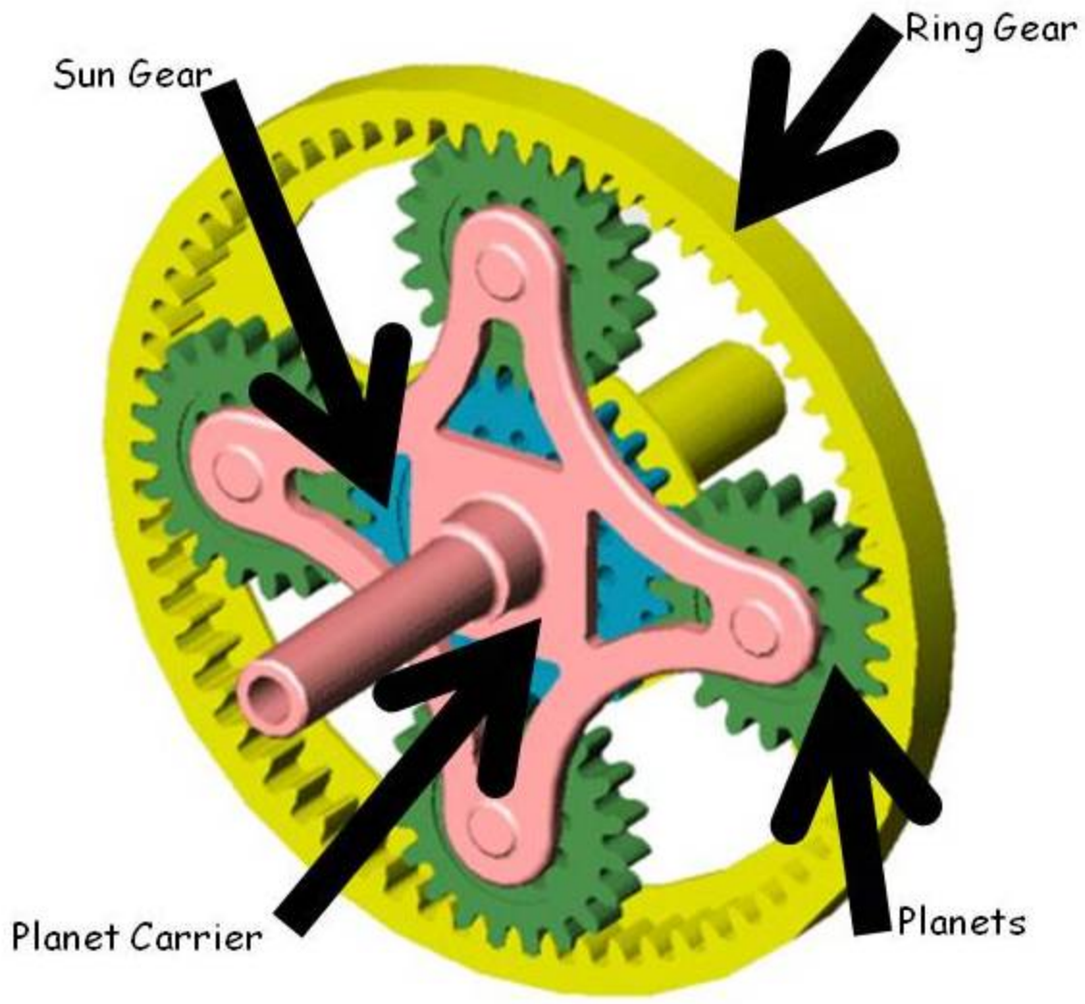
Key Terminology

- Pilot – the front rider of a tandem bike
- Stoker – the back rider of a tandem bike
- Chainring – front set of sprockets
- Freewheel – back set of sprockets attached to the rear wheel
- Planetary Gear – a set of gears consisting of a sun, ring, and planet carrier, used either as a gear reduction or to couple two inputs to one combined output
- Shiftable Hub – self contained set of gears that is normally used to replace a freewheel
- One-Way Clutch – a special bearing that only allows rotation in one direction

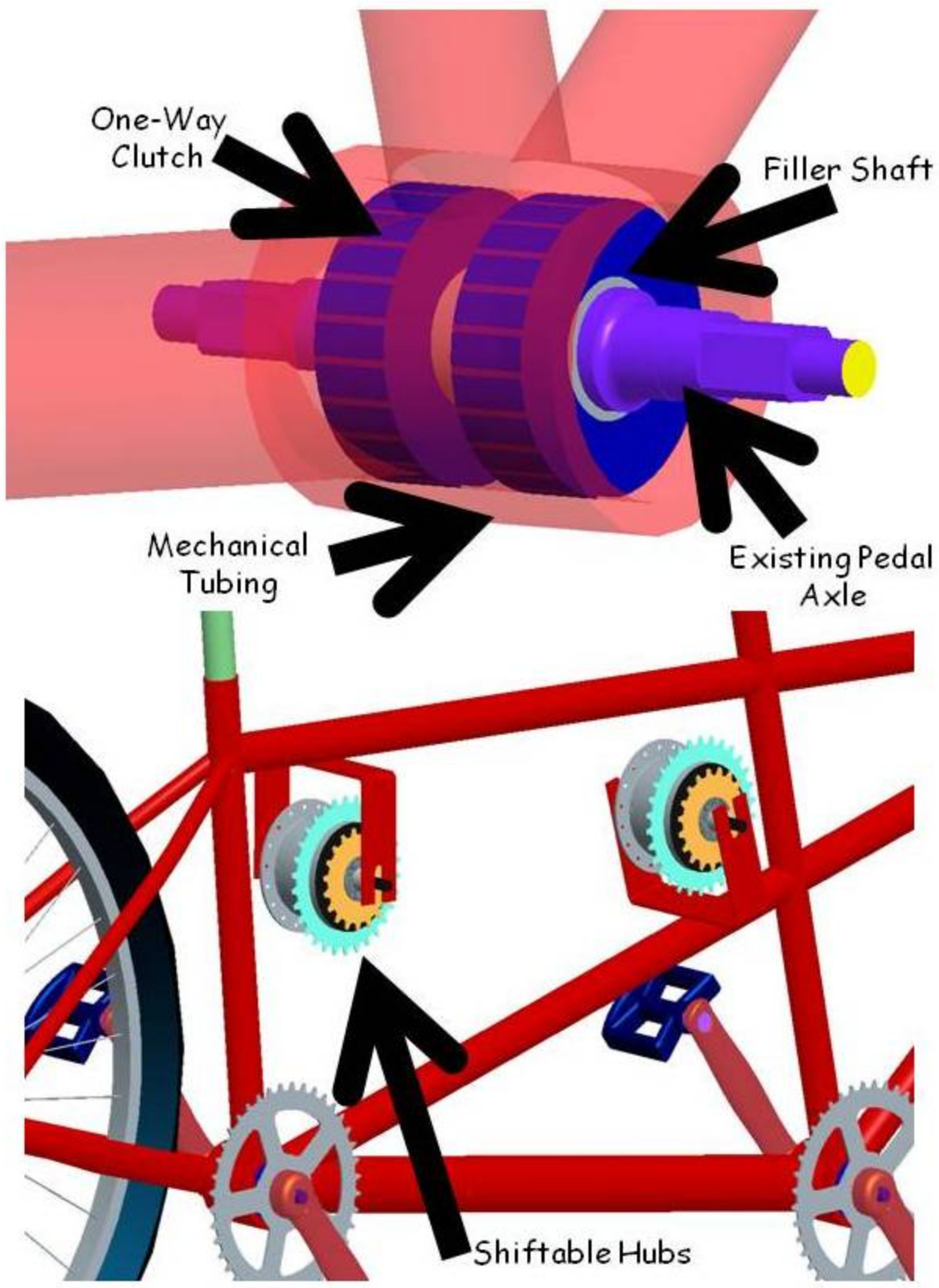


Rider Inputs				
gear of pilot		8	1	6
gear of stoker		8	1	3
Pilot N	RPM	80	80	80
Stoker N	RPM	80	80	90
torque input p1	in*lb	455	455	455
torque input p2	in*lb	455	455	455
Intermediate				
hub ratio (pilot)		1.62	0.53	1.22
hub ratio (stoker)		1.62	0.53	0.75
speed of wheel	rpm	320	104	205
pilot power	hp	0.58	0.58	0.58
stoker power	hp	0.58	0.58	0.65
total power	hp	1.16	1.16	1.23
overall speed ratio		4.00	1.31	2.40
torque of planet carrier	in-lb	228	697	378
torque into range hub	in-lb	228	697	378
Output				
Bike Speed	mph	25	8	16

First Objective
The Calculations

Calculations for speed, power, and torque would be needed for:

- Speed – for the sizing of sprockets, the planetary speed ratio and to mimic the original tandems gear ratios
- Torque – to make sure the components used can withstand the torque exerted by the rider, particularly the hubs and the planetary gear set
- Power – to ensure the functionality of the planetary when driven by riders at different speeds and force inputs



Second Objective
The CAD Model

- Assists in the overall layout of components
- Provides an accurate visual reference present conducive layout options
- Allows different layouts quickly to see how they work compared to others without physically modifying the tandem bike
- Help with dimensioning of fabricated parts
- Study the interference between components before assembling

Tandem Bicycle With Planetary Transmission

Andy Berg, Tyler Stieglitz, John Schildmier

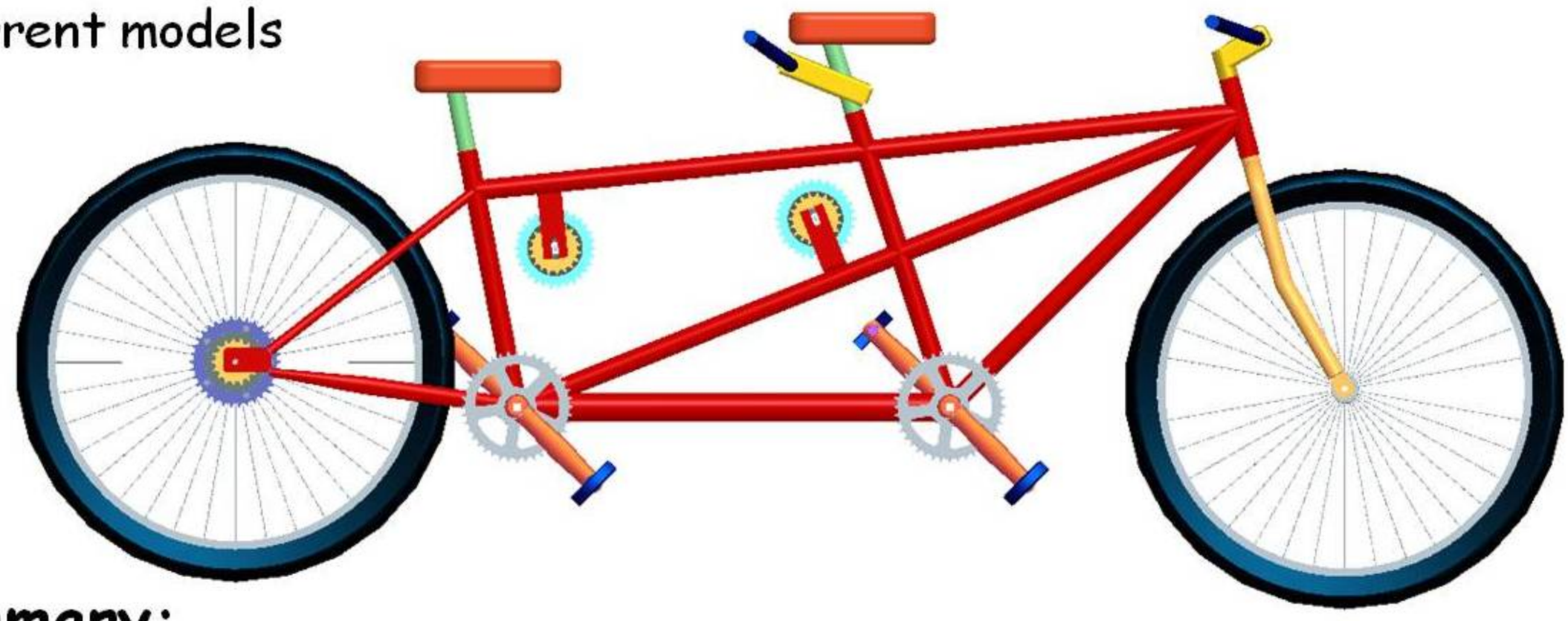
April 17, 2008

Introduction:

When riding standard bicycles in groups, many riders are forced to compromise their preferred riding style. Some may have to pedal more leisurely than they would like, and others may have to pedal harder to keep up. Our goal is to make this a thing of the past.

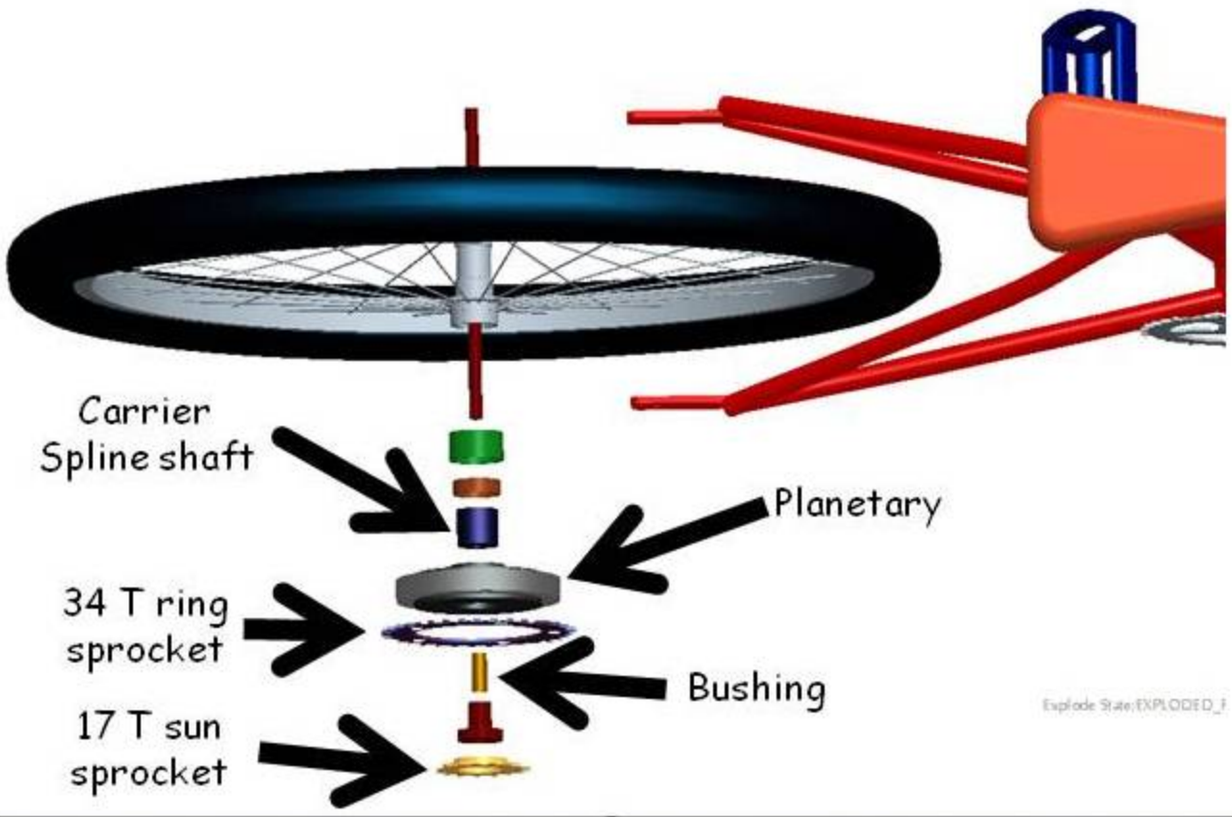
Objectives:

- Formulate a design concept and feasibility study
- Develop a CAD model to aid in the design and layout of components
- Build a prototype tandem bicycle, test and compare its performance to current models



Summary:

- Modeling and analysis of components have been completed
- All components and accessories have been purchased
- Major fabrication and changes to the frame have been completed
- Assembly and minor adjustments are in progress
- Testing and evaluation will follow



Planetary

Internally Geared Hub

Cost to Build Prototype

Description	Cost
Purchased Items	$1,863
Fabricated Materials	$100
Labor	$400
Total	
	$2,363

Potential Price of Tandem

Description	Cost
Bike	$200
Hubs	$400
Planetary	$175
Miscellaneous Parts	$150
Total	
	$925

Third Objective

Bicycle Building

This constitutes multiple stages related to the fabrication and assembly of the tandem bike

- Two bikes were ordered, one to be assembled and used normally, the other to be modified for our application
- The second bike was stripped for modification and assembly
- Parts were fabricated, with the exception of machining and welding which was done by more experienced persons
- There were multiple set-backs with parts being incompatible for our design

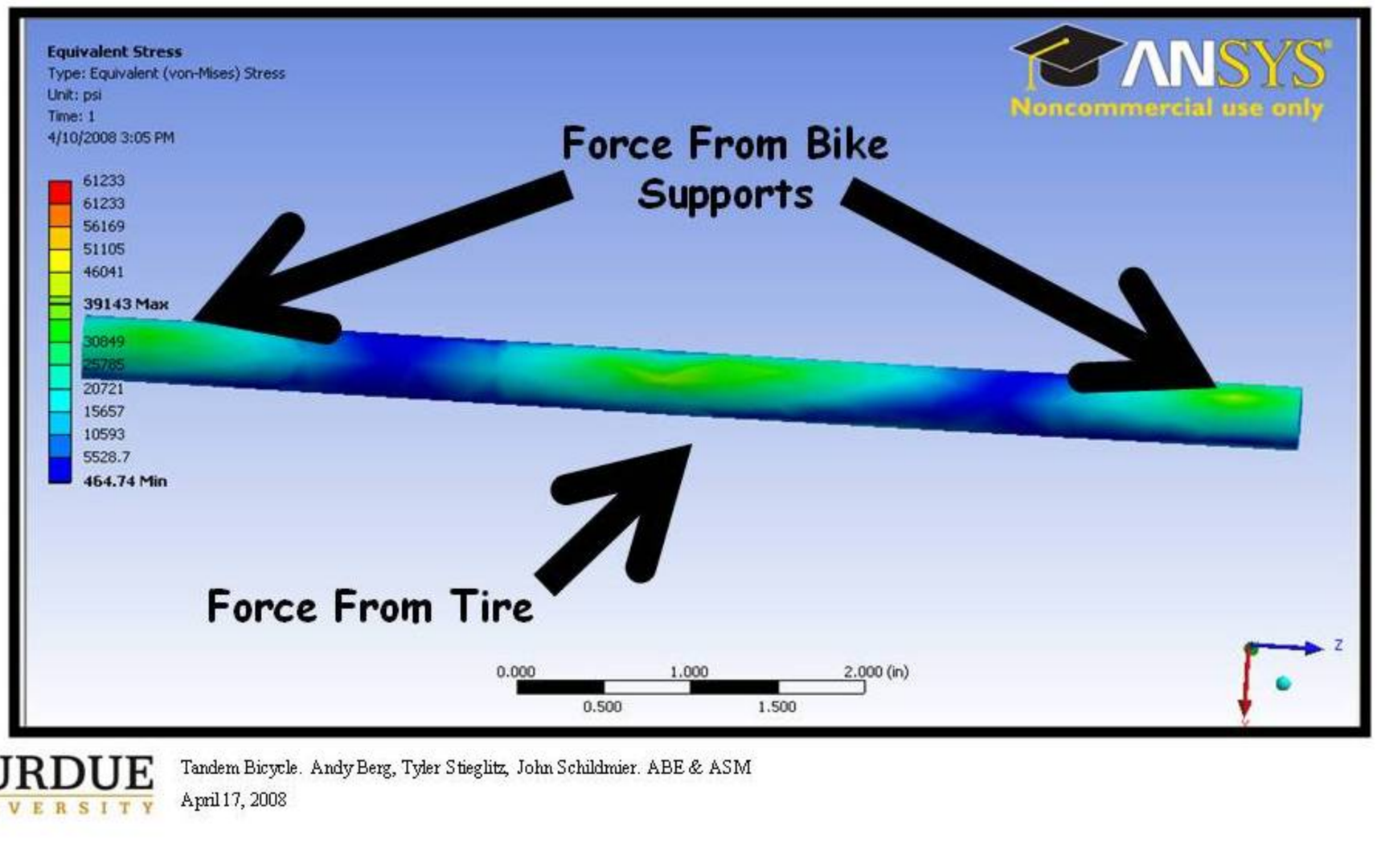
Original Sleeve Cut Out

New Sleeve With One Way Bearing

Analysis

Frame Change

- Pedal Sleeve- the normal pedal sleeve was replaced with a larger, heavier mechanical tubing.
- A longer rear axle was needed because the planetary is wider than the freewheel that used to be there. For this reason Finite Element Analysis was done in ANSYS to ensure the integrity of this change.



Acknowledgements

Project Technical Advisors
Dr. Dennis Buckmaster

Course Coordinator
Dr. Joseph Irudayaraj
Dr. Gaines Miles

Special Thanks
Scott Brand
Garry Williams