

MECH 3230: Machine Design

Lecture #1

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This is a New Lecture

- Nearly 20% of the class failed last semester. Many more made D's. I don't like this.
- I was inspired by some books I read and movies I have watched over the past year(s) (The Last Lecture, The Alchemist, The Pursuit of Happiness).
- I want everyone to do well, but everyone must prove that they have earned it.
- I grade on the knowledge you have retained (it does not matter how hard you worked).
- This is important, especially if you become a practicing engineer (as I will show later).

The Auburn Creed



I believe that this is a practical world and that I can count only on what I earn. Therefore, I believe in work, hard work.

I believe in education, which gives me the knowledge to work wisely and trains my mind and my hands to work skillfully.

I believe in honesty and truthfulness, without which I cannot win the respect and confidence of my fellow men.

I believe in a sound mind, in a sound body and a spirit that is not afraid, and in clean sports that develop these qualities.

I believe in obedience to law because it protects the rights of all.

I believe in the human touch, which cultivates sympathy with my fellow men and mutual helpfulness and brings happiness for all.

I believe in my Country, because it is a land of freedom and because it is my own home, and that I can best serve that country by "doing justly, loving mercy, and walking humbly with my God."

And because Auburn men and women believe in these things, I believe in Auburn and love it.

-George Petrie (1945)

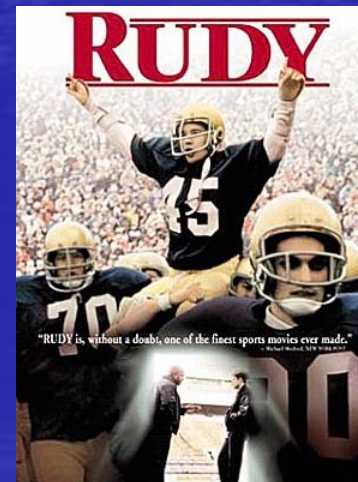
The Last Lecture by the Late Randy Pausch

- [Oprah Version](#)
- [Full Version at Carnegie Mellon](#)
- Or read the book- it's short.
- Key Points:
 - Never Give up.
 - Don't complain, work harder.
 - You've got to get the fundamentals down, because otherwise the fancy stuff is not going to work.
 - If something seems hard, remember that it could always be worse. Prof. Pausch's father was fighting the Germans at his age when he was in college.
 - Time management: [Randy Pausch](#)



Take Advantage of Your Opportunities

- Opportunities must be taken when they present themselves to you.
- When the other team fumbles, you take advantage.
- Do your homework, and if you need to, do extra problems.
- Learn from exams and quizzes to do better on the next one.



By the way,
Rudy was
offside.

A Story about MUD



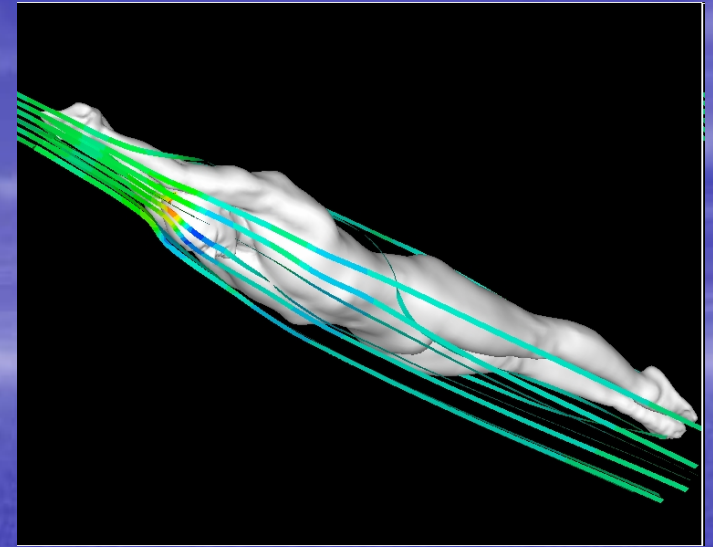
- **MUD (Multi-User Dungeon, Domain or Dimension)**- All text role-playing game.
- My roommate in 1994 at Georgia Tech played this all night almost every night.
- He was smart, could play guitar by ear, was a Peer Advisor.
- Was put on academic suspension and removed as PA.
- I had my own room for half price!

Too many distractions



- Turn it off.
- I've seen students study for hours but actually cover material for a few minutes.
- Instant Messenger: Turn it off.
- Cell Phone: Turn it off.
- iPod: Turn it off.

Believe it or not...



- I was a varsity swimmer at Georgia Tech. Here's proof:
 - [ACC Honor Roll](#)
- I noticed that my grades were usually better during the quarters occurring during the season.
- We usually swam 4:30-5 hours a day and also did weight training. Had away meets on many weekends.
- How could I maintain good grades during all of this. If I could, so can you.
- The season forced me to use my time more efficiently.

Do Not Waste Time

- When you plan to visit a waiting room, bring something to work on rather than reading the magazines.
- In between classes is a good time to study.

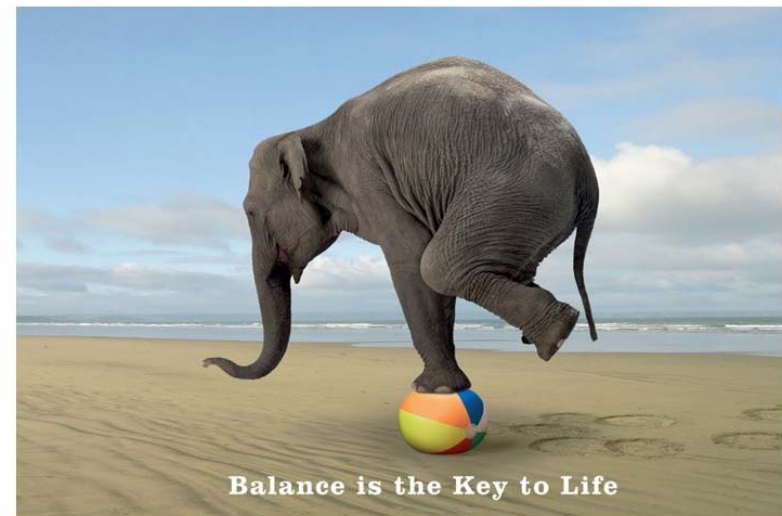


Sleep

- Make sure you get enough sleep, especially before an exam or final.
- This means that you CANNOT put off studying until the last minute. It will backfire.
- You must keep up with the class while it is going on.
- One of my best friends used to study overnight before every exam. I would bring him breakfast (also important). Guess who did better?

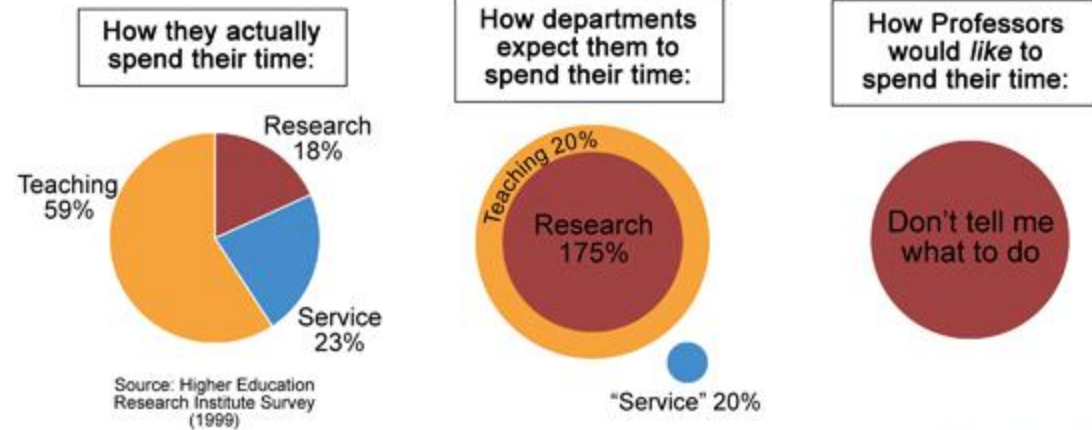
Balance

- It is important to have fun and to maintain balance with other parts of your life.
- The key is efficiency, prioritizing and balance.
- Many times the best students in my classes are those with families. They should have much less time (believe me they do), but they are much better at time management and prioritizing.



The Life of a Prof.

HOW PROFESSORS SPEND THEIR TIME



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- You probably have never been told, but as students and possible graduate students I think you all should know what professor does.
- Three main duties: Research-Teaching-Service
- Research- Generate research funds. Supervise graduate students. Write papers and present them at conferences.
- Teaching- This class and others.
- Service- Organize and attend conferences. Review papers for journals. Student organizations (ASME, SAE, etc.)
- I love my job, and I think most Profs. Do, but it does have difficulties.

Mechanical Engineering



- Mechanical Engineering was said to be the most liberal major (Dr. Ward Winer). Students are exposed to the widest range of material.
- Engineering is not just about making money-it's not, it's about designing, repairing, or solving problems-and it takes hard work.
- It's not all cars. Most ME's work in other industries.
- It should be fun to you. Try to make it fun. Try to imagine how this can be applied to objects you see everyday.
- Mechanical Engineering is arguably more important than Computer Science (RP). You'll now see why.

Probe after Concorde loses rudder

Wednesday, December 4, 2002 Posted: 5:52 PM EST (2252 GMT)



Part of the lower of four rudders
was found to be missing

<http://www.cnn.com/2002/WORLD/europe/12/04/concorde.tail/index.html>

USNS John Ericsson

Investigation Just hours after putting out to sea, the USNS John Ericsson sustained a rod bearing failure that left the starboard main engine crippled. Within 24 hours of receiving the call, Exponent engineers flew to Singapore for an extensive investigation. Optical and laser-based measurement techniques, designed specifically for this case, identified the cause of the failure as an improperly ground crankpin journal. We recommended adding a measurement to current grinding operations that would reduce the likelihood of future failures.



<http://exponent.com/practices/marine/cases.html>

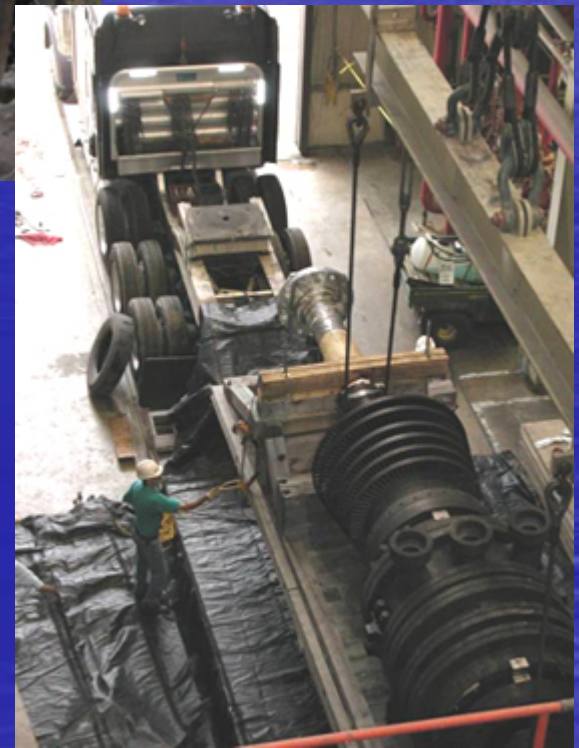
Finite Element Analysis of Turbine Blade

KKAI develops new products and manufacturing processes, and provides consulting services that maximize profitability for our clients.

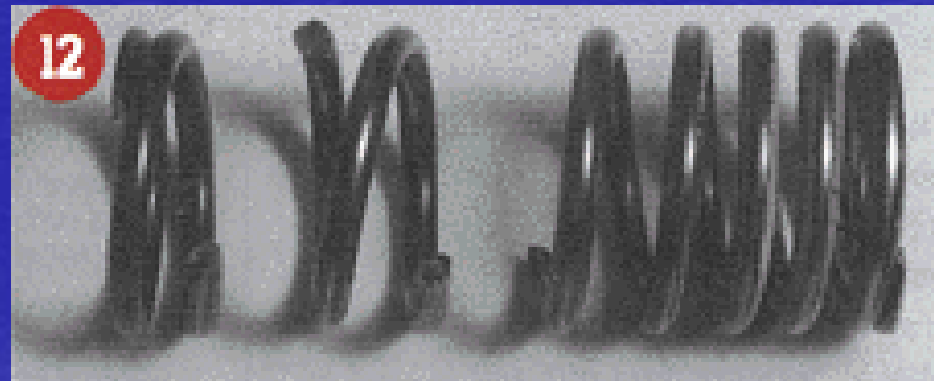
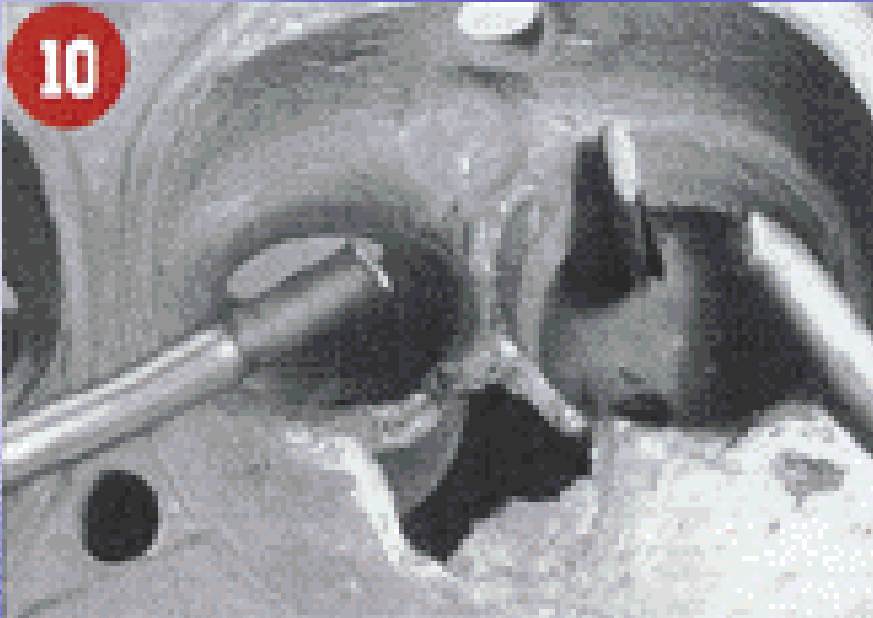


<http://www.rapid-response-consulting.com/matpr8n.html>

www.choctawelectric.com



<http://www.automotiverebuilder.com/ar/ar79938.htm>





Load (N):	New	260.9	1239	1239
Speed (rpm):	New	1,300	1,300	13,000
Duration(cycles):	0	10 ⁶	6,000	6,000



German Train Crash - 1998

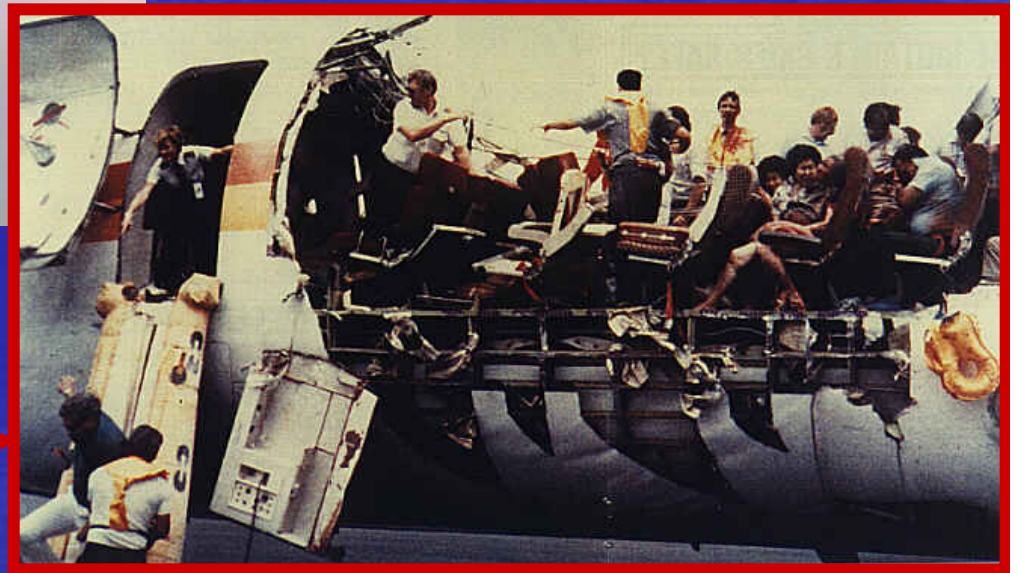


The carriages of a German ICES high-speed train left the tracks and piled one on top of the other after a wheel collapsed.



Aloha Airlines 737 Accident

The "Miracle Landing"



Pacific Western Airlines, Calgary



World Airlines Flt. 30H, Logan Int.



Scandinavian Airlines Flt. 901, JFK



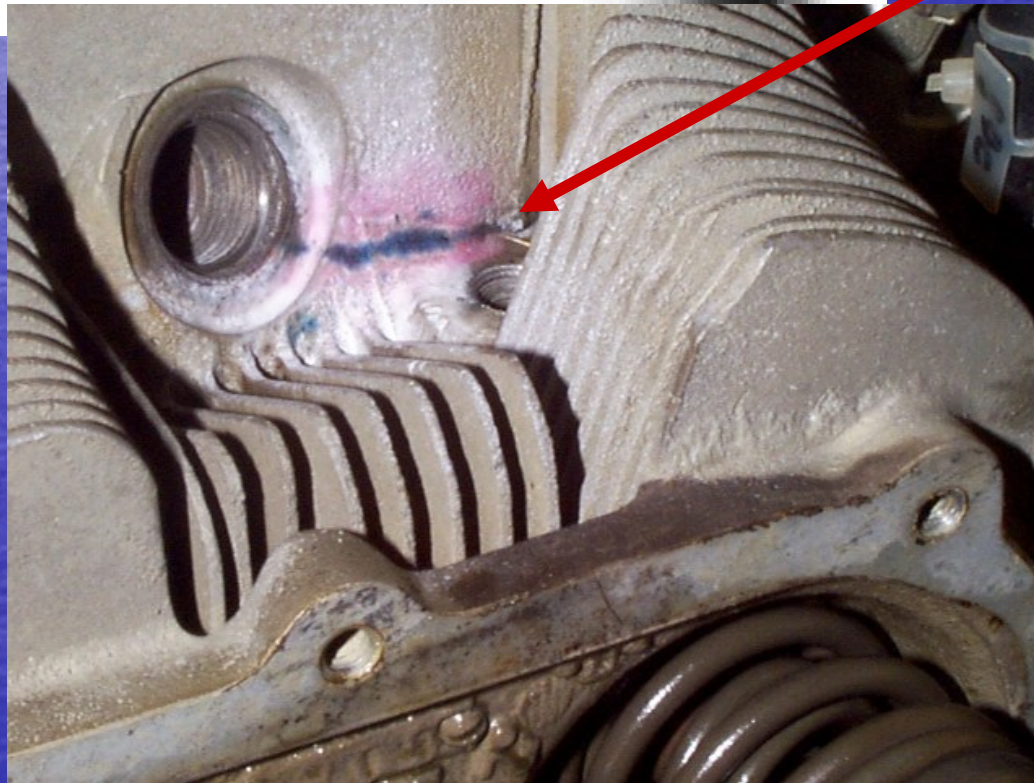
National Airlines Flt. 193, Pensacola



United Airlines Flt. 811, Honolulu to Sydney



Automotive



Dye penetrant reveals a fatigue crack in cylinder head.

Fatigue Failures in Turbines



Abrams M1A Tank



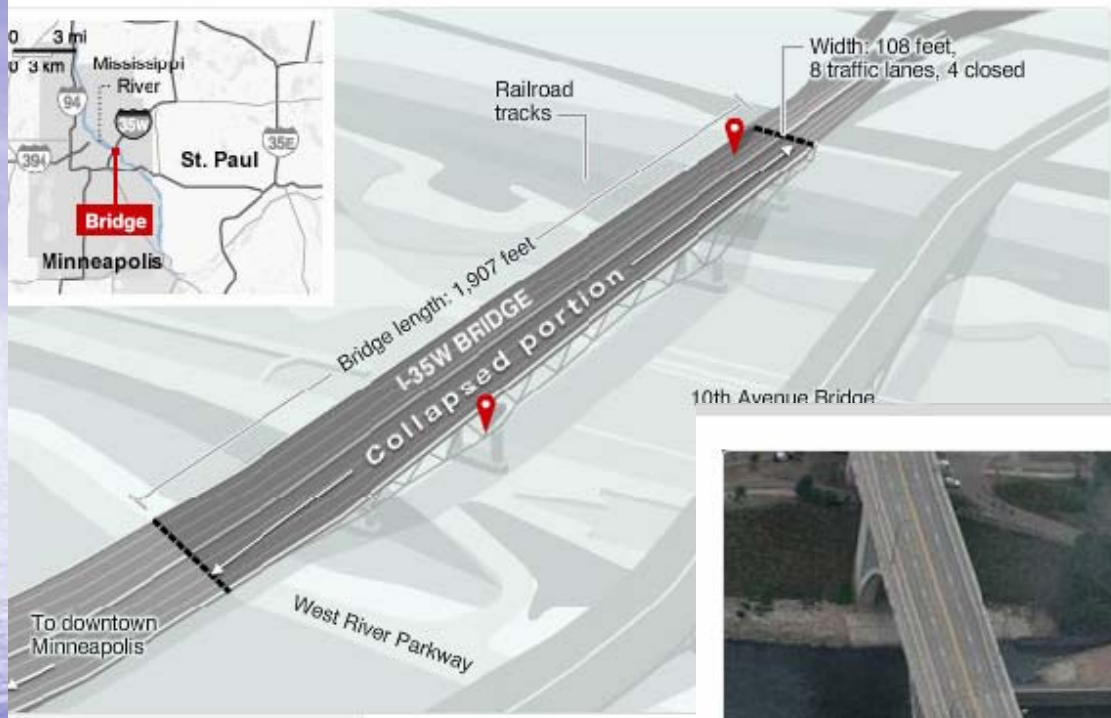
Helicopters

States warned to inspect bridges

<http://www.cnn.com/2007/US/08/02/bridge.structure/#cnnSTCPhoto>



A federal review of the Interstate 35W bridge, seen here in 2005, said the span was "structurally deficient."



Map

Bridge diagram

Sources: AP, Minnesota Department of Transportation, "Climbing the Mississippi



AP PHOTO

Map

Bridge diagram

Before and after

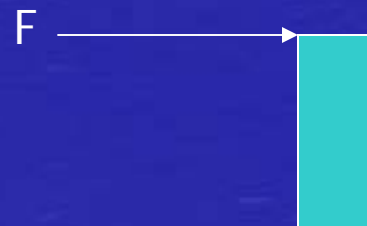
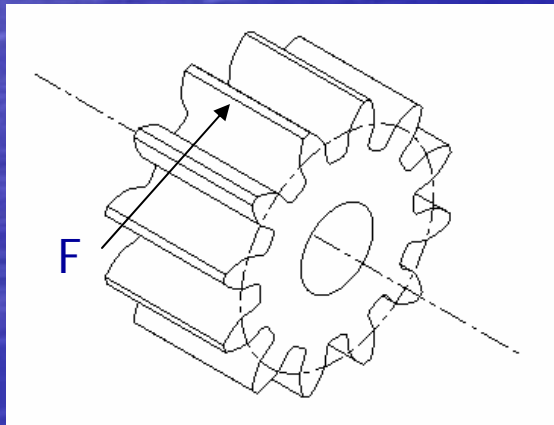
Sources: AP, Minnesota Department of Transportation, "Climbing the Mississippi Bridge by Bridge" by Mary Costello, "The Bridges and Structures of the Major Rivers of Minneapolis and St. Paul" by John Weeks; T. Steve, St. Paul Pioneer Press; C. Osgood, N. Rapp - AP

MECH 3230: Machine Design

- Web: <http://www.eng.auburn.edu/~jacksr7/>
 - Syllabus is on my website.
- Class Objectives: To learn how to design and implement various individual mechanical components into the design of mechanical systems (machines). To learn about methods and components of design which result in mechanical systems with long operating lives and high reliability. To be able to predict the life and reliability of an existing mechanical component or system.
- Make-up Policy: Unless there are dire circumstances, students are expected to inform the instructor of an expected absence prior to the absence. If you miss an exam and have a written authorization (such as a doctor's note) then please inform me as soon as possible after the absence. Unless there are extenuating circumstances, if I am not informed after one week I will no longer give a make-up exam. Make-up exams will also be different (but near the same level of difficulty) from the test given to the rest of the class.

This Course

- I want to teach you how to think, not how to solve one particular problem.
- Unfortunately, that also requires work on your part.
- That is why the fundamentals are so important. They are tools that you can use to solve a large number of problems.
- For instance, a gear tooth is very similar to a beam problem from Mechanics of Materials.



The Fundamentals

- This is a higher level class.
- It requires that you know the basics.
- As a practicing engineer, you need to be able to use the fundamentals to solve a new problem.
- Not every problem or component can be solved in class.
- Show chart.

Undergradese

What undergrads ask vs. what they're REALLY asking

"Is it going to be an open book exam?"

Translation: "I don't have to actually memorize anything, do I?"

"Hmm, what do you mean by that?"

Translation: "What's the answer so we can all go home."

"Are you going to have office hours today?"

Translation: "Can I do my homework in your office?"

"Can i get an extension?"

Translation: "Can you re-arrange your life around mine?"

"Is this going to be on the test?"

Translation: "Tell us what's going to be on the test."

"Is grading going to be curved?"

Translation: "Can I do a mediocre job and still get an A?"



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How I Teach

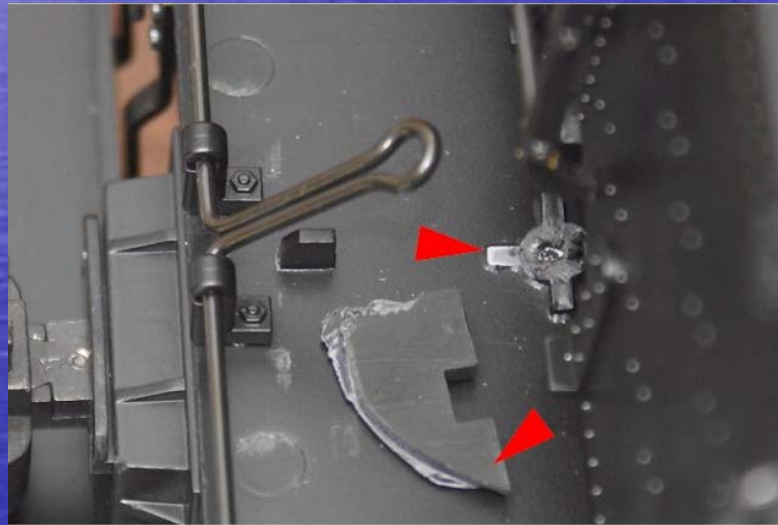
- I write on the board.
 - Copy what I write and make notes.
 - Go back and review and read the book.
 - If I make a mistake, please let me know.
 - Ask questions (be specific).
- Real world examples (show and tell).
- Homework problems. Do them yourself first. When you get stuck, go to the solution manual. You are cheating yourself when you copy from the solutions and it will show on the final.
- Everybody learns differently. Find what works for you. It is not my responsibility to teach to every style. That is impossible.

Difficulty

- Engineering is difficult. Otherwise everyone would do it.
- That is why most engineers are paid fairly well.
- Mathematically, this class is relatively easy compared to others (only algebra).
- However, it requires you to think differently and learn to design and solve open ended problems.

The Real World

- You might get a problem that looks like this:
 - It's broken, fix it (or redesign so it doesn't happen again).

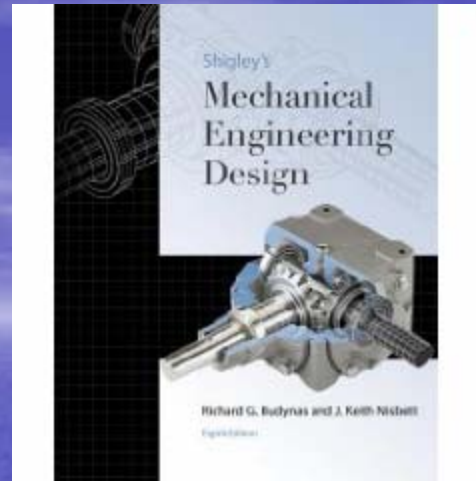


- No inputs are given, no equations, no properties, type of problem not given, not even the subject.

Cheating and Plagiarism

- Cheating is unacceptable and it will only hurt you in the long run.
- I have caught people I will take action.
- Plagiarism: to steal and pass off (the ideas or words of another) as one's own : use (another's production) without crediting the source.

Textbook



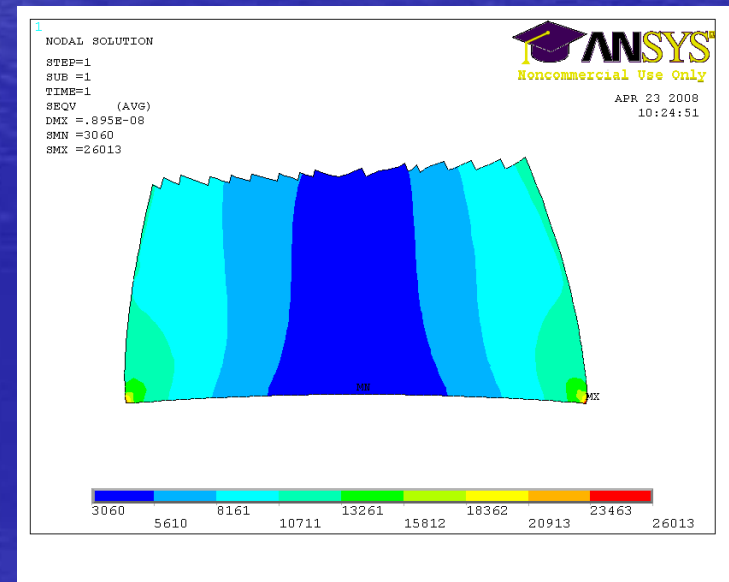
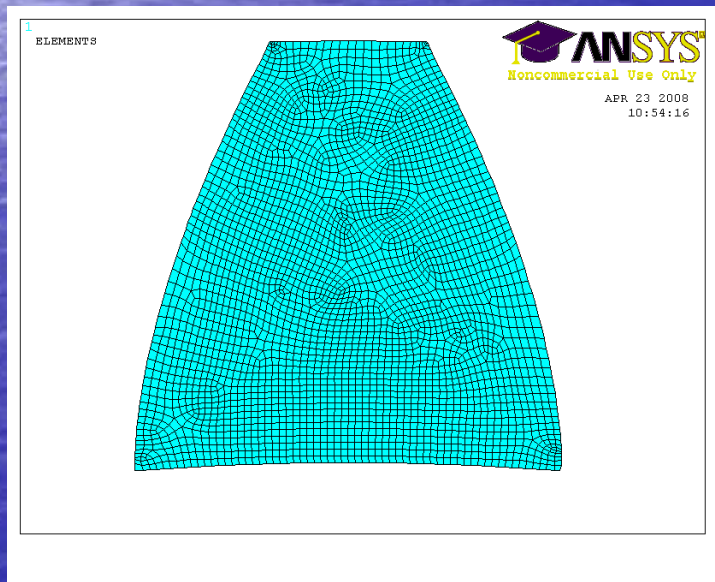
- Text: Shigley's Mechanical Engineering Design (8th Edition), R. G. Budynas and J. K. Nisbett, McGraw Hill, 2008.
- References:
 - Fundamentals of Machine Component Design (4th Edition), R. C. Juvinell and K. M. Marshek, Wiley & Sons, 2006.
 - Machine Design (3rd Edition), R. L. Norton.

Homework

- Homework will usually be due one week after it is assigned.
- Homework will be checked for satisfactory completion on a ten point scale.
- Late homework will be deducted three points.
- Students are encouraged to work in groups, but are strongly encouraged to work individual problems themselves.
- Will post all the homework assignments on the web before semester begins. Due dates assigned later.
- Solutions to each homework will posted soon after they are turned in.

Finite Element Projects

- Two finite element projects will be assigned during the semester.
- The goal is to reinforce FEM techniques that were taught in prerequisite courses.
- They will be performed using the commercial FEM software ANSYS.
- They will each be graded on a ten point scale (similar to the homework assignments).



Quizzes and Exams

- 2 exams and a final.
- Throughout the semester short 10-15 minute unannounced Quizzes will be given at the end of class. They will cover material presented in prior classes and homework already turned in.
- Open book and notes (same as Exams)

- Grading: Homework 10%
- Quizzes 15%
- FEM Projects 10%
- Prereq. Exam 5%
- Exam #1 15%
- Exam #2 15%
- Final Exam 30%

Change in Grading Scale

- 87.5% to 100% A
- 75% to 87.5% B
- 62.5% to 75% C
- 50% to 62.5% D
- Less than 50% F

Tentative Class Schedule

Chapter and Sections	Subject
1	Introduction
	Prereq. Exam (1 hour)
2	Materials
3.1-3.5	Stress and Strain
3.6-3.18	Bending, Torsion, Mohr's Circle, Stress Concentrations
3.19	Stresses in Contact
4.10	Statically Indeterminate Problems
5.1-5.11, 19	Failure Theories (FEM Project #1)
6.1-6.4, 6.7-6.15	Fatigue
6.16	Surface Fatigue + Wear
7	Shaft Design
8	Screws and Fasteners
	Exam #1
9	Rivets, Welding and Bonding
10	Springs
11	Rolling Element Bearings
12	Lubrication and Bearings
13	Intro to Gears
14	Spur and Helical Gears (FEM Project #2)
	Exam #2
15	Bevel and Worm Gears
16	Clutches and Brakes
17	Other Machine Components
18 + Review	Machine Component Inter-relationships
Final Exam	

The Stork

- I may miss a lecture depending on when a new member of the family arrives.
- It will probably be in the next three weeks.
- I'll try to get someone to cover for me, but if not, just leave after 15 minutes (Good time to work on homework!)



Prerequisite Exam

- A chance to brush up on old things before the new things:
 - Calculus, Algebra, Differential Eqs.
 - Statics and Dynamics
 - Mechanics of Materials
 - Fluid Mechanics
 - Heat Transfer
 - Thermodynamics
- I cannot cover all prerequisite (fundamental) material in the course.
- I will review some mechanics of materials, but it will be very quickly.

Good Luck!

