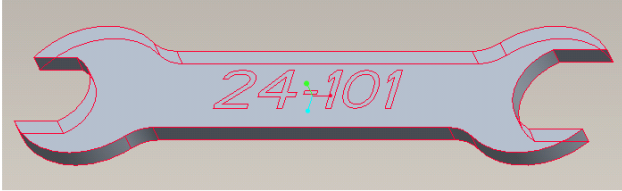
Carnegie Mellon PTC

Overview Modeling Tutorial Analysis Tutorial Manufacturing Tutorial Acknowledgments

Part Modeling in Pro/Engineer Wildfire

Introduction

In this tutorial we will be creating a three-dimensional model of a wrench. Three dimensional modeling is a vital part of the CAE process; without a model there would be nothing to analyze or machine. The wrench you will be making is double ended, with jaws of 1 and 1.25 inches. It will be made from aluminum. When you are finished your model will look like below.



Setup

Step 1: Start ProE Wildfire from Start - All Programs - PTC - Pro/Engineer - proewildfire

Step 2: Select the origin as the modeling direction by clicking on it in the left tree pane.

Introduction
Setting up Pro/E
Sketching the wrench body
Sketching the wrench jaws
Finishing the sketch
Filletting the 3d wrench
Wrap-up
Your Report

Tutorial 7
Engineering Drawings

Tutorial 8
Assembly Modeling

Advanced Modeling Techniques

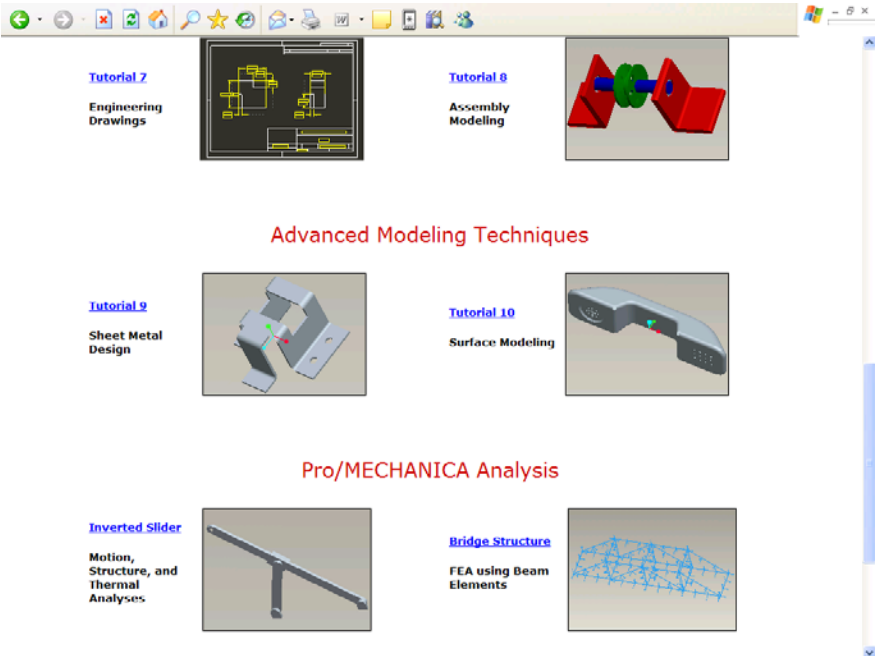
Tutorial 9
Sheet Metal Design

Tutorial 10
Surface Modeling

Pro/MECHANICA Analysis

Inverted Slider
Motion, Structure, and Thermal Analyses

Bridge Structure
FEA using Beam Elements



Computational Skills in Accreditation

- ABET (k): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- CAE modules throughout the curriculum emphasize relationships among theory, physical reasoning, and numerical modeling
- Computational target skills
 1. Exposure to current industry-grade CAE packages (required)
 2. Ability to “think in front of a computer” (required)
 3. Skill at programming in a high-level language, and exposure to numerical or symbolic packages (required, elective)
 4. An understanding of the governing equations and methods used within software (elective)

| Target Skills: | 1. Exposure | 2. Critical | 3. Programming | 4. Gov Eqns | Packages, Projects |
|-------------------------------------|-------------|-------------|----------------|-------------|---|
| <i>Required Courses</i> | | | | | |
| 8 General Educ Courses | | | | | |
| Freshman | | | | | |
| Calculus I | | | | | |
| Calculus II | | | | | |
| Physics I | | | | | |
| Physics II | | | | | |
| Computer Skills | H | | L | | Word Proc., HTML, Spreadsheet |
| MechE Fundamentals | H | M | | | ProE, ANSYS, Pro/Manufacturing, Projects with CAD, FEA (solids), CAM, CNC Milling |
| Non-MechE Fundamentals ¹ | | | | | |
| Sophomore | | | | | |
| Calculus in 3D | | | | | |
| Differential Equations | | | | | |
| Chemistry w/Lab | | | | | |
| Computer Programming | L | | H | | C++ Programming |
| Thermodynamics I | | | | | |
| Fluid Mechanics | | | | | |
| Statics | M | H | | L | |
| Mechanics of Materials | H | H | | M | ANSYS: Beams and Intro to Stress Concentrations |
| Junior | | | | | |
| MechE Seminar I | | | | | |
| MechE Seminar II | | | | | |
| Numerical Methods | H | H | H | H | MathCAD, Matlab, C++ Programming |
| Thermal-Fluids Engineering | M | H | | M | ANSYS: Heat Spreader Problem Coupled with Experiments |
| Heat Transfer | M | M | | | ANSYS: Conduction Analysis of a Composite Wall |
| Dynamics | | | | | |
| Dynamic Sys. and Control | M | L | L | | MathCAD, Matlab |
| Electrical Engineering | | | | M | |
| Senior | | | | | |
| Engineering Analysis | L | M | | M | ANSYS, MathCAD, Mathematica as needed |
| Engineering Design | M | | | | ProE as needed |

Course Modules and Curriculum Integration

| Course | Title | Link to Software Web Module | CAE Assignment (word .doc) | Purpose & Skills (word .doc) | Point of Contact |
|------------------------|------------------------------|--|---|--|--|
| 24-101 | Introduction to ME | Computer-Aided Design of a Wrench with Pro/ENGINEER Wildfire | Fresh_CAE Assignments | Fresh_CAE Skills | Contact Dr. Jonathan Wickert |
| 24-261 | Statics of Deformable Solids | Statics: Mechanism Visualization with Solidworks | Solidworks Assignments (4 Problems) | Solidworks Assignment Skills | Contact Dr. Paul Steif |
| 24-361 | Intermediate Stress Analysis | Stress Analysis: Finite Element Simulations with ANSYS | Project #1 Uniformly Loaded Beam | Project #1 Skills | Contact Dr. Jack Beuth |
| | ○ | ○ | ○ | ○ | |
| | ○ | ○ | ○ | ○ | |
| | ○ | ○ | ○ | ○ | |

Outreach Activity

- Two-day summer workshops coordinated through Carnegie Mellon Institute for Talented Elementary and Secondary Students
- Middle school students from the Pittsburgh area



Acknowledgements

- NSF EEC-0235156 (Susan Kemnitzer)
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- PTC (John Stuart and Ralph Coppola)

www.caetutorials.com

and

www.me.cmu.edu/academics/courses/NSF_Edu_Proj/NSFOverview.html
