

Nature of ME

395:Introduction to Design

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What is Engineering Design?

ABET Definition of Design

- ◆ **Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective.** Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.

ABET Definition of Design (cont.)

The engineering design component of a curriculum must include at least some of the following features: development of student creativity, use of **open-ended problems, development and use of design methodology, formulation of design problem statements and specifications, consideration of alternative solutions, feasibility considerations, and detailed system descriptions.** Further, it is essential to include a variety of realistic constraints such as economic factors, safety, reliability, aesthetics, ethics, and social impact. Courses that contain engineering design normally are taught at the upper division level of the engineering program.

How do we design?

- ◆ Ad hoc process- *just do it!*
- ◆ A methodical, Step-by-Step Process (ME 395)

Analysis

Vs

Synthesis

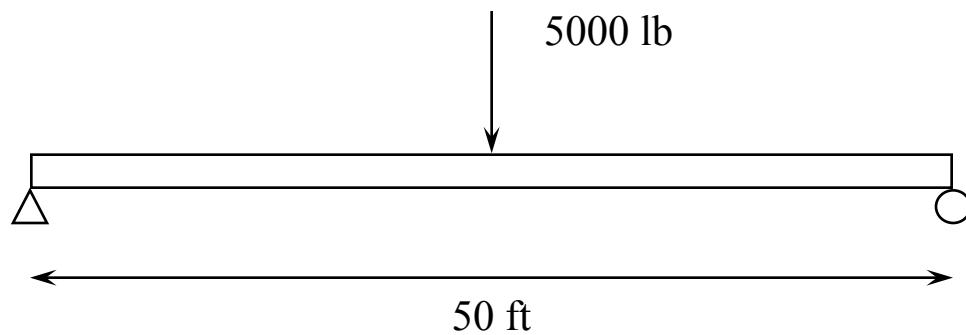
**ME 395 is the first ME
course dealing with
synthesis**

Characteristics of an Engineering Science Problem

- ◆ Problem statement is compact and well-posed
- ◆ Problem has a readily identifiable closure
- ◆ Solution is unique and compact
- ◆ Problem uses specialized knowledge

Typical Engineering Science Problem Statement*

A simply supported steel beam with a 3" diameter circular cross-section is loaded as shown. Determine the maximum stress and deflection.



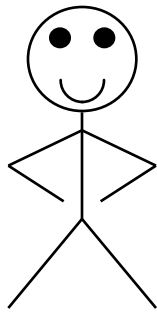
Characteristics of an Engineering Design Problem

- ◆ Problem statement is incomplete, ambiguous, and self-contradictory
- ◆ Problem does not have a readily identifiable closure
- ◆ Solutions are neither unique nor compact
- ◆ Problem requires integration of knowledge from many fields

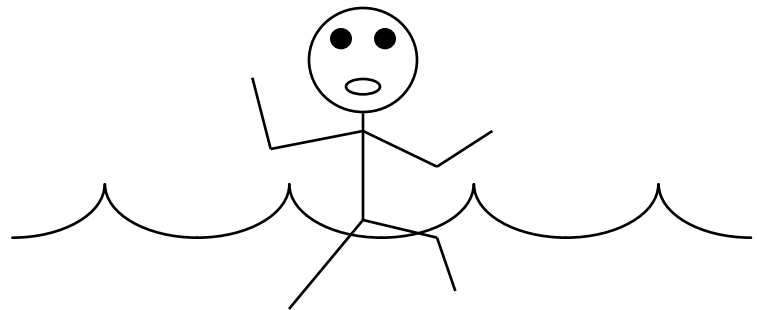
Typical Engineering Design Problem Statement*

Design a system for lifting and moving loads of up to 5000 lb in a manufacturing facility . The facility has an unobstructed span of 50 ft. The lifting system should be inexpensive and satisfy all relevant safety standards.

Topography of Engineering Science and Engineering Design*

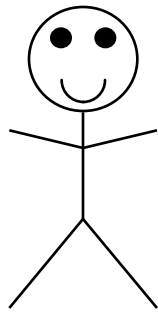


solid ground of
engineering science



the design swamp

Contemplating Engineering Design



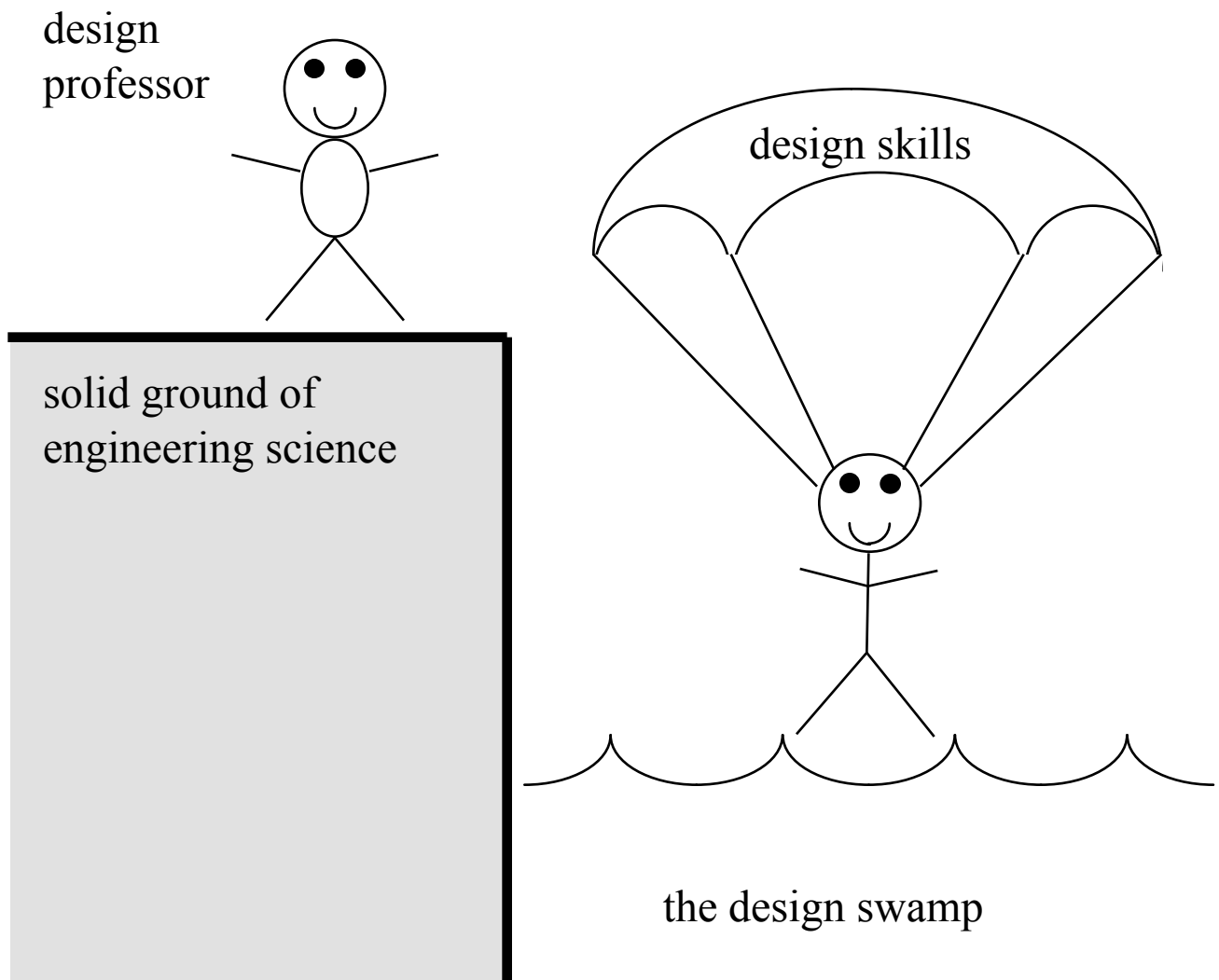
← typical engineering student
with science and
mathematics background

solid ground of
engineering science

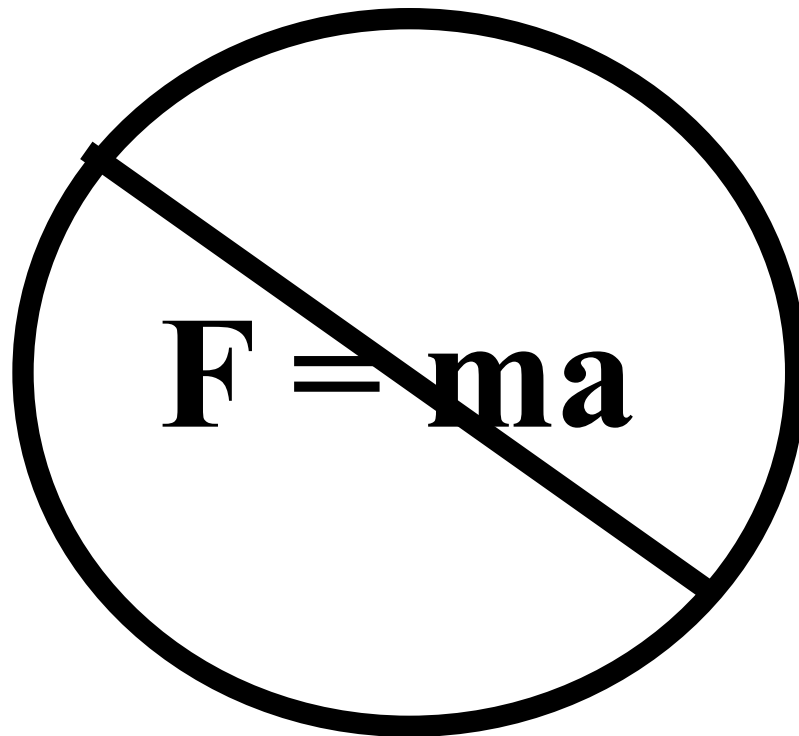


the design swamp

Benefits of Understanding Engineering Design Process



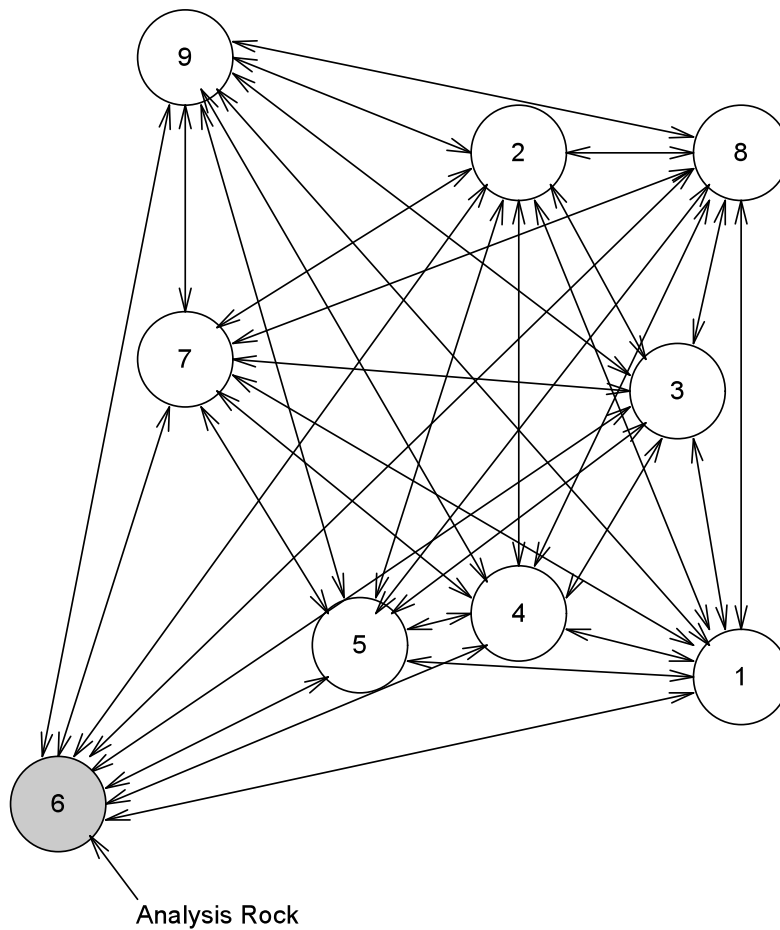
Possible Logo for Engineering Design*



Nine Step Model of Design Process (Hyman)

1. Recognizing the need
2. Defining the problem
3. Planning the project
4. Gathering information
5. Conceptualizing alternative approaches
6. Evaluating the alternatives
7. Selecting the preferred alternative
8. Communicating the design
9. Implementing the preferred design

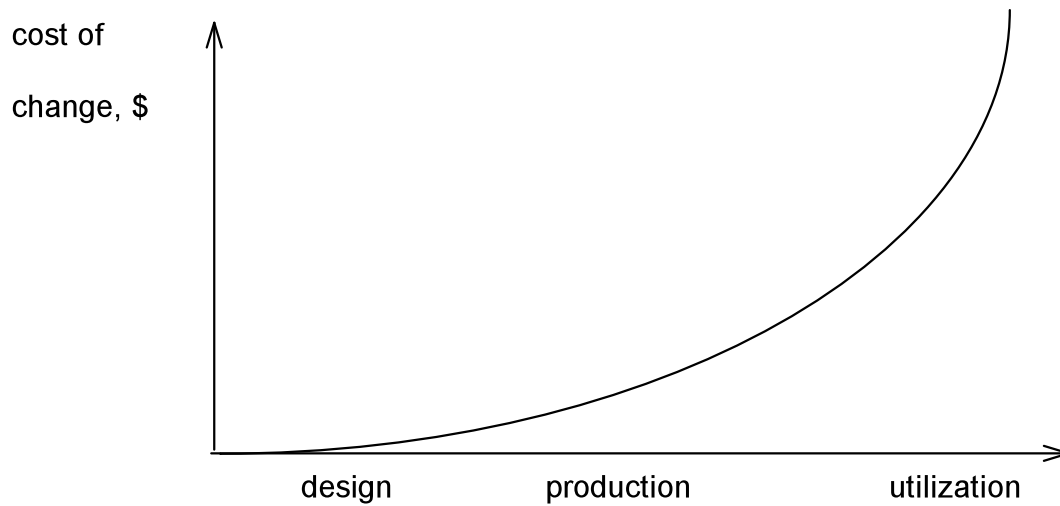
A Map of The Design Swamp



Life Cycle of Engineering Designs

1. Needs analysis
2. Feasibility study
3. Preliminary design
4. Detailed design
5. Production
6. Distribution
7. Consumption
8. Retirement

Cost of Making Changes During Different Phases of the Design Life Cycle



ME 395: Course Objectives

- ◆ **The student should be able to apply the skills needed to execute the design process**
- ◆ **Key Skills needed for Design Process**
 - Need identification; Problem formulation;
Project Planning; Gathering information
Design Axioms; Concept generation and
selection; Patents & Intellectual Property
Product Liability; Professional Ethics
Design Communication
- ◆ **Engineering Economics**

Course Outline

◆ **Instructor** Vipin Kumar

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◆ **Teaching Assistants**

– Adam Niblick

adamlee@uw.edu

– Huimin Guo

hmguo@uw.edu

Course Outline, Cont'd

◆ Course Website

[http://
courses.washington.edu/
mengr395](http://courses.washington.edu/mengr395)

◆ Text (required)

Engineering Design by
George E. Dieter, 4th Ed,
McGraw Hill, 2009.

Course Project

- ◆ A Laboratory for applying concepts and tools taught in course
- ◆ Project launched in week 3
- ◆ Random Teams of 3 to 4 students
- ◆ 40% of course grade.
- ◆ More information later

Homework

- ◆ Team Homework, assigned in class
- ◆ Electronic Submission only
- ◆ 10% of grade

Exams

- ◆ Two midterms in weeks 5 and 9 respectively
- ◆ Worth 25% each for course grade
- ◆ Closed book, closed notes.
- ◆ *No Final Exam*

Course Website

- ◆ [http://
courses.washington.edu/
mengr395](http://courses.washington.edu/mengr395)
- ◆ Detailed course Outline with weekly reading assignments
- ◆ Teams posted
- ◆ Guest lectures
- ◆ Check often!