# Second Generation Bicycle Charging Station Final Project Proposal

Jon Jerome, Michael Klinefelter, Connor Kroneberger, Kori Molever, Robert Rosenberg

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# Overview

- Recognizing the need
- Objectives and constraints
- Concept generation
- Gearing analysis
- Structural analysis
- Future project timeline
- Proposed budget
- Conclusion

# Recognizing the Need

- Demonstrate the importance of renewable energy sources
- Provide students of all levels with a way to understand and compare the amount of energy required to power and charge electronic devices with the amount of energy produced by pedaling a bicycle

# Recognizing the Need

Several issues exist with 1st Generation station:

- Not compatible with all major cell phones/AC Charging
- Cannot readily be transported to different locations
- Current display system is not user friendly and does not display adequate information
- User comfort and adjustability
- No consideration towards varying power inputs (gearing and resistance)

# Constraints

- Charging station must be able to be moved easily around campus to be used in various buildings and at different events
- Power generation information will be displayed both as numerical information and graphically
- Station must incorporate various phone chargers and 3-prong AC outlet
- Charging station must be built within the budget of $1,600 provided by Green Fund

# Concept Generation

Design Concepts:

- Adjustability
- Portability
- Gearing configuration

| Design Option | Assembly Time (sec) | Weight (lb) | Range of Adjustability (inches) | Cost ($) | RPM | Maintenance (hours) | Total |
|---|---|---|---|---|---|---|---|
| Assembly Time (sec) | - | 0 | 0 | 1 | 0 | 0 | 1 |
| Weight (lb) | 1 | - | 0 | 1 | 0 | 1 | 3 |
| Range of Adjustability (inches) | 1 | 1 | - | 1 | 0 | 1 | 4 |
| Cost ($) | 0 | 0 | 0 | - | 0 | 1 | 1 |
| RPM | 1 | 1 | 1 | 1 | - | 1 | 5 |
| Maintenance (hours) | 1 | 0 | 0 | 0 | 0 | - | 1 |

# Decision Matrix

| Scale: 1-unfavorable 5-favorable | Assembly time (sec) | Weight (lb) | Range of Adjustability (inches) | Cost ($) | RPM | Maintenance (hours) | Total |
|---|---|---|---|---|---|---|---|
| Collapsible | 5 | 2 | 1 | 1 | 1 | 2 | 23 |
| Rear Wheel Stand | 5 | 2 | 1 | 3 | 1 | 2 | 25 |
| Upright Frame | 5 | 1 | 5 | 4 | 3 | 1 | 48 |
| Recumbent Frame | 2 | 2 | 5 | 2 | 1 | 2 | 37 |
| Geared | 1 | 1 | 3 | 4 | 5 | 3 | 48 |
| Single Speed | 1 | 1 | 2 | 1 | 5 | 1 | 39 |
| Battery | 1 | 1 | 1 | 4 | 1 | 1 | 18 |
| Capacitor | 1 | 4 | 1 | 4 | 1 | 1 | 27 |
| Relative Weight | 1 | 3 | 4 | 1 | 5 | 1 | |

# User Adjustability

- **Upright configuration**
  - Readily Available
  - Seat Adjustability to 12 inches
  - Lower cost

# Portability

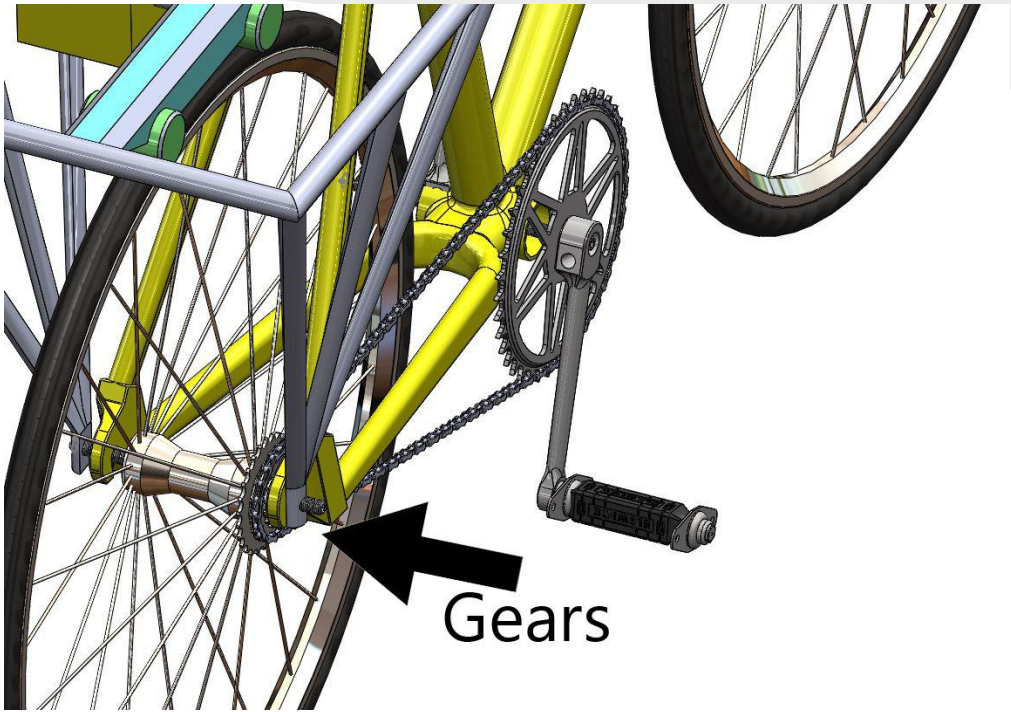
- **Rotating wheel stand**

  -Rotates around to top of wheels for ease of travel

  -Bicycle can be ridden to new location

# Gearing

- **Geared Bicycle**
  - More expensive
  - Maintain high RPM comfortably



# Engineering Analysis

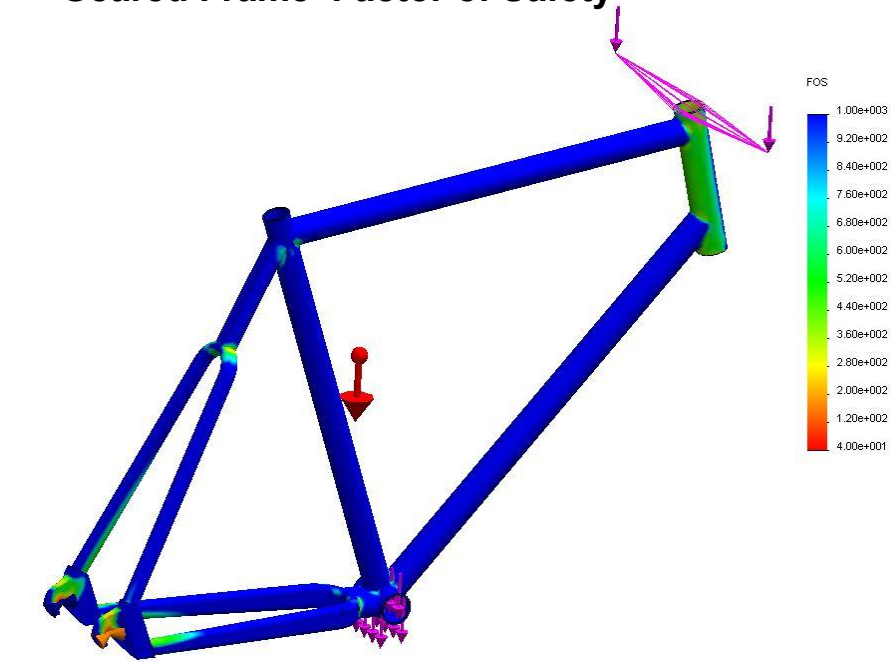
- **Gearing**
  - Load Analysis - rpm
- **Structural Analysis**
  - Frame
  - Stand

# RPM Analysis

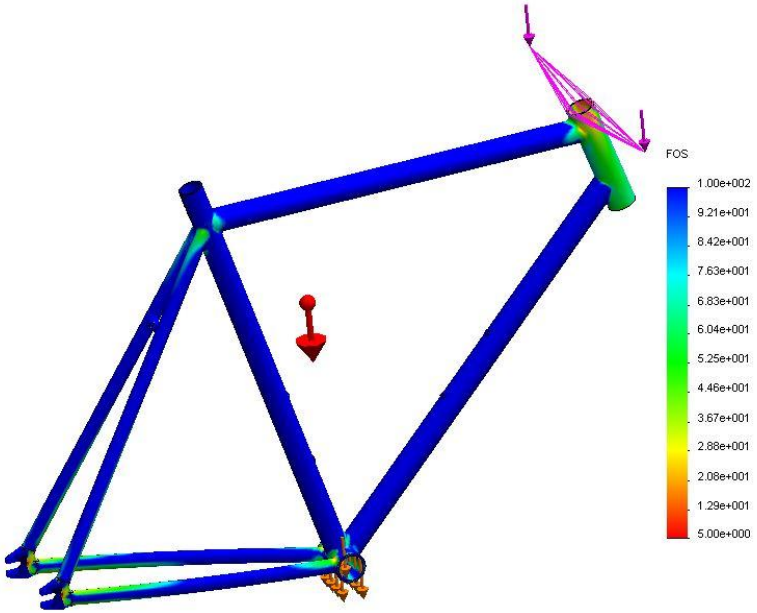
| | User Input (RPM) [Average] | Front Gear (teeth) | Rear Gears (teeth) | Rear Tire Diameter (in.) | Generator Shaft Diameter (in.) | Expected Range (RPM) [Average] |
|---|---|---|---|---|---|---|
| **3-Gear** | **40-132 [68]** | **42** | **16-32** | **26.6** | **3** | **1536-3072 [1653]** |

# Frame Analysis

**Geared Frame Factor of Safety**




**Single Speed Frame Factor of Safety**

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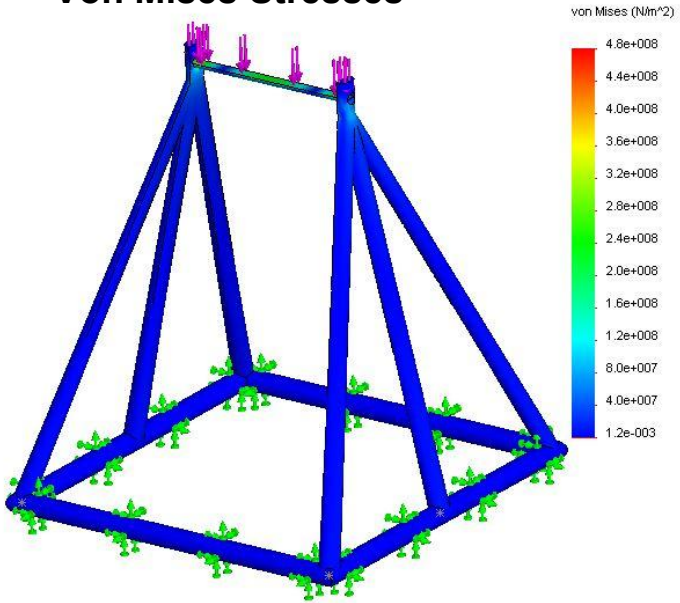
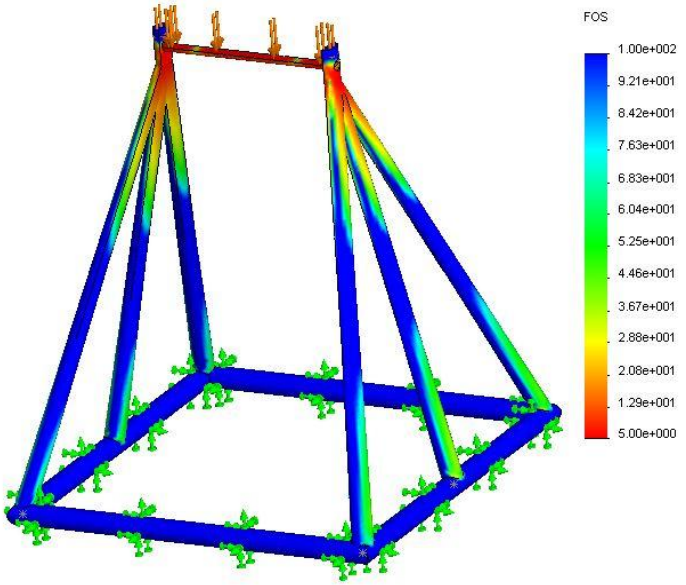
# Stand Analysis

**Von Mises Stresses**




**Factor of Safety**

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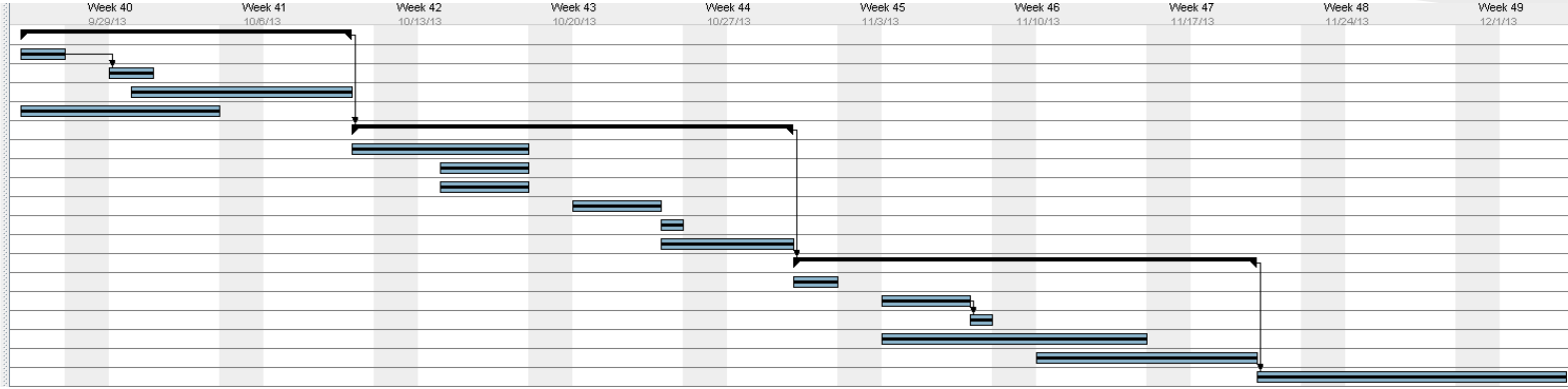
# Project Timeline Fall 2013

| Name | Begin d... | End date |
|---|---|---|
| Project Needs, Specifications, Plan | 9/26/13 | 10/10/13 |
| Project Needs Generation | 9/26/13 | 9/27/13 |
| Objectives/Specification Gener... | 9/30/13 | 10/1/13 |
| QFD Analysis | 10/1/13 | 10/10/13 |
| Semester Project Timelin Plan... | 9/26/13 | 10/4/13 |
| Concept Generation and Selection | 10/11/13 | 10/30/13 |
| Gearing Concept Generation | 10/11/13 | 10/18/13 |
| Adjustability Concept Generation | 10/15/13 | 10/18/13 |
| Power Storage Concept Gener... | 10/15/13 | 10/18/13 |
| Portability Concept Generation | 10/21/13 | 10/24/13 |
| Update QFD/Decision Matrix | 10/25/13 | 10/25/13 |
| Concept Selection | 10/25/13 | 10/30/13 |
| Engineering Analysis | 10/31/13 | 11/20/13 |
| Preliminary Analysis Meetings | 10/31/13 | 11/1/13 |
| Portability Design | 11/4/13 | 11/7/13 |
| Portability Analysis | 11/8/13 | 11/8/13 |
| Power/Gear Analysis | 11/4/13 | 11/15/13 |
| Adjustability Analysis | 11/11/13 | 11/20/13 |
| Project Proposal | 11/21/13 | 12/4/13 |

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# Project Timeline Spring 2014

| | | |
|---|---|---|
| Assemble Parts | 1/16/14 | 1/31/14 |
| Build Phase | 2/3/14 | 2/28/14 |
| Test Phase | 3/3/14 | 3/21/14 |
| Rebuild and Test | 3/24/14 | 4/1/14 |
| Present | 4/2/14 | 4/15/14 |

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# Budget

Bicycle: **$0-$200**

Handlebars: **$50**

Stands- Materials and Labor: **$350**

Gear cassette/derailer: **$50**

Seatpost clamp: **$25**

Tools to be included: **$10**

Fasteners: **$15**

Total: **$700**

# Conclusions

- Mechanical priorities for 2nd generation station are adjustability, versatility, portability, and efficiency.
- Additional areas for improvement include user adjustability and power output.
- Bicycle will be an upright frame that will utilize gears for user adjustability. Power storage will consist of capacitors to release energy created by generator attached to wheel.

# Conclusions

- Rear-wheel stand will allow user to ride bicycle freely for transportation and provide stationary stand for use and demonstration purposes.
- Interactive display will include power generation over lifetime of bicycle that will be displayed numerically and graphically.
- Our budget totals $700 from the $1600 to be split with the electrical team. Donations will lower our expenditures further.

# References


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# Questions?