Process of Design

Concepts I
Lecture Tuesday of 7th Week

Tutorial #2 Feedback

- Grade distribution [All time best]
  - A = 11
  - B = 22
  - D = 2
  - F = 6 (3 of the 6 already seeking feedback)
Outline of coming events

• Today
  – Process of design
  – Conflict resolution

• Thursday (7th week)
  – Problem statement
  – Background research (video)
  – Lab activities – make groups + brainstorm + conceptual designs

• Tuesday (8th week)
  – Design review expectation + review sign up
  – Optimization and simulation testing

• Thursday (8th week)
  – Intro to machine shop (lecture)
  – Mini design reviews (no labs)

Outline of coming events

• Tuesday (9th week)
  – 1-hr exam during lecture
  – Open machine shop time

• Thursday (9th week)
  – Discussion of problems and solutions during lecture
  – Open machine shop time

• Tuesday (10th week)
  – Course evals and discussion of project progress
  – Open machine shop time

• Thursday (10th week)
  – No lecture
  – Open machine shop

• Nov 23rd Competition Day
Lecture outline

- Every lecture from now on is focused on final project!
- Design
  - Is a key component we will discuss the proper process
- Team dynamics
  - A multi-week project will increase # of problems
  - We will discuss how to deal with situations

Process of Design

Identification of roles
- Client: sets objectives for the designer
- User: sets requirements of the product
- Designer: develops specifications that can be built and satisfies everyone
• Engineering design is the organized, thoughtful development & testing of new objects that have a particular configuration or perform some desired function(s) to meet customer and client needs without violating any specified limitation.

• Successful designs meet or exceed the given specifications and satisfies or exceeds the clients expectations.

How to conduct organized thoughtful development and testing

- Client Statement
  - identify client needs; user requirements
  - Identify constraints; establish function

- Conceptual Design
  - Focus on high level issues with weak technical details; establish design specs.; generate alternatives

- Preliminary Design
  - Size or select subunits; back-of-the envelop calculations; evaluate; make final choice

- Detailed Design
  - Design is left to component specialists; simulation, prototype, refine optimize

- Final Design
  - Fabrication and documentation
Accomplishing the goals in each design step?

**Client Statement** (problem definition)

**Means:**
- Conduct a literature review
- Brainstorm
- User surveys etc

**Output:**
- Revised problem statement
- Detail and set weights to objectives
- List of constraints
- List of user requirements
- State function

Accomplishing the goals in each design step?

**Conceptual Design:**

**Means:**
- Analogies
- Brainstorm
- Benchmarking
- Reverse engineering

**Output:**
- 3 to 5 conceptual design alternatives
- Design specifications
Accomplishing the goals in each design step?

**Preliminary Design:**

*Means:*
- Simulation
- Proof of concept testing
- Prototype development
- Reverse engineering

*Output:*
- Select a single design from alternatives
- Create a single design from modifying alternatives into one
- Design matrix evaluation results

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Accomplishing the goals in each design step?

**Detailed Design:**

*Means:*
- Formal design review
- Design to code or national standards
- Component specifications
- CAD drawings
- Beta testing, modification to optimize

*Output:*
- Fabrication specifications
- Final design review in company
Accomplishing the goals in each design step?

**Final Design:**

*Means:*
- Verify that product meets user and client specification
- Verify with production facilities that volume production is possible

*Output:*
- Final production
- Final report to client

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**Example**

If I asked you to design a safe ladder, what questions come to mind? (Brainstorming)

1. How is the ladder to be used?
2. How high should someone on the ladder be able to reach?
3. How much weight should a safe ladder support?
4. Should the ladder be portable?
5. How does one define safe?
6. How much should it cost?
7. Will the ladder be made of wood, aluminum or fiberglass?
8. How many steps are there on the ladder?
9. How are the steps to be attached to the frame?
Here we are clarifying the client objectives
  – How is the ladder to be used?
  – What color should the ladder be?
  – How much should the ladder cost?
Here we are establishing the user requirements
  – Should the ladder be portable?
  – How much should the ladder cost?
Here we are identifying design constraints
  – How does OSHA define “safe”?
  – Can this ladder be assembled?
Here we are establishing design specifications
  – How much weight should a safe ladder support?
  – What is the allowable load per step?
  – How high should someone on the ladder be able to reach

Group Dynamics
Conflict Resolution
Groups under go 5 stages of development
1. Forming
2. Storming
3. Norming
4. Performing
5. Adjourning

Spend to much time up here you will never get the task done
Forming

- Becoming oriented to the task at hand
- Becoming acquainted with other members
- Testing behaviors to determine viewpoints and values
- Seeking out the person whom will be “in charge”
- Define some initial ground rules!

It is important to recognize that judgments made in the forming stage may prove to be invalid over the lifetime of the project.

Storming

- Resistance to task demands
- Interpersonal conflicts
- Venting of disagreement without resolution
- Struggle for group leadership

It is important to for effective teams to recognize when the team is spending too long in the storming phase and the team must encourage all team members to move on.

SEEK HELP FROM ADMINISTRATORS = DR. LAZ and DR. LENGSFELD
Norming

- Clarification of roles in the group
- Emergence of informal leadership
- Development of a consensus on group behavior
- Emergence of consensus on the groups activity and performance

It is important for members who want a successful outcome to recognize that simply ignoring unacceptable behavior or poor work products will not be productive.

Performing

- Clearly understood roles and tasks
- Well-defined norms that support the overall goals
- Sufficient interest and energy
- Emerging solutions and results

This is the point in the team development at which it becomes possible for the goals of the team to be fully realized.
Today in lab

• Tutorial #4 and 9c
Or
• IC engine report