

What is Mechanical Engineering?

Mechanical Engineering is the profession related to the study and use of machines.

A machine transforms, transmits, or uses energy, force or motion for a specific purpose



Machines

- Machines range from mechanical pencils to automobiles to the human body
- Machines are designed to fulfill some function (*design*)
 - Machines require power (*thermodynamics, combustion*)
 - Machines pollute (*air pollution control*)
- Machines make heat that has to be removed (*heat transfer and fluid mechanics*)

Machines

- Machines move, so their motion must be understood (*kinematics, dynamics*) and controlled (*controls*)
- Motions are resisted by surrounding air or fluid (*fluids*)
 - Machines must be constructed (*manufacturing*)
- Machines have to be made from something (*materials*)

Where Do Mechanical Engineers work?

- Automotive industry
- Power generation industry (*\$200 billion*)
- Manufacturing (*computers to valves*)
- Aerospace and Defense
- Robotics
- Air pollution control
- Oil industry
- Consulting firms

What would you study?

- Calculus and Differential Equations
- Physics and Chemistry
- Humanities and Social Science
- **Communication**
- **Engineering Fundamentals** (*Statics, Fluid Mechanics, Dynamics, Thermodynamics, Heat Transfer, Circuits, Materials, Strengths, Kinematics, Controls, Vibrations*)
- **Design**
- **Technical Electives** (*Engineering Economics, Combustion, Robotics, Air Pollution Control, Mechatronics*)

Characteristics of a Mechanical Engineer

- **Capable communicator**
- **Willing to do hands-on work**
- **Affinity for machines**
- **Strong interest in math and science**
- **Innovative problem solver**

Automotive Engineering Design & Manufacturing

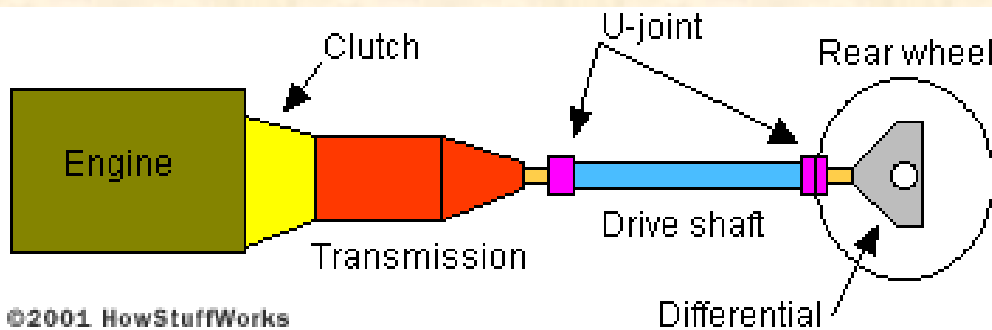




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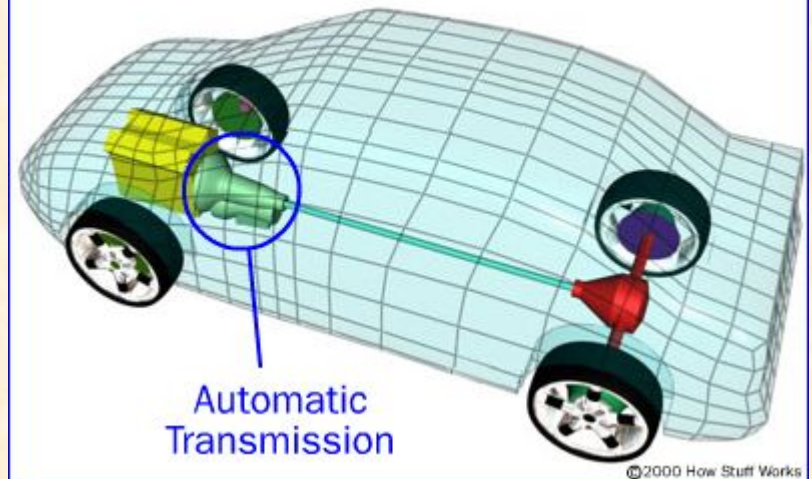
Automotive Engineering

Engines and Power Transmission



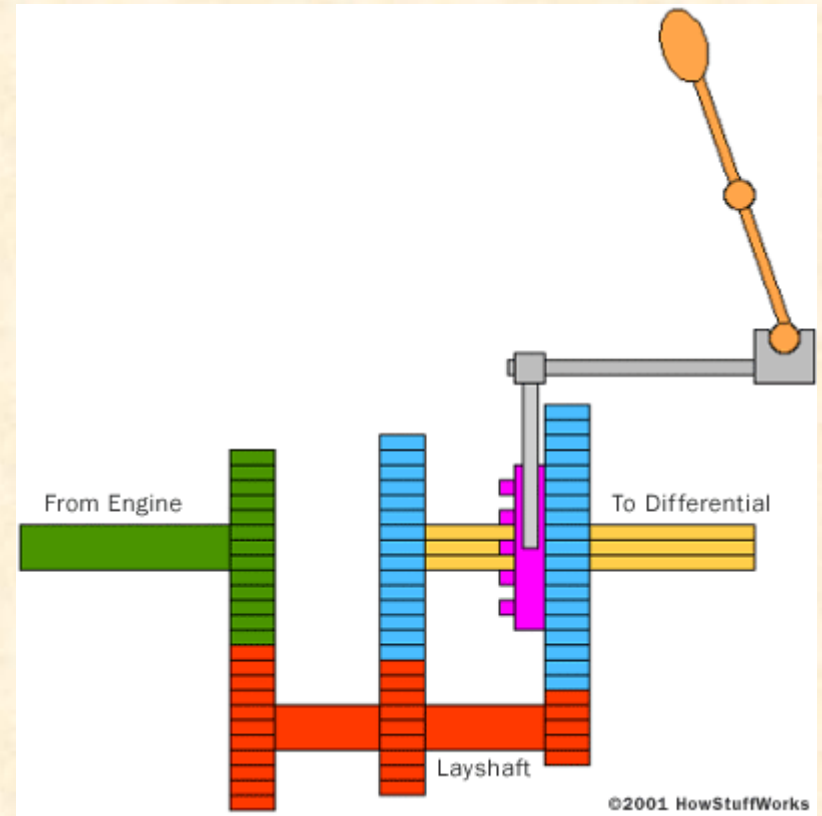
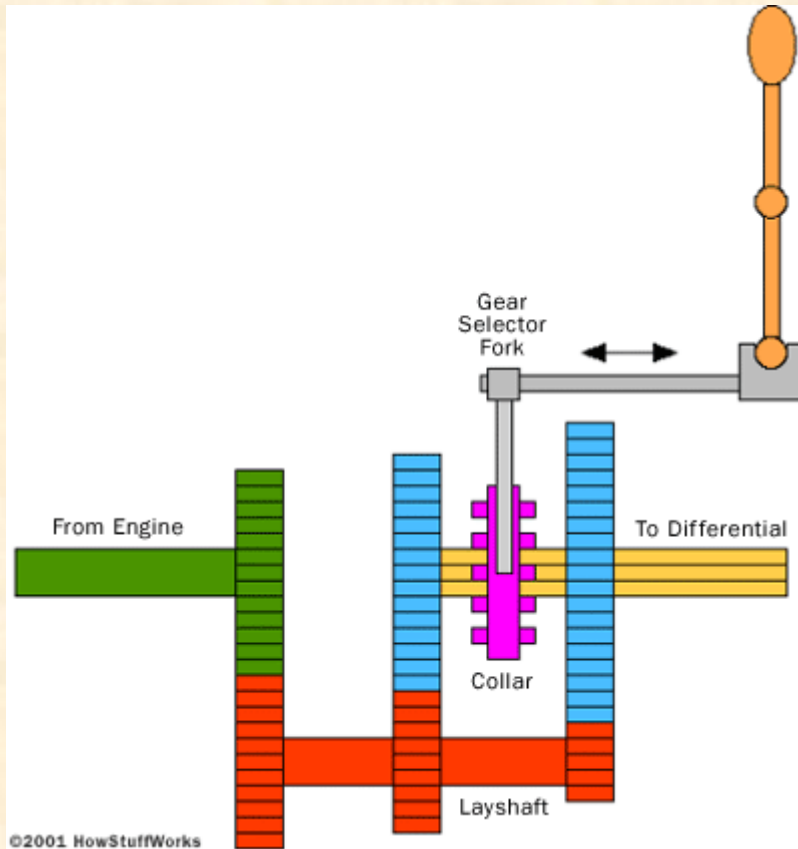
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How Automatic Transmissions Work

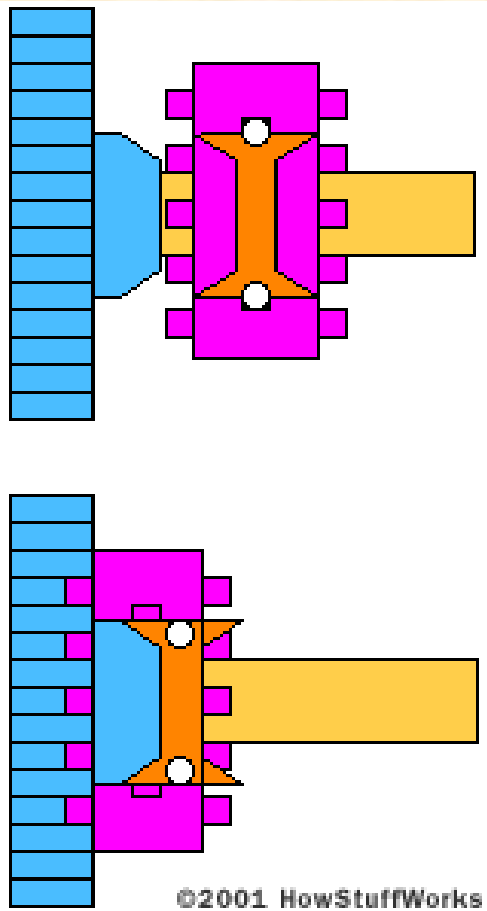


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Manual Transmission – Engaging First Gear



Manual Transmission Details

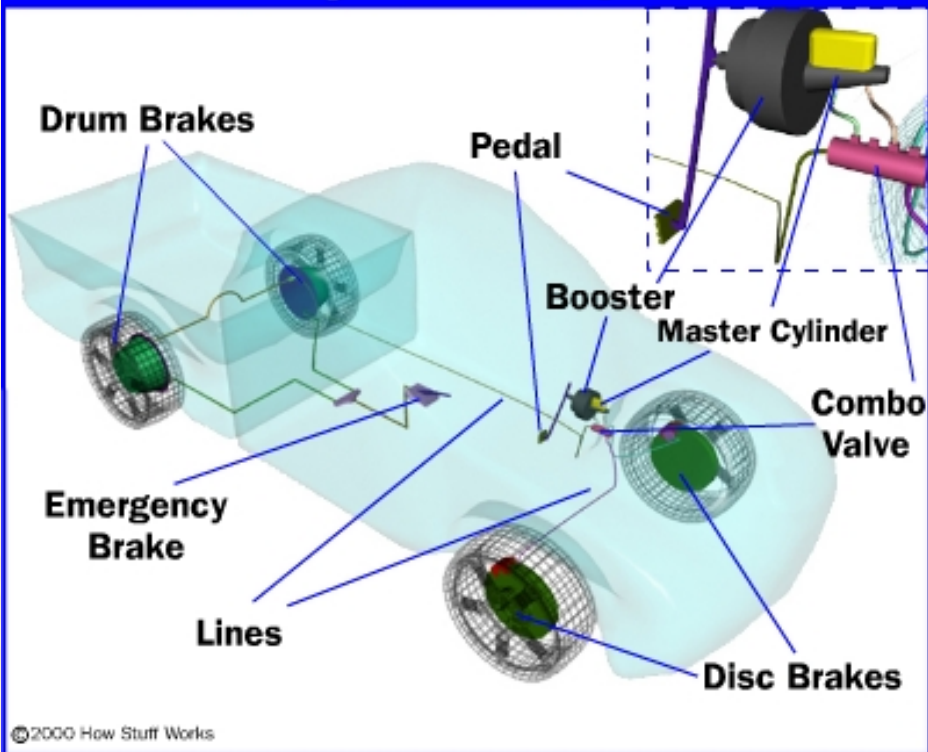


Synchronizer



Spur Gears

Brake System Components



Vehicle Stability and Control



ME and Multidisciplinary Student Organizations

- **Ebobcat**, Electric Bobcat Racing Team
- **SAE**, Society of Automotive Engineers
- **ASME**, American Society of Mechanical Engineers
- **Aeromobile**, NASA Revolutionary Vehicle Design Competition Team
- **EWB-ohio**, Engineers without Borders
- **Robocup**

Contact me for details on getting involved!

The Electric Bobcat Racing Team



Dr. Greg Kremer, Faculty Team Leader



The Electric Bobcat Racing Team



What is the Electric Bobcat Racing Team?

A multidisciplinary team of engineering and technology students that construct a high-performance battery-powered electric race car

- Mechanical Engineering
- Electrical Engineering
- Industrial Technology
- Industrial & Manufacturing Systems Engineering
- Others from University are welcome
- ~ 30 active members

The Electric Bobcat Racing Team

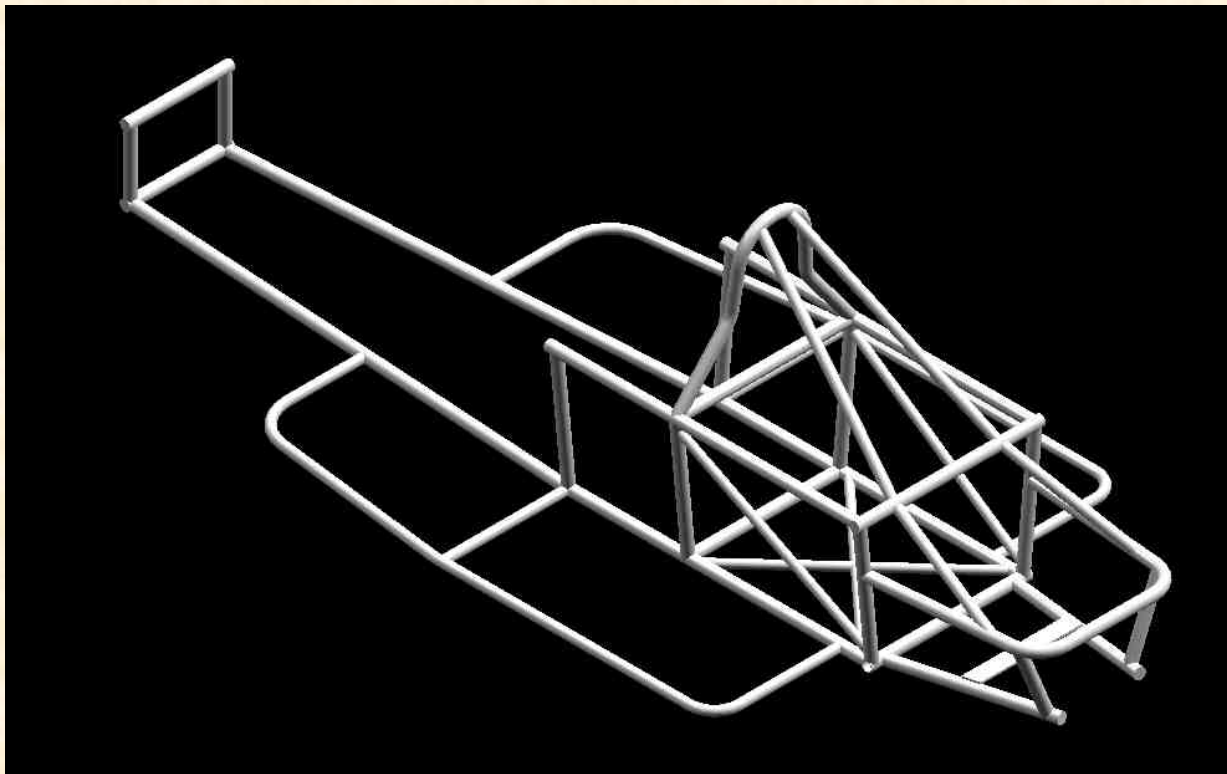


The Electric Bobcat Racing Team



What does the Electric Bobcat Team Do?

We start with an empty Formula Lightning © chassis





Here is a picture of our Formula Lightning © chassis near the beginning of the rebuild



Students (with limited assistance from advisors)

- Design
- Produce and/or purchase
- Install

an electromechanical drive train in the chassis



The Electric Bobcat Racing Team



The Electric Vehicle is raced by a professional driver against 12 other teams in the UCEVRT, including

Ohio State University

University of Notre Dame

West Virginia University

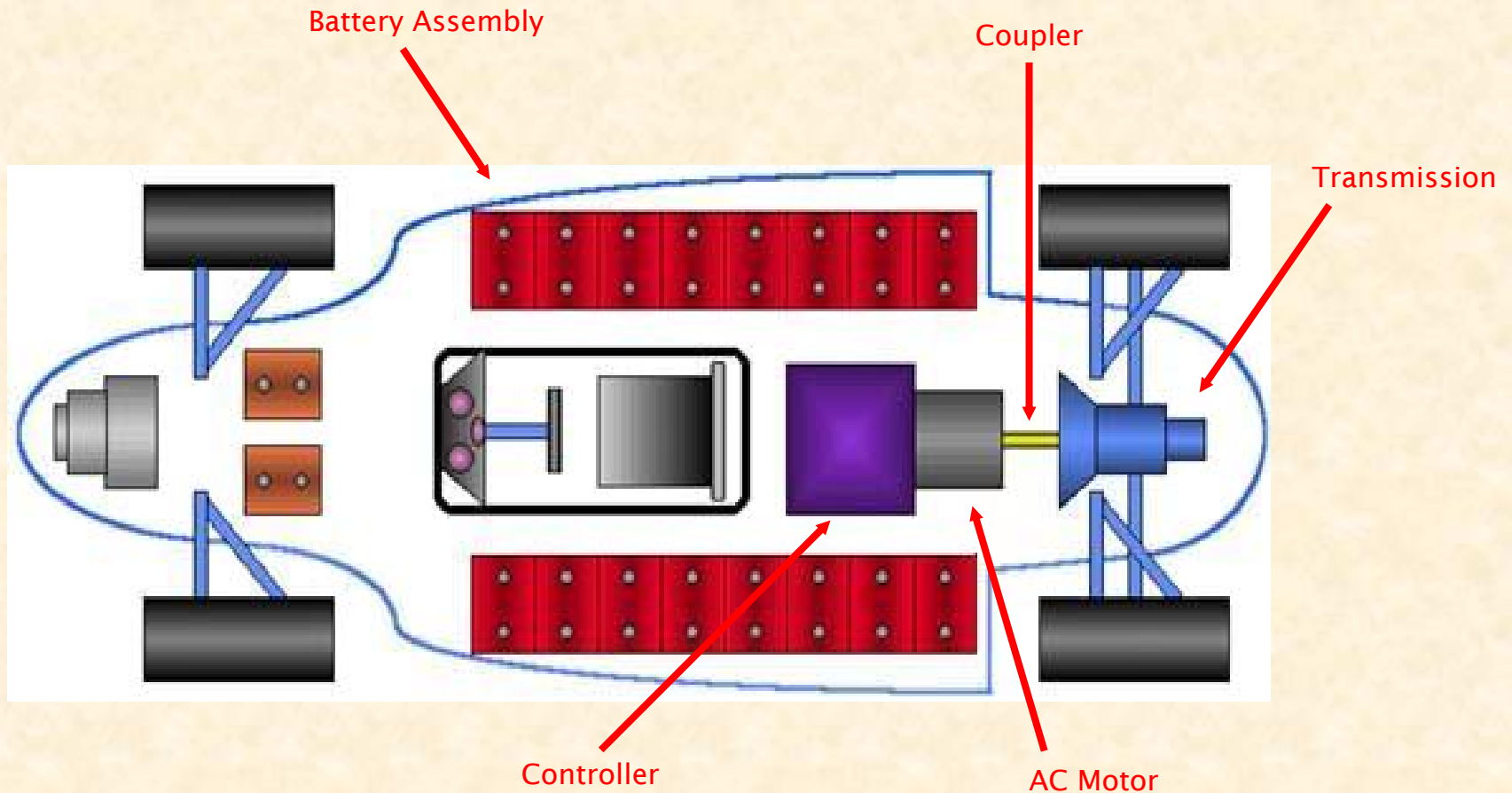
Brigham Young University



The Electric Bobcat Racing Team



Electric Vehicle Design Issues

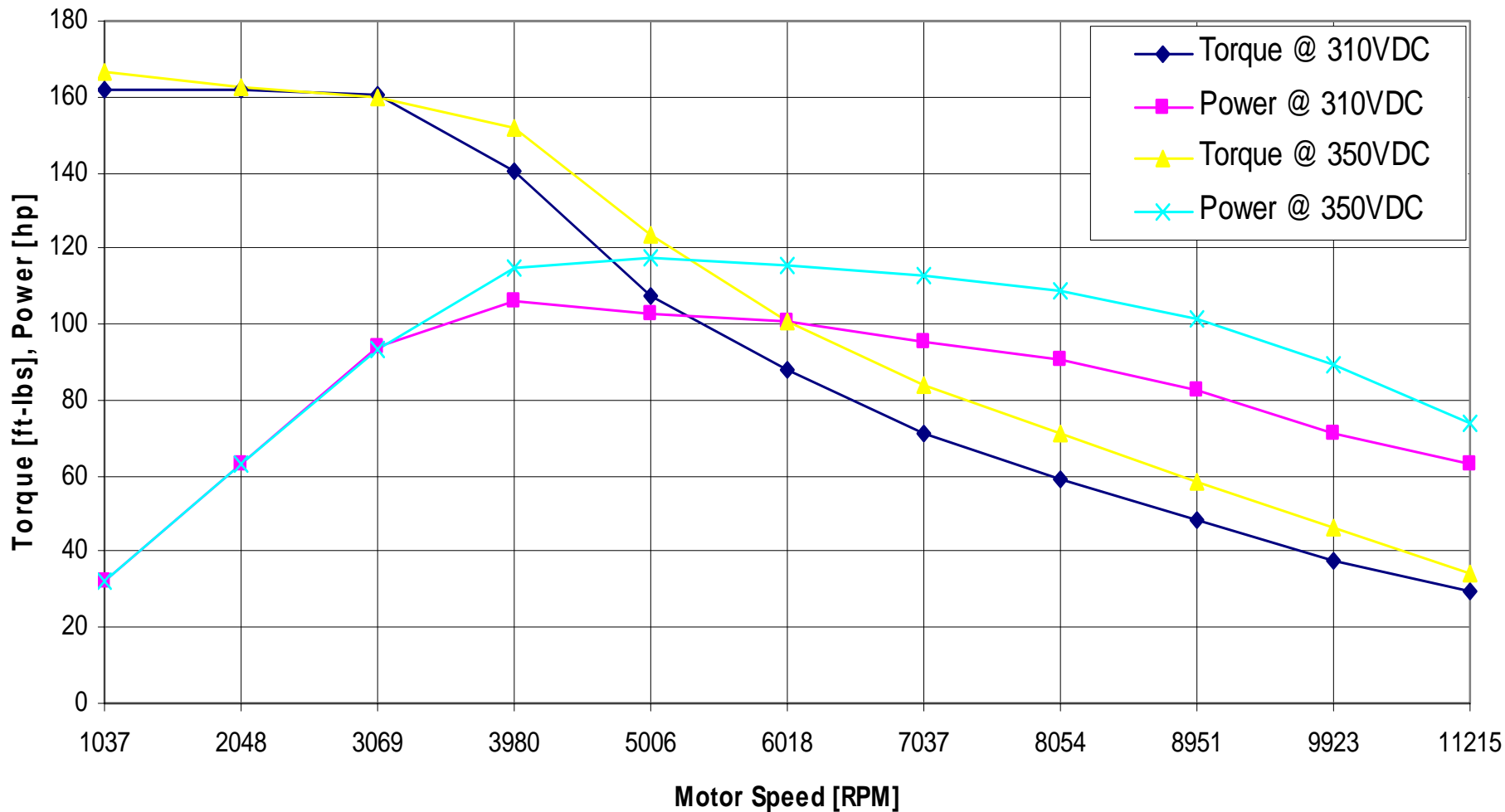


The Electric Bobcat Racing Team



Motor Curve

Torque & Power vs Speed (3K6)

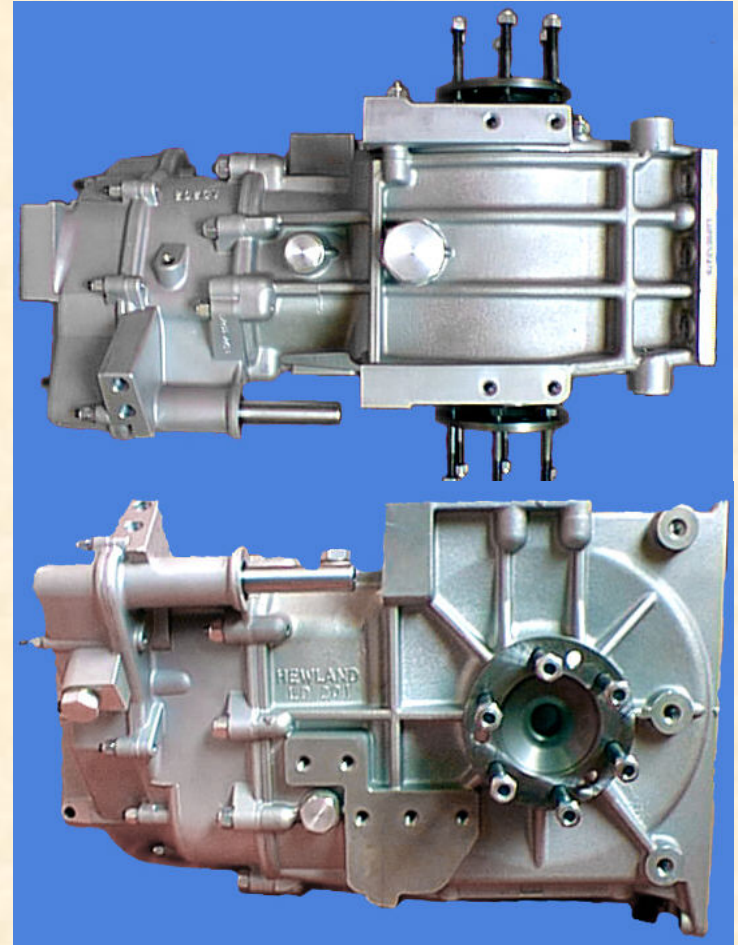


The Electric Bobcat Racing Team



Hewland LD 200 →
Transmission

Quick-Flex Coupling ↓



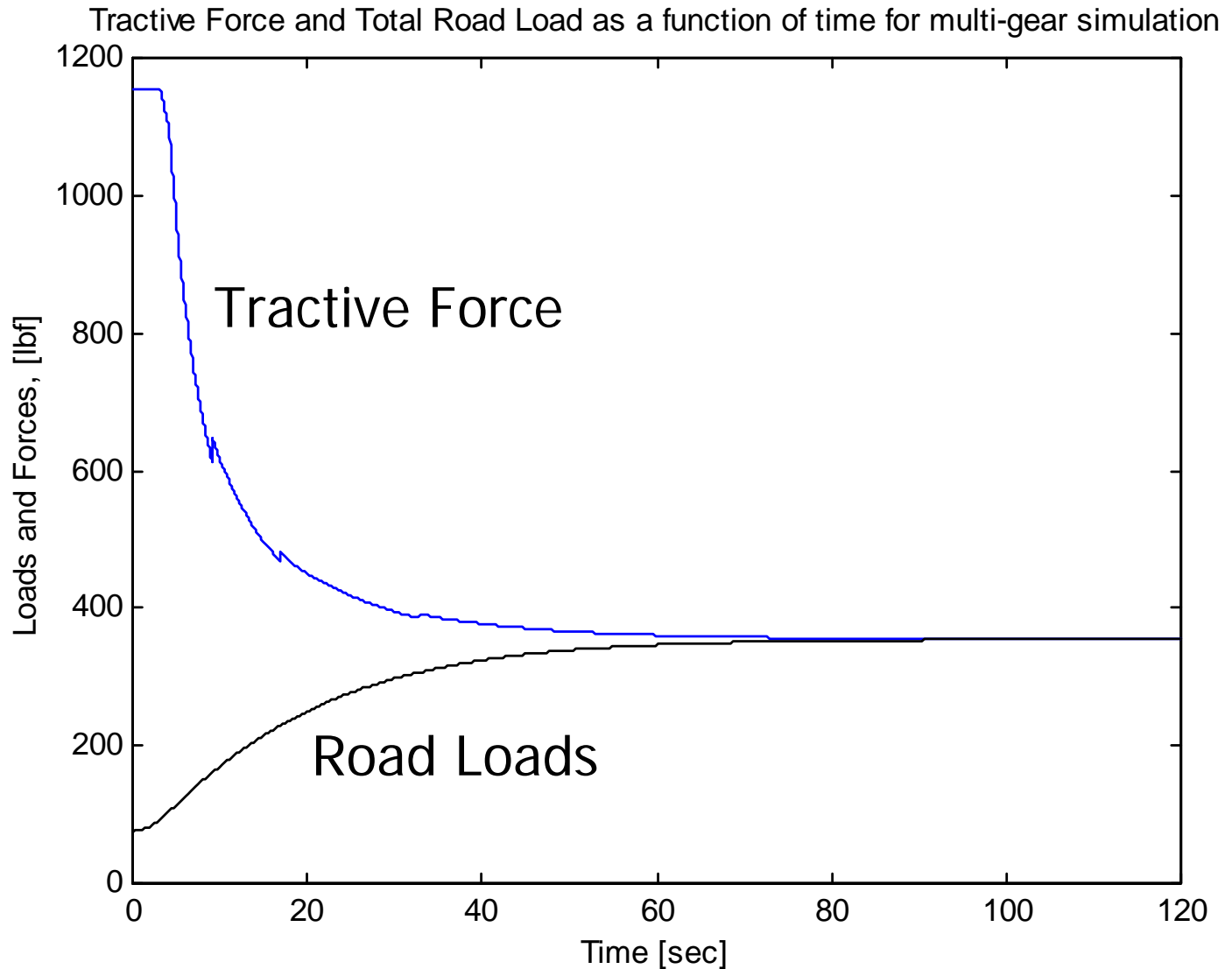
The Electric Bobcat Racing Team



VEHICLE DYNAMICS

- Vehicle Acceleration Limitations
 - Engine power (torque/speed relationship)
 - Max gear ratio (torque multiplication by transmission)
 - Wheel traction limit
- Vehicle Speed Limitations
 - Engine power
 - Engine speed
 - Min gear ratio (speed effect of transmission)
 - Rolling resistance
 - Aerodynamic drag

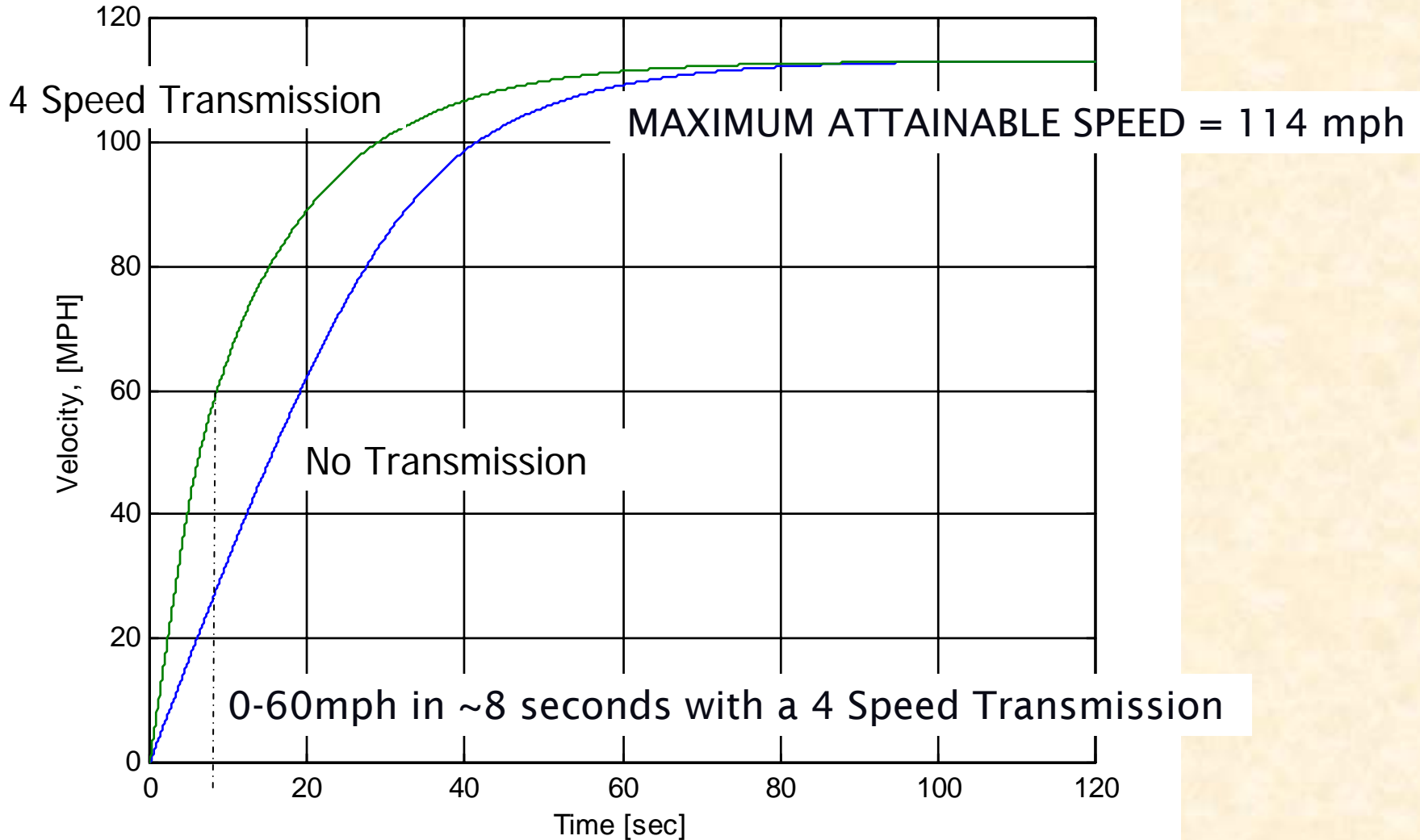
The Electric Bobcat Racing Team



The Electric Bobcat Racing Team



Vehicle Speed vs. Time for a 4 gear simulation



2nd Annual SAE Car Show



SAE Aero Design East 2003

Ohio University

Team Bobcat Flyer

Eric Bucher

Nick Haynes

Scott Szymczak

Jesse Shoup

Jason Fink

Andy Hughes

Caleb Woodby

Joel Bokelman



Eric Aber

Jennifer Leake

Faculty Advisor:

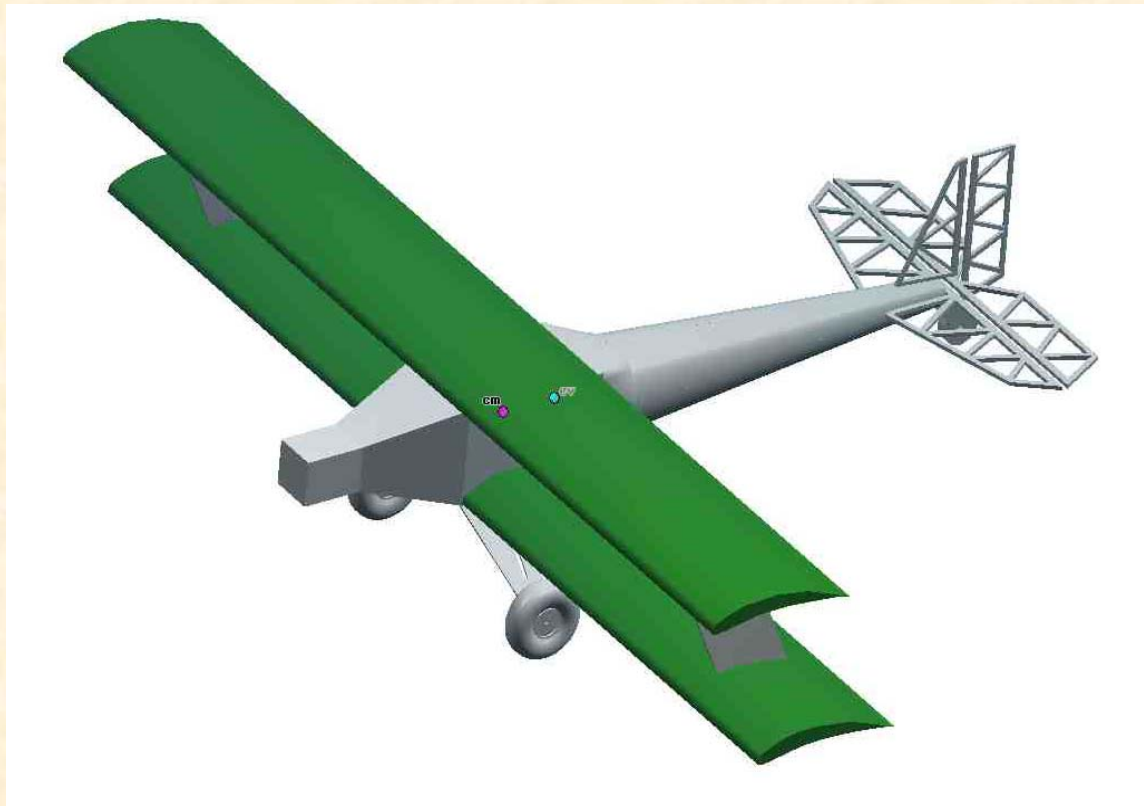
Dr. Greg Kremer

Design specifications and goals

- Fixed wing, payload aircraft
- Minimum 300 in³ cargo bay, centering homogeneous payload about aircraft CG
- Maximum wingspan of 72 inches
- Maximum takeoff runway of 200 feet

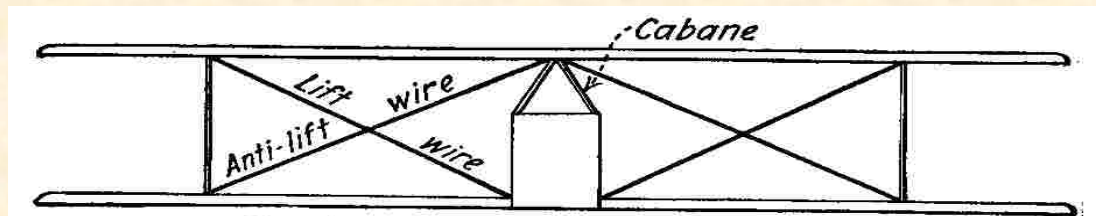
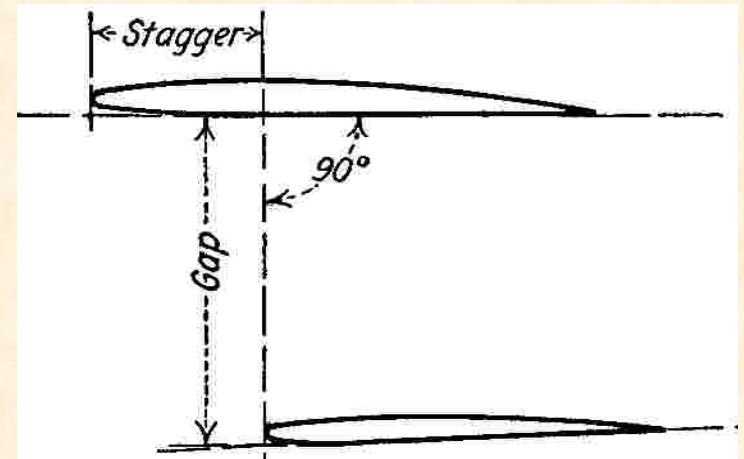
2003 Bobcat Flyer

- Tailwheel biplane design



Biplane wing design

- Gap
- Span Ratio
- Stagger
- Wing Struts



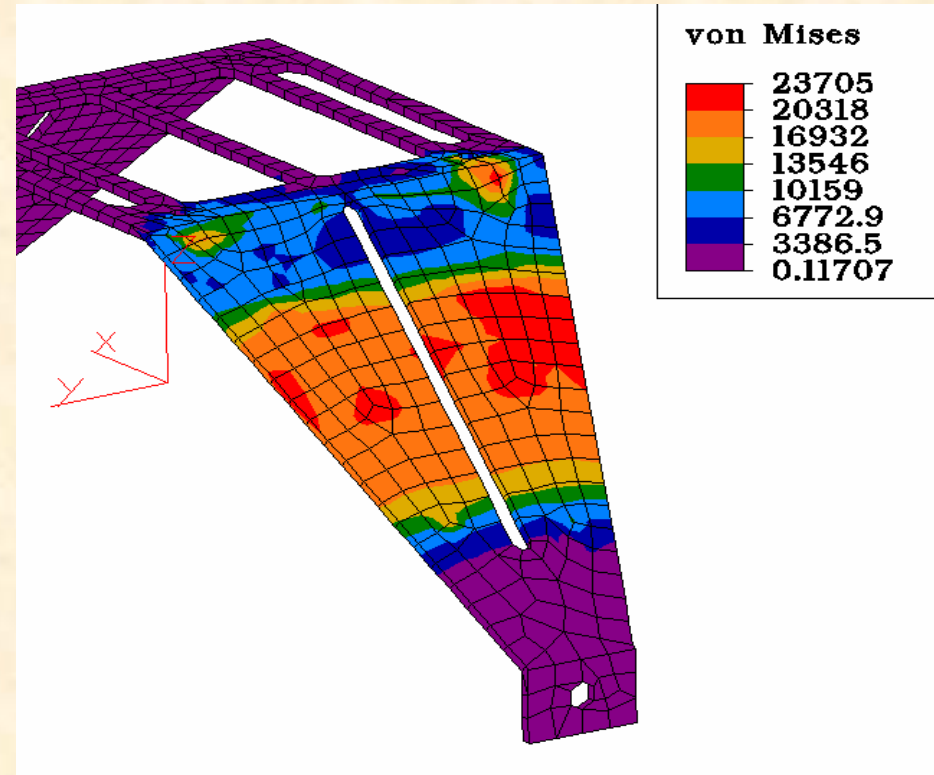
Landing gear

- 1/8" tempered aluminum Dural landing gear
- 3/16" diameter, 2" length plated steel axle
- Support arm and axle—two critical sections of the main gear designed to at least $FOS_{DE} = 1.5$
- 4" diameter Lightweight pneumatic wheels



Landing gear design and analysis— Support arm

- Fuselage mounting plate modified to reduce weight
- Uniform stresses highlight design optimization
- Worst-case loading yields $FOS_{DE} = 1.56$ ($S_{yield} = 40\text{ksi}$)



Aero Design East 2002

Team Bobcat Flyer 12

Ohio University

Jason J. Fink

Anthony Glick

Faculty Rep:

Andy Hughes

Anthony Gerstenberger

Dr. Greg Kremer

Nick Haynes

Rob Welch



Technical Difficulties



ASME Lecture Series

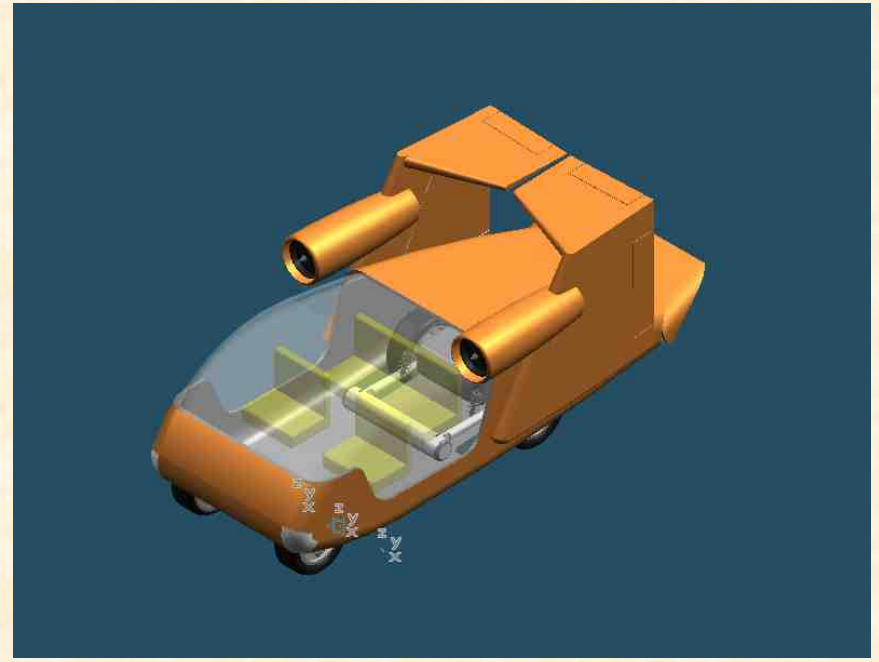
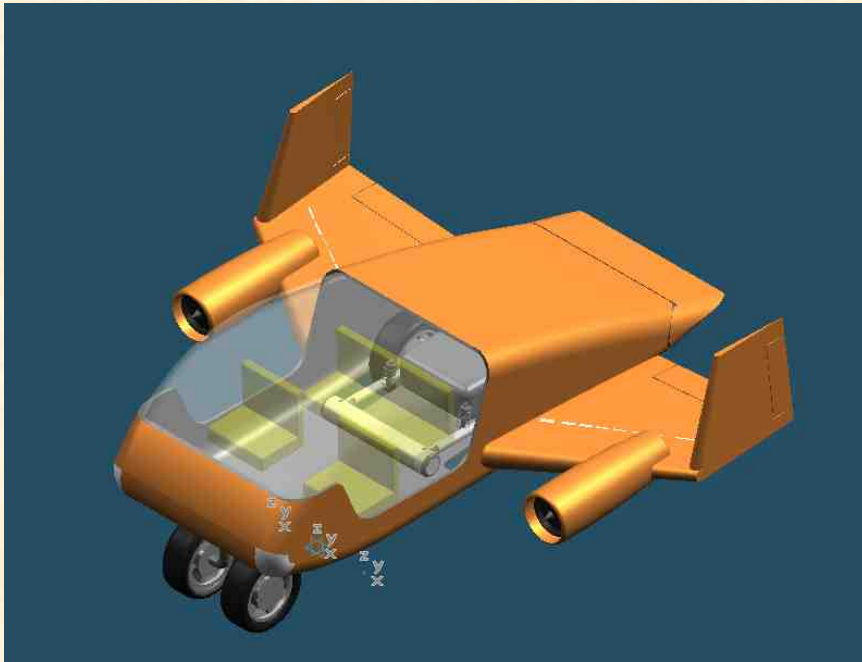
AEP Gavin Plant

Twin 1300MWN Turbine Generators

With FGD, Low NO_x Burners, SCRs, SO₃ Mitigation



NASA/GAPO National Student Design Competition



The Aeromobile, Ohio University's entry in the Revolutionary Vehicle Systems Design Competition

ME Senior Design Project

See our webpage (<http://www.ent.ohiou.edu/~me470/>) for examples of projects from the past several years



Other places to get info about Mechanical Engineering

How Stuff Works – Automotive <http://auto.howstuffworks.com/>)

Jet Engines (<http://www.geae.com/education/engines101/>)

Airplanes – Boeing 777

(<http://www.boeing.com/commercial/777family/flash.html>)

International Space Station

(http://www.nasa.gov/mission_pages/station/main/index.html)

Summary

- Mechanical Engineering can be fun and exciting
- We design vehicles that move fast and fly high, and machines that allow mankind to do things they couldn't otherwise do
- Get involved in student organizations – they are a great learning experience
- See me if you have any questions about Mechanical Engineering (Dr. Kremer, 257 Stocker)