

## On the Existence of Detailed Analytical Models for Machine Design

24-370 - Spring 2011  
Professor Steve Collins

## Reminders and Announcements

- Pick up graded HW6 today
- Carnival week: Wednesday lecture a must
  - Project 2 results announced
  - Project 3 announced
  - Motor analysis lecture
  - Homework assigned
- Initial Project 2 reports graded...

## Reminders and Announcements

- Project 2:
  - Catalog orders due tonight (from same \$250)
  - Testing in 1 week
    - Must attend entire period: group shout-outs
  - If having trouble with design or analysis, think:
    - Reductionist approach: Simple models and FBDs
    - Complex interactions (set screw, contact): SolidWorks Sim
  - Project reports due at beginning of testing period
    - Review of project report requirements
    - Graded initial reports available now

## Analytical component models

- Our approach thus far has primarily been:
  - Reduce components into simplified models
    - Simple shapes and FBDs
  - Analyze using small set of techniques
    - Stress as load over area, bending beam stress
  - Use finite element methods for details (SolidWorks)
  - Use manufacturer specifications for complex parts
    - For example, bearings or springs
  - Some limitations and inefficiencies
    - Can't analytically resolve irreducible elements
    - What if we wish to *design* those complex catalog parts?

## Detailed analyses presented in Shigley:

- Shafts and shaft components
- Screws, fasteners, and nonpermanent joints
- Welding, bonding, and permanent joints
- Mechanical springs
- Rolling-contact bearings
- Lubrication and journal bearings
- Spur, helical, bevel and worm gears
- Clutches, brakes, couplings, and flywheels
- Belts, chain, wire rope, and flexible elements

## Here, we flipped through Shigley

- You might need to use some of these techniques for your Project 2 reports :D

## How to use these analyses in design

- Analysis gives us insight into an existing design
  - But in design, we bring things into existence...
- How do we use these methods for design?
  - Inverse analytical approach: solve for parameters
  - Intuition development: see what parameters matter
  - Iterative approach: redesign and check
- How to balance approach for complex elements?
  - Place less emphasis on analytical results
  - Use higher factors of safety
  - Tests performance empirically

## Bonus Assignment

- For extra credit towards your HW grade
  - Especially those who are missing HW(s)
- Apply an analysis from Shigley Part 3
  - For example, analysis of a roller bearing
- More detailed and accurate, more bonus
  - Up to one full homework of credit
- Turn in any time before May 5th