# TEAM 18: PENETROMETER

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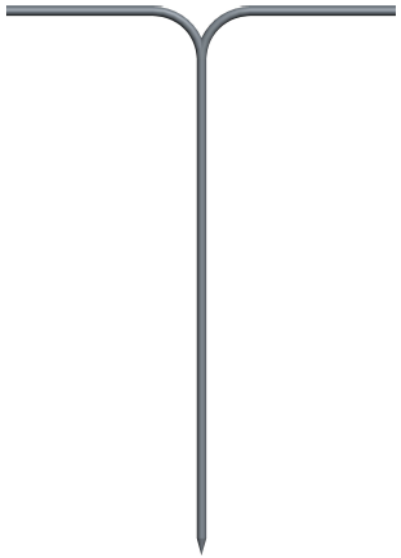
# SCOPE OF PROJECT – PENETROMETER

- National Park Service
- Penetrometer's Current Use
- Design Use
  - Load Cell & Strain Gauge
- Mechanical and Electrical Aspect



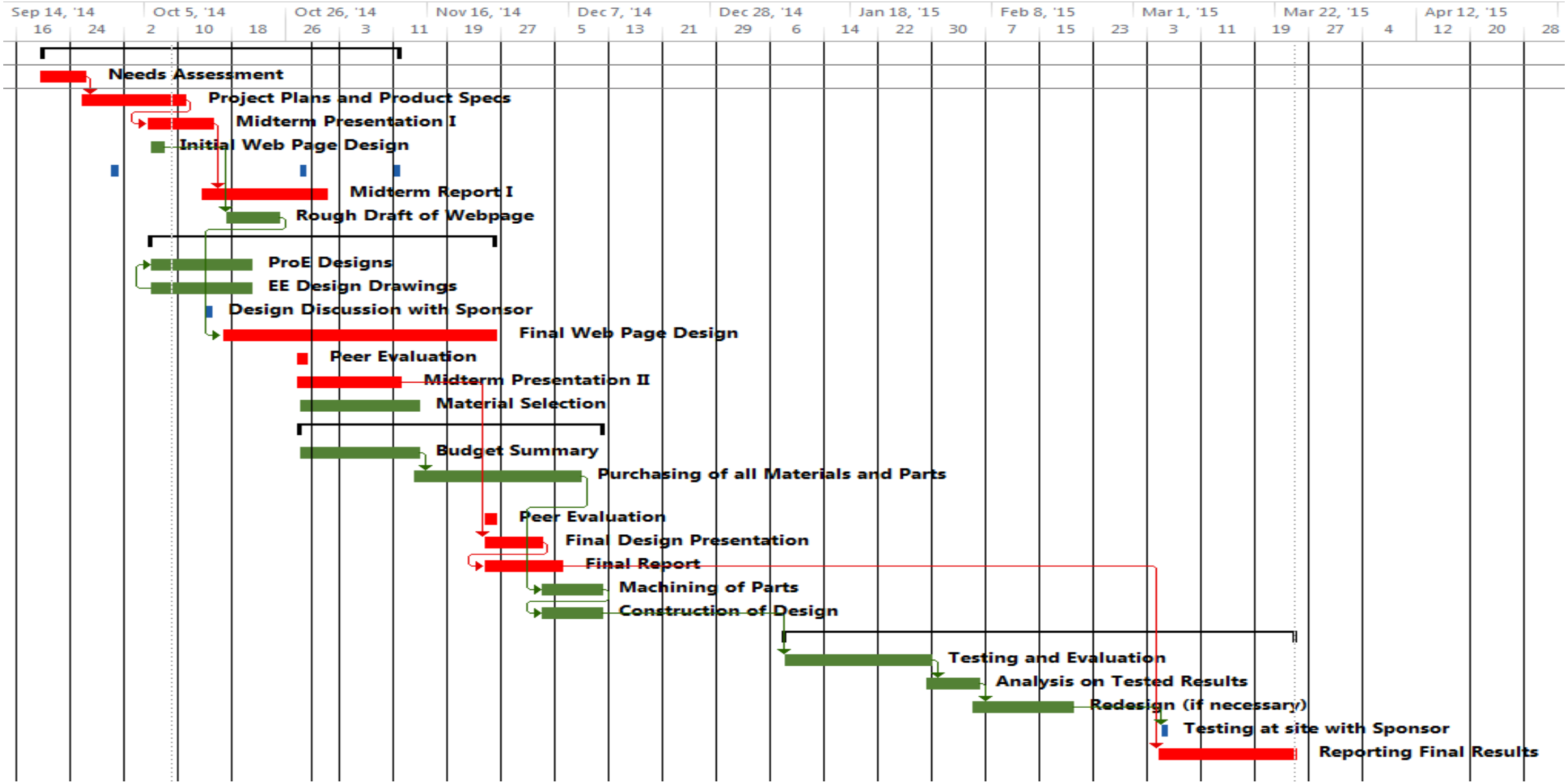
# SCOPE OF PROJECT – PENETROMETER

## Objectives

- Identify midden levels
- Weigh no more than 50 lbs.
- Should be portable
- Reach at least 20 feet into the ground
- Display results on handheld device

## Constraints

- Must be easy to use
- No bending or fracturing
- Locate the midden
- Data should be reliable


Sep 14, '14
Oct 5, '14
Oct 26, '14
Nov 16, '14
Dec 7, '14
Dec 28, '14
Jan 18, '15
Feb 8, '15
Mar 1, '15
Mar 22, '15
Apr 12, '15
16 24 2 10 18 26 3 11 19 27 5 13 21 29 6 14 22 30 7 15 23 3 11 19 27 4 12 20 28
Needs Assessment
Project Plans and Product Specs
Midterm Presentation I
Initial Web Page Design
Midterm Report I
Rough Draft of Webpage
ProE Designs
EE Design Drawings
Design Discussion with Sponsor
Final Web Page Design
Peer Evaluation
Midterm Presentation II
Material Selection
Budget Summary
Purchasing of all Materials and Parts
Peer Evaluation
Final Design Presentation
Final Report
Machining of Parts
Construction of Design
Testing and Evaluation
Analysis on Tested Results
Redesign (if necessary)
Testing at site with Sponsor
Reporting Final Results

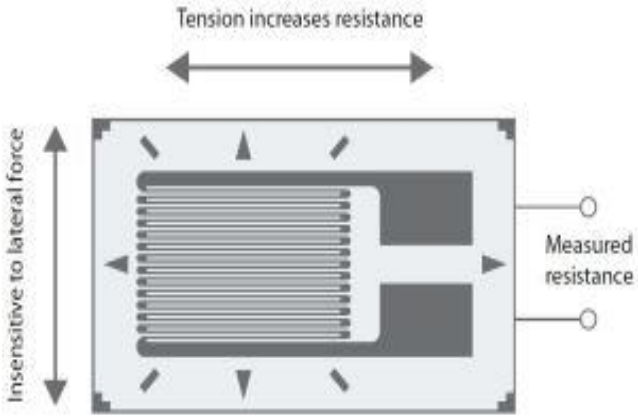
# CURRENT DESIGN CONCEPTS

## Load Cells

- Protective housing for strain gauges
- Higher load capacities and more readily available
- Larger housing needed for accurate measurement of load

## Strain Gauge

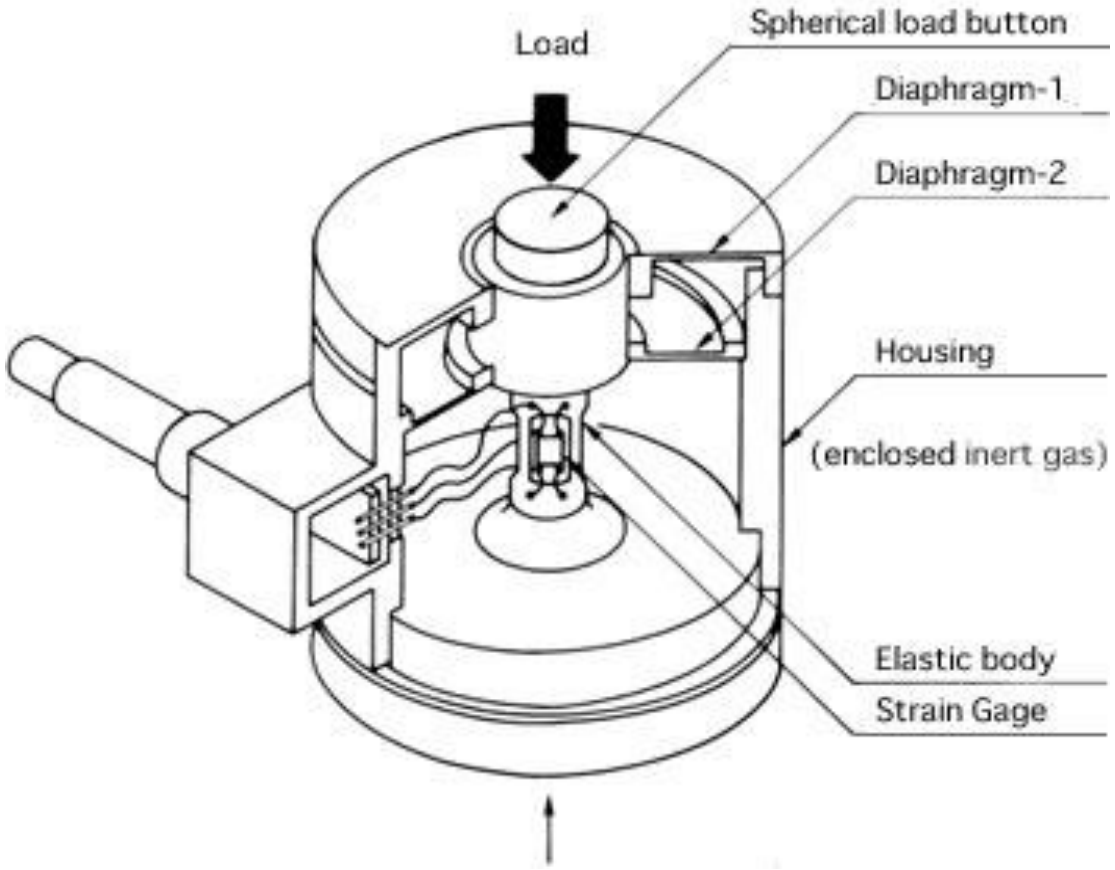
- Flexible foil material pasted between two protective materials
- Induced stress changes resistive properties of the foil
- Smaller in size and applied directly to shaft



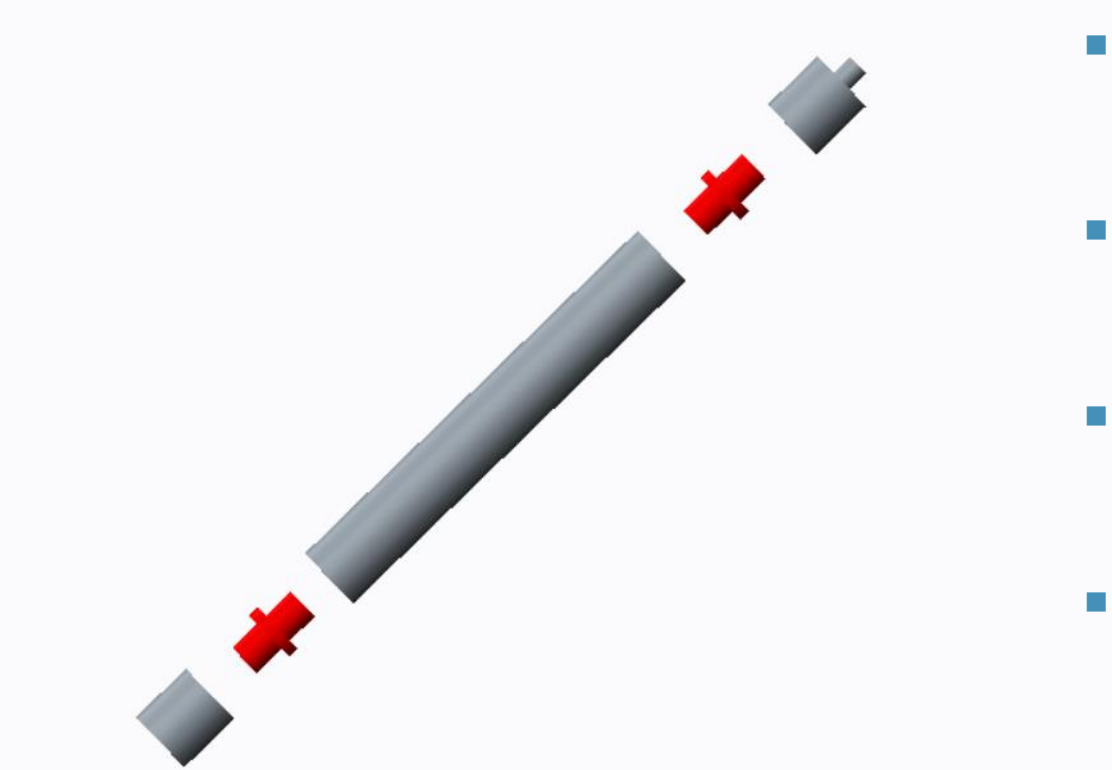
# CURRENT DESIGN CONCEPT: LOAD CELL

## Criteria

- Design Use
  - Top load cells
- Advantages and Disadvantages
  - Would not have to recalibrate it every time it is used
  - Inaccuracy of testing
- Choosing the Proper Load Cells
  - Can range from 5 – 500,000 lbs.



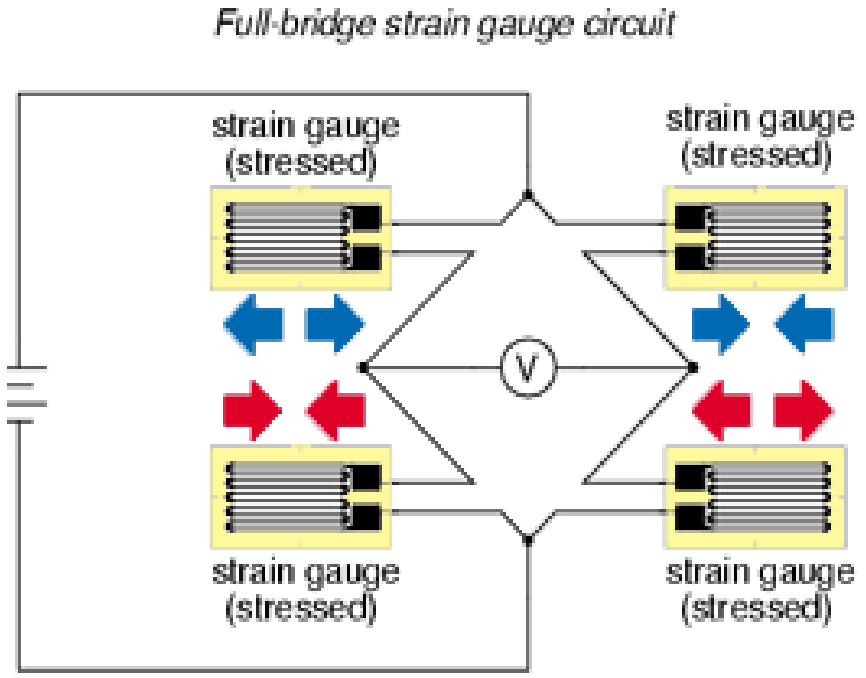
# CURRENT DESIGN CONCEPT: LOAD CELL



- Load Cells located at the top of shaft
- Utilizes a protective housing
- More accurate than strain gauges
- Reads out a voltage from the impact force of penetration

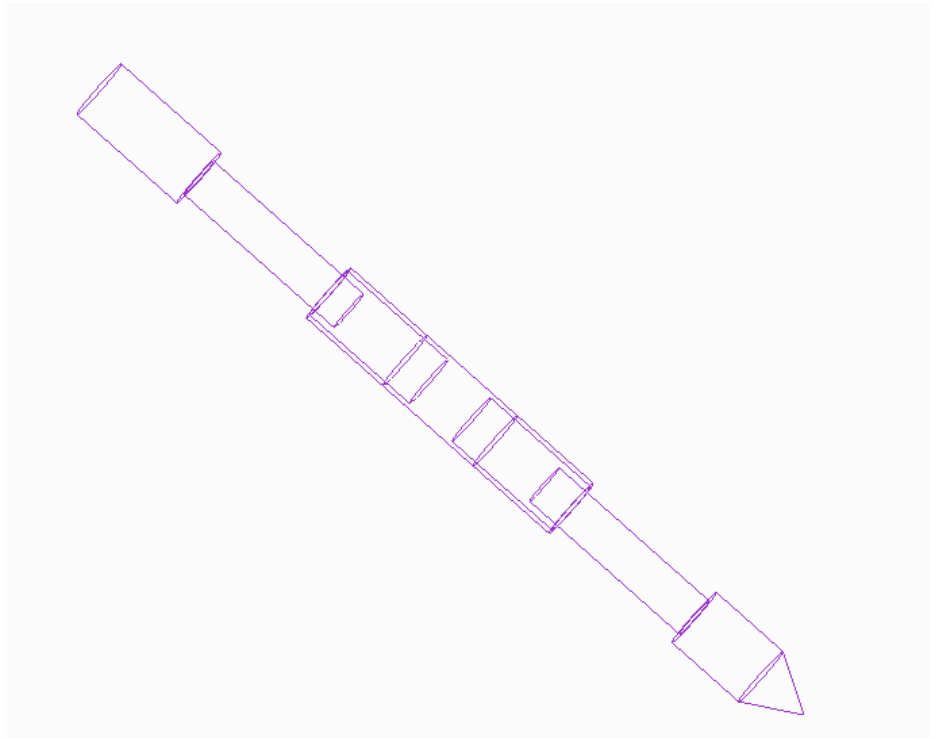
# CURRENT DESIGN CONCEPT: STRAIN GAUGE

- Using a flexible resistive foil compacted between an adhesive material
- Wheatstone bridge allows for an accurate measure of the voltage change
- Smaller and more compact due to no protective housing of the elastic membrane



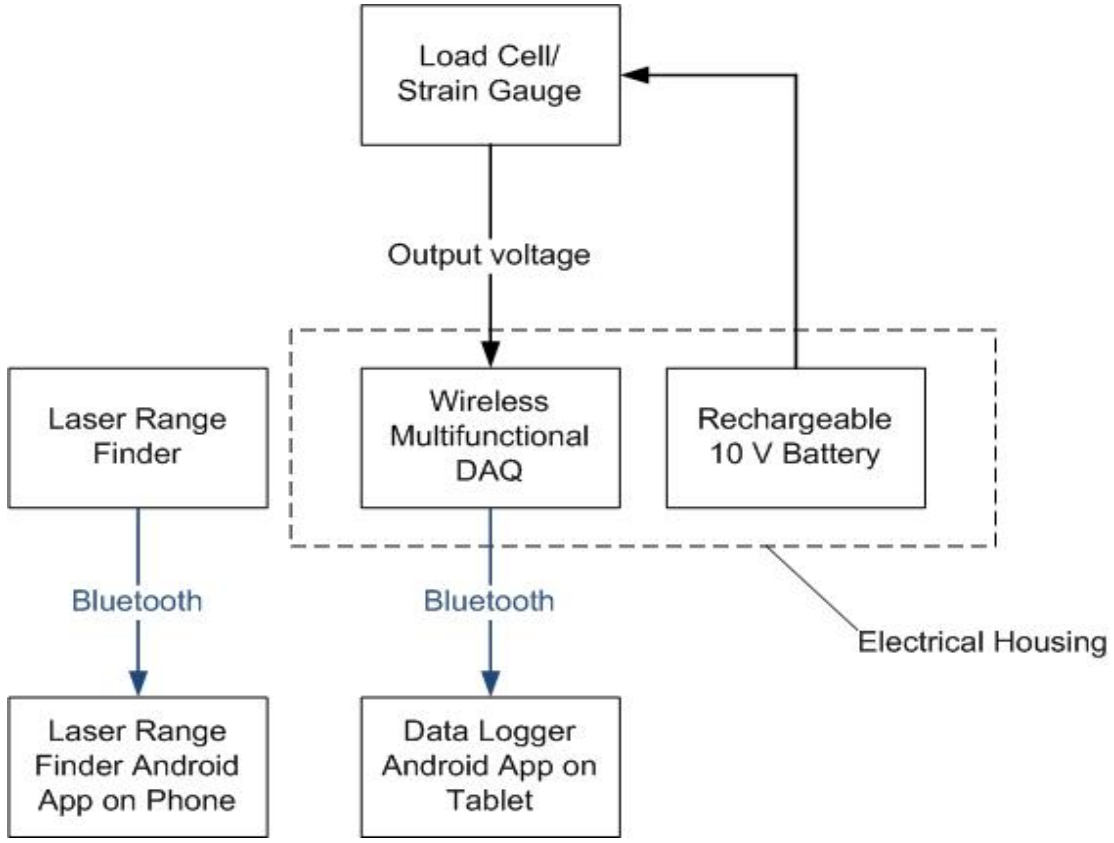
# CURRENT DESIGN CONCEPT: STRAIN GAUGE

- Encased elastic membrane much like a load cell configuration
- Strain gauge directly attached to elastic material of the rod
- Impact force changes the strain gauge resistance
- Exposure to the environment while penetrating the ground



# ELECTRICAL ASPECT OF DESIGN

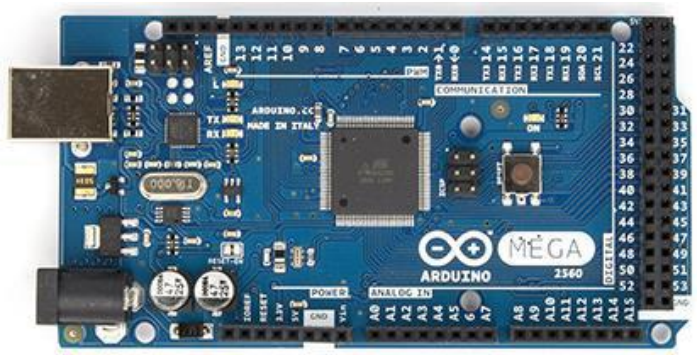
- 10 Volt rechargeable and replaceable battery
- Bluetooth capable data acquisition module
- Bluetooth capable laser range finder
- Data will be displayed on an Android device
- Android App will be created to display and store the data



# ELECTRICAL DESIGN: ARDUINO MEGA 2560 DAQ

## Arduino

- Operating Voltage: 5V
- 54 Digital I/O pins
- 16 MHz clock speed
- 256 kB flash memory




## LCD

- 1.77” diagonal, with 160 x 128 pixel resolution
- LCD screen will have to be wired to the Arduino board
- protective case will have to be made house the LCD screen

# ELECTRICAL DESIGN: BTH-1208LS DAQ

- Sample rate: 1 kS/s continuous, 47 kS/s burst mode
- Battery or USB power options
- Two 12-bit analog outputs
- Eight 11-bit SE or four 12-bit DIFF analog inputs
- May require an Op-amp for better resolution

# ELECTRICAL DESIGN: LASER RANGE FINDER

- Measured with laser and reference point
- Laser measures displacement of reference point
- Device records the depth and sends the data to an Android device
- Android application developed by the company, Vertek.

# ELECTRICAL ASPECT: DESIGN MATRIX

| | | Portable/Wireless | | Cost | | Ease of Use | | Durability | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weight (%) | 0.35 | | 0.10 | | 0.40 | | 0.15 | | 1.00 |
| Designs | Wireless DAQ | Score | Total | Score | Total | Score | Total | Score | Total | 8.65 |
| | | 8 | 2.80 | 2 | 2.0 | 7 | 2.80 | 7 | 1.05 | |
| | Arduino | Score | Total | Score | Total | Score | Total | Score | Total | 5.30 |
| | | 5 | 1.75 | 8 | 0.80 | 5 | 2.00 | 5 | 0.75 | |

- BTH-1208LS has the most value and will be the DAQ device used for this project

# ELECTRICAL ASPECT: WHY THE BTH-1208LS?

- The BTH-1208LS won in almost every category
- DAQ is wireless Arduino is not
- An LCD screen must be attached to Arduino
- Arduino Board has no enclosure
- Enclosure would also be needed for the LCD screen
- BTH-1208LS has many Demo Apps

# SUMMARY

- Extendable attachments
- Prototype design of housing
  - Load cells & strain gauges
- T-bar vs drop weight design
- BTH-1208 DAQ system
- Future orders and testing of load cells & strain gauges
- Maintain communication with the sponsor

# ANY QUESTIONS?

## Visit Our Website

http://eng.fsu.edu/me/senior_design/2015/team18/