TEAM 18: PENETROMETER

Sponsor: National Park Service - Dr. Russo
Advisor: Dr. Shih
Instructors: Dr. Gupta, Dr. Frank

CARREN BROWN – ME

DENEUVE BRUTUS – CpE

PETER HETTMANN - ME
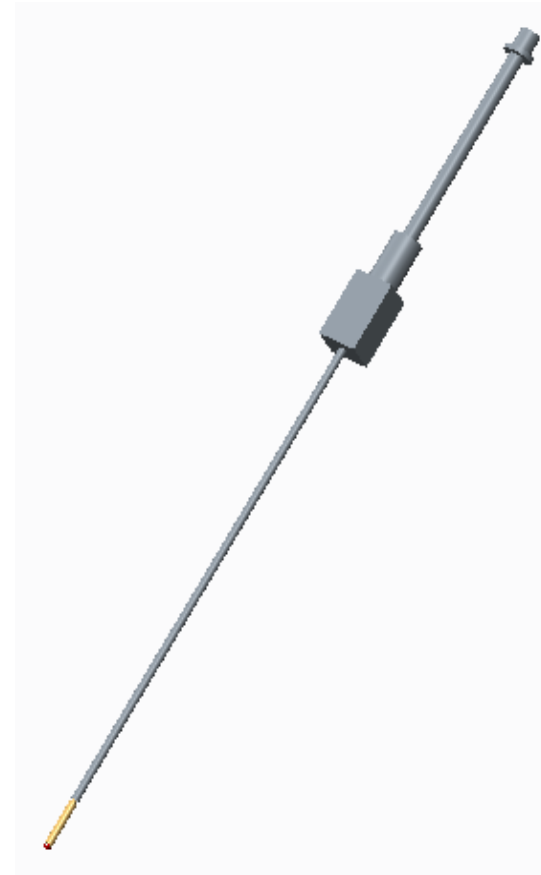
SEAN KANE - EE

NATALIE MARINI - ME

MITCHELL ROBINSON - EE

MARITZA WHITTAKER - ME

PROJECT SCOPE

- National Park Services – Dr. Michael Russo

- Need for this penetrometer

  - Identify midden levels in soil

- Current design – user friendly device

Speaker: Carren Brown

Penetrometer
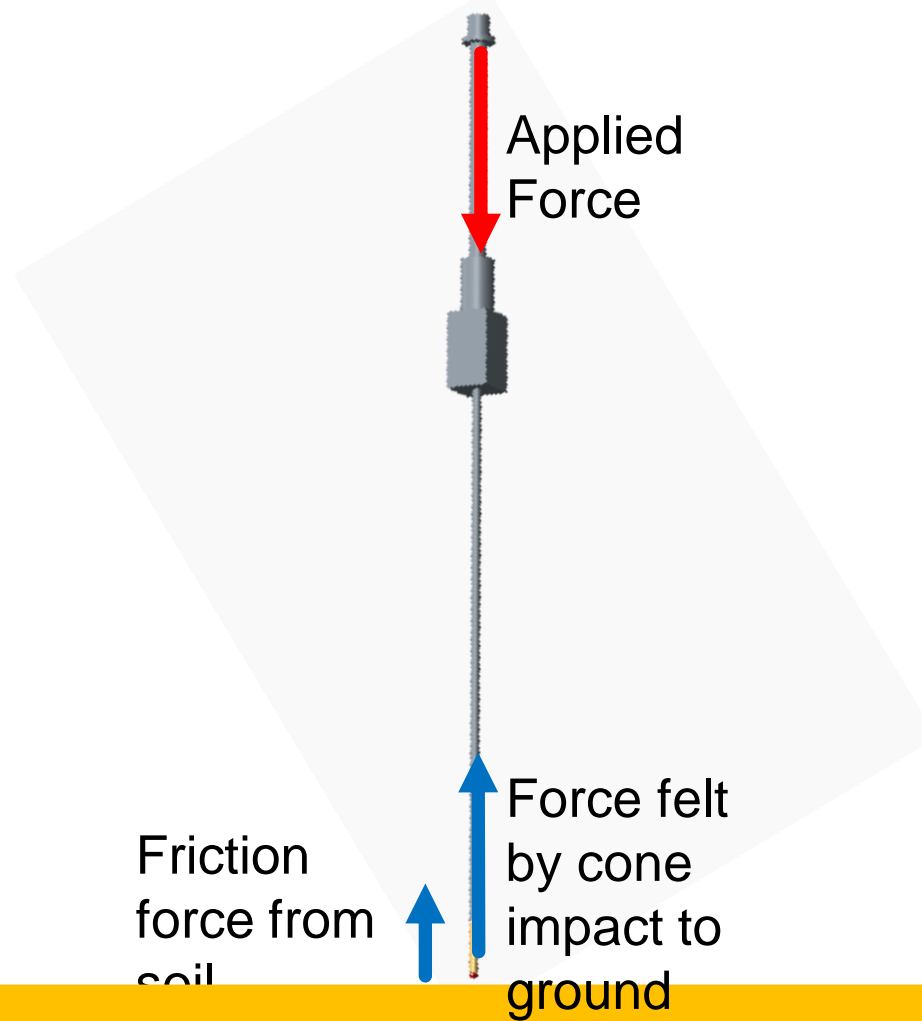
PROJECT OVERVIEW

Objectives

- Ability to identify midden

- Weight not to exceed 50 lbs

- Be portable

- Display results on a handheld device
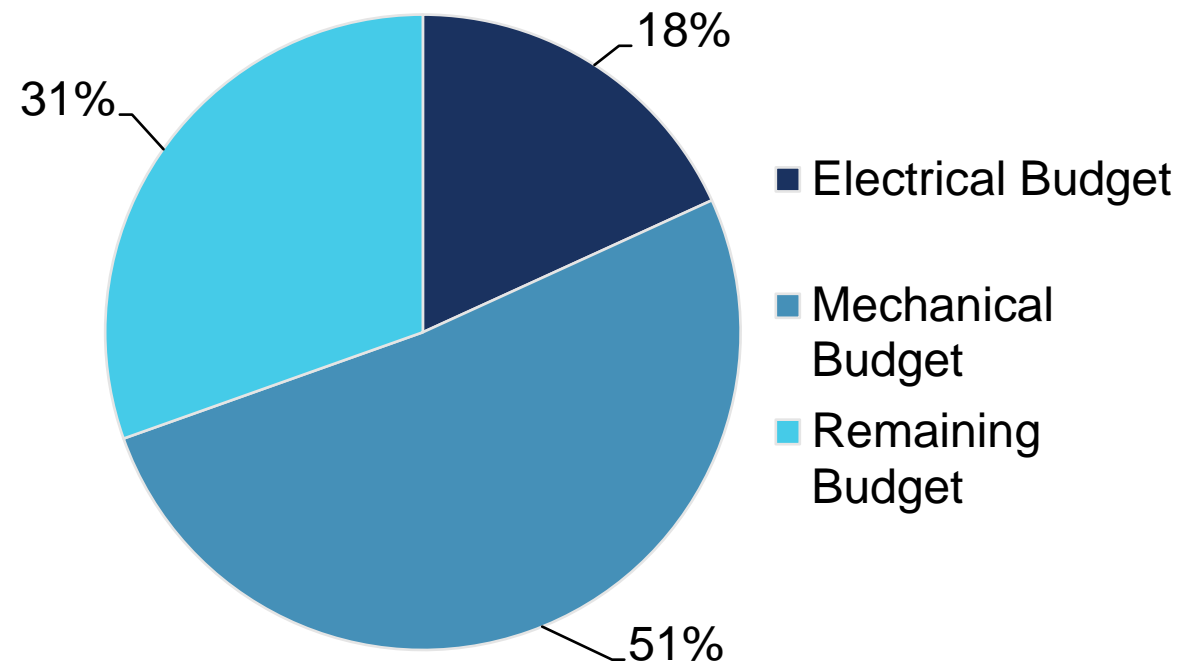
- Low maintenance

Constraints

- Ease of use

- Strong under compressive loads

- Locate midden

- Transmit reliable data

FORCE DIAGRAM

Applied Force

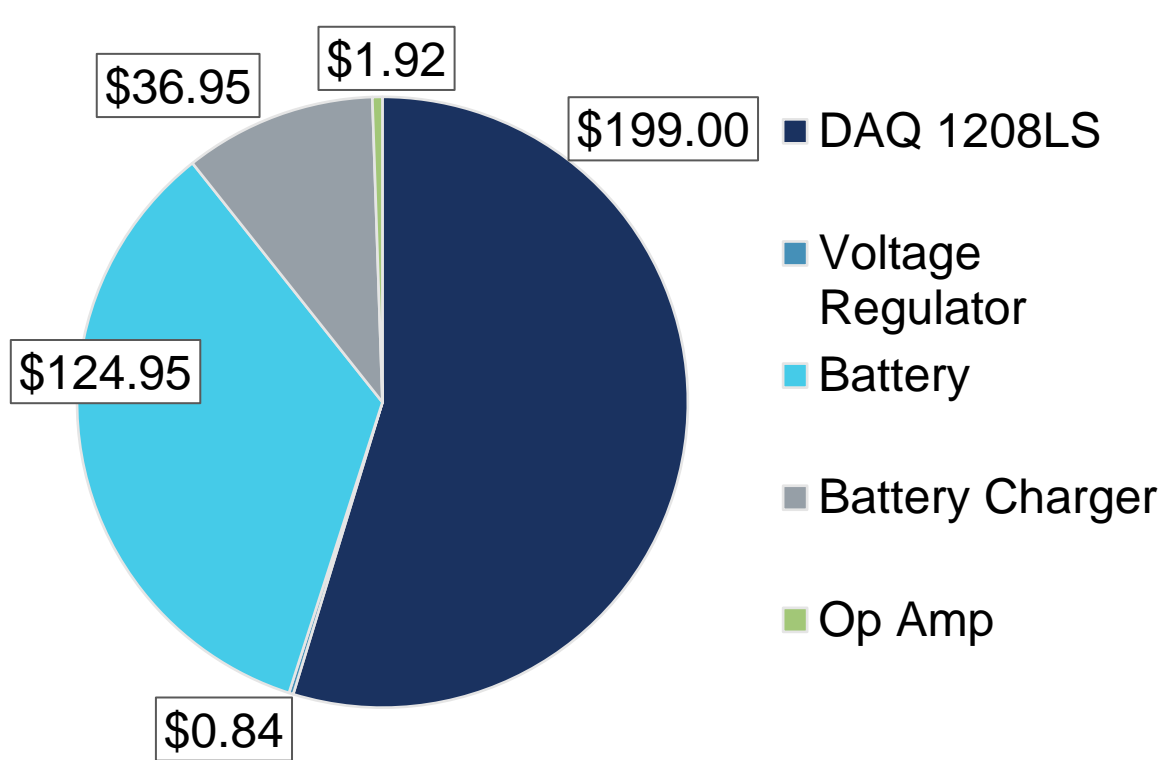Force felt by cone impact to ground

Friction force from soil

Ground

PROCUREMENT

- Allotted Budget: $2000

- All electrical components have been received for ~$324

- Mechanical components have been ordered

- Load Cells ~ $500 each

- 18% Electrical Budget
- 51% Mechanical Budget
- 31% Remaining Budget

PROCUREMENT

Electrical Component Breakdown

Legend:
- DAQ 1208LS
- Voltage Regulator
- Battery
- Battery Charger
- Op Amp

Values: $199.00, $1.92, $36.95, $124.95, $0.84

Mechanical Component Breakdown

Legend:
- Button Load Cell
- Donut Load Cell
- Center Load Rod
- Friction Sleeve Support
- Housing Wall
- Linear Bearings
- Rubber Seals

Values: $40.58, $20.00, $23.05, $9.07, $10.00, $500.00, $425.00

Speaker: Carren Brown

Penetrometer
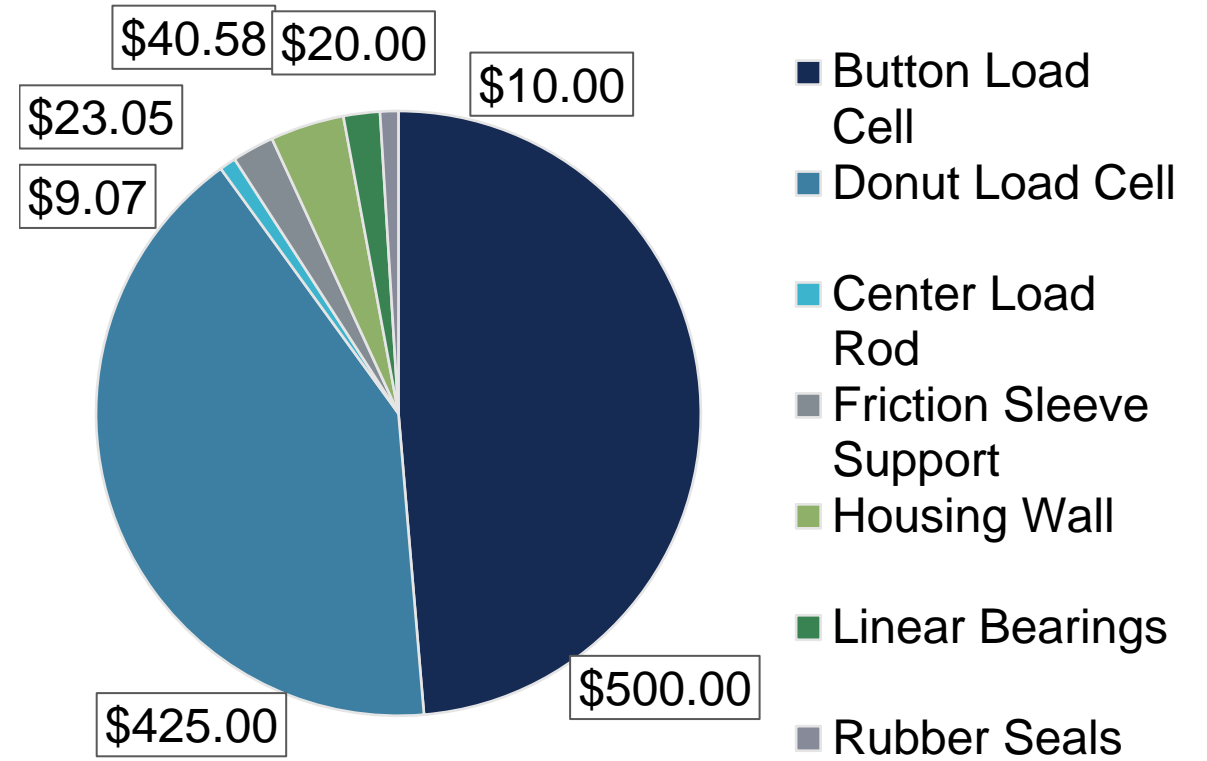
MECHANICAL SHAFT DESIGN

Outer Shell

.0675

.0675

1.00

.625

.25

2.50

Friction Sleeve

.05
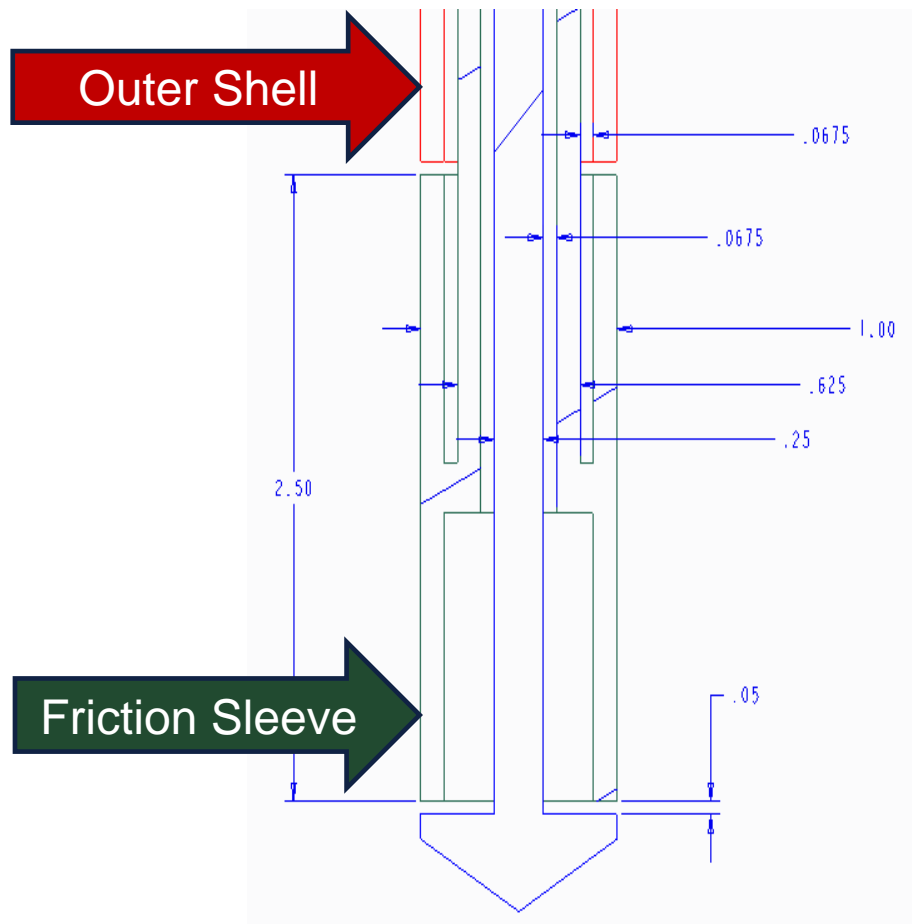
- Applied Force = F_a

- Cone Tip Force = F_c

- Soil Friction Force = F_μ

F_a

F_μ F_μ

F_c

Speaker: Peter Hettmann

Penetrometer

LOAD CELL ARRANGEMENT

Friction Shaft

Cone Shaft

Button Load Cell
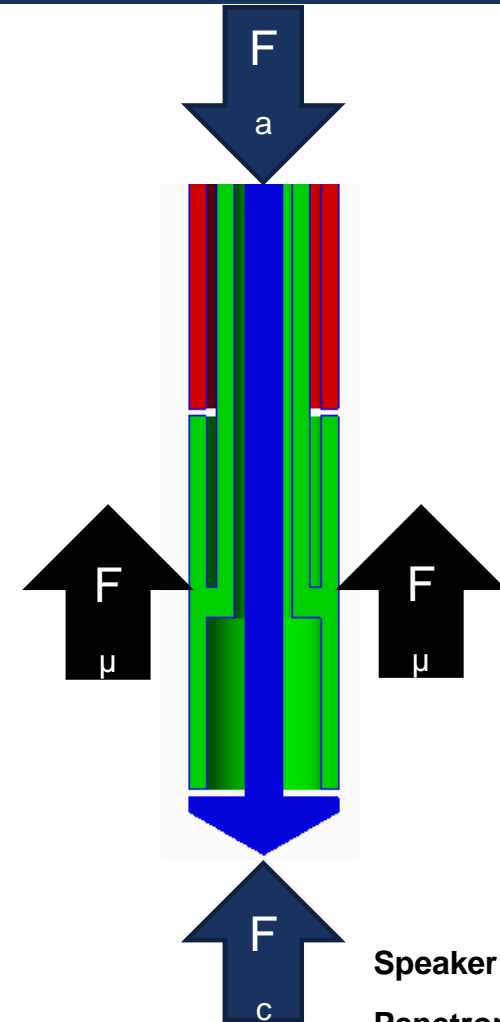
Donut Load Cell
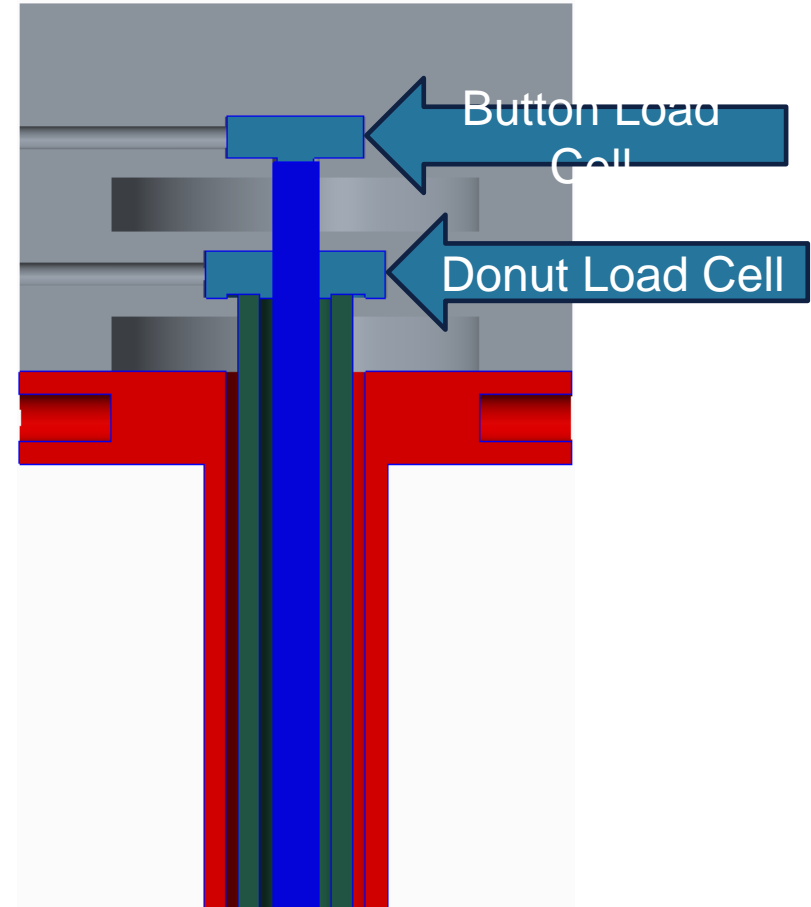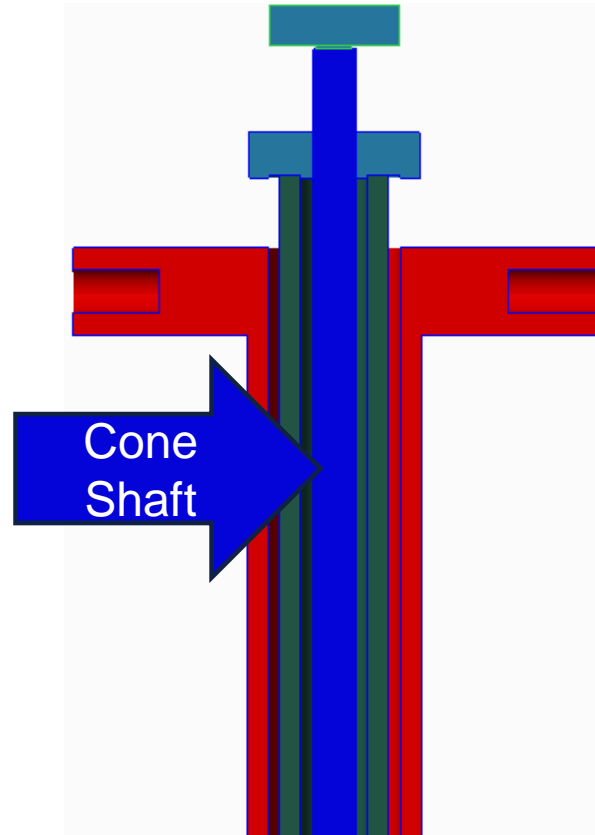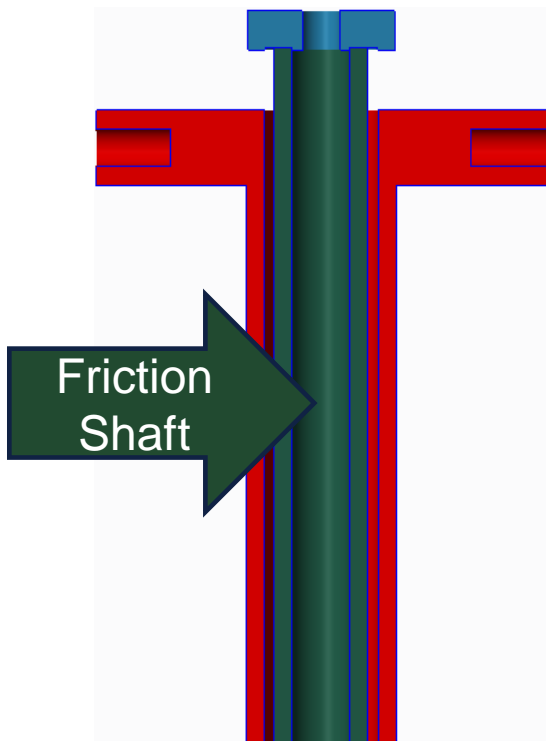
LOAD CELLS

Load Cell Configuration

- 2 mV/V Rated Output

- 18 V max input

- 250 lb Capacity

- 150% safety overload

Voltage Output

- 15 V Excitation input

- Rated Output: $(15\ V) * \left(2\ \frac{mV}{V}\right) = 30\ mV$

- $\frac{1\ lb}{250\ lb} * 30\ mV = 0.12\ mV$

CONCERNS AND CHANGES

Concerns

- Output Voltage from the load cells

- Friction losses from load transmission

- Sealing

Changes

- Uses of Acetal vs Nylon, Teflon

- Standard Steel sizes

PROGRAMMING AND SIMULATION

Requirements

- Wireless via Bluetooth
- Android
- Manipulate in real time

Design

- GUI(Easy to Use)
- Interface

NPSP Penetrometer

Detect DAQ devices

Connect   Disconnect

Status: Tap detect button. (If you need to detect a network DAQ device manually, press and hold detect button)

Low Channel:

High Channel:

Channel Mode:

Speaker: Deneuve Brutus

Penetrometer
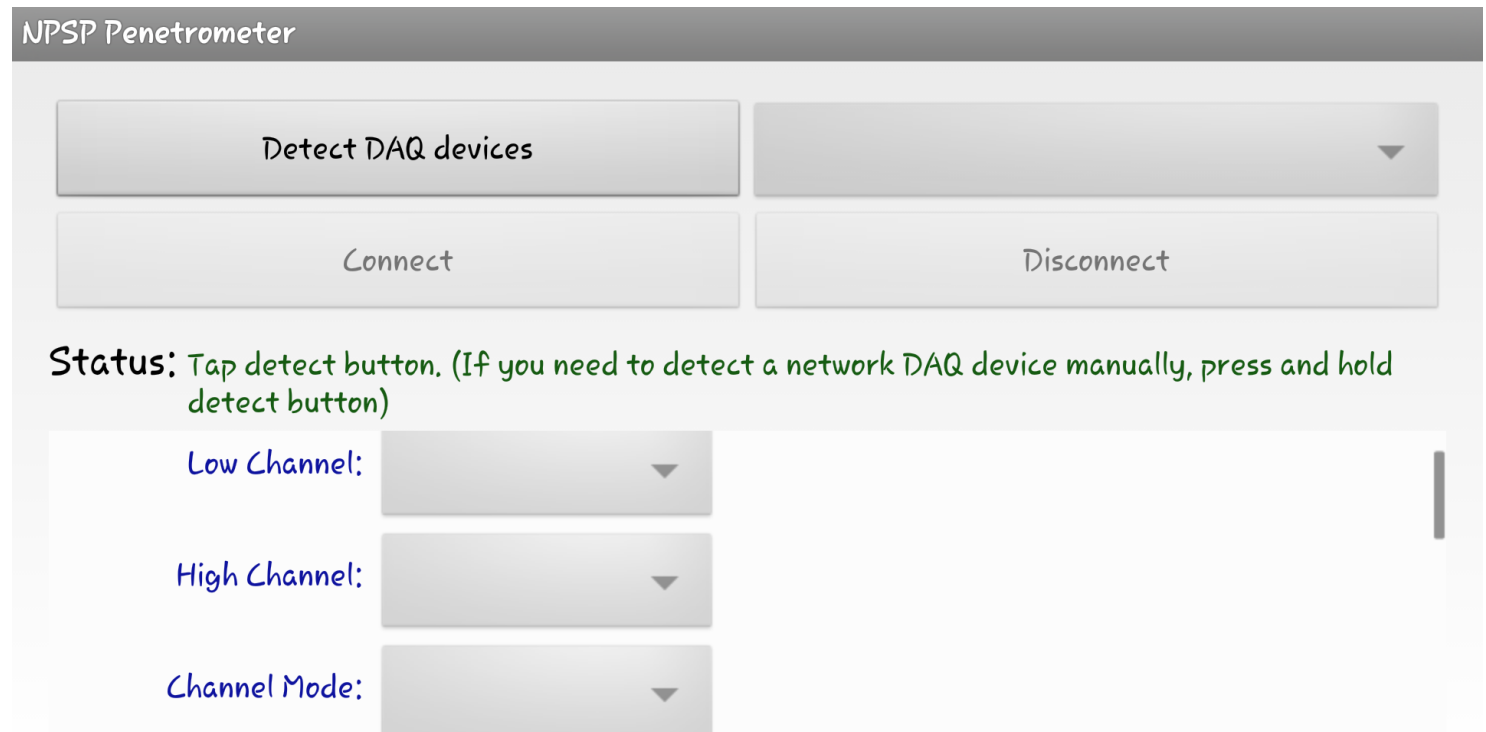
PROGRAMMING AND SIMULATION

Functionality

- Reads DAQ

- Channels

Planning

- Data Storage

- Sample Data

Concerns

- Time

Detect DAQ
Connect DAQ

Channel:
Disconnect DAQ

Voltage:
Store Data to:

Range:

Voltage (mV)

time (s)
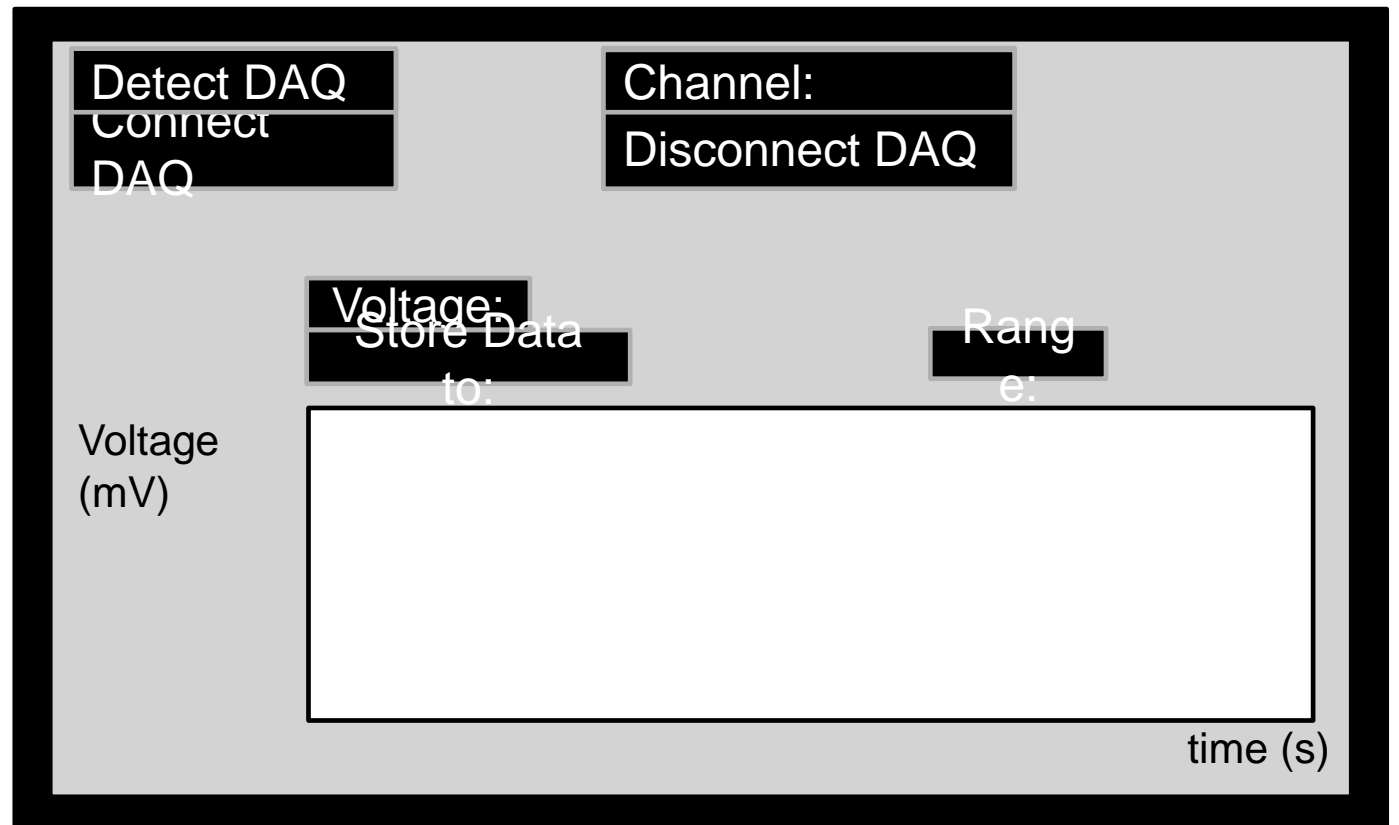
CONCERNS AND CHANGES

Concerns

- Output Voltage from the load cells

- Integrating laser distance sensor data into Android app

- Time to develop Android app

Changes

- Futek Amplifier

  - 14-26VDC Power Supply

  - ABS-94HB Black Enclosure

  - +/-5VDC, or +/-10VDC Analog Output

  - 1-25 kHz Bandwidth

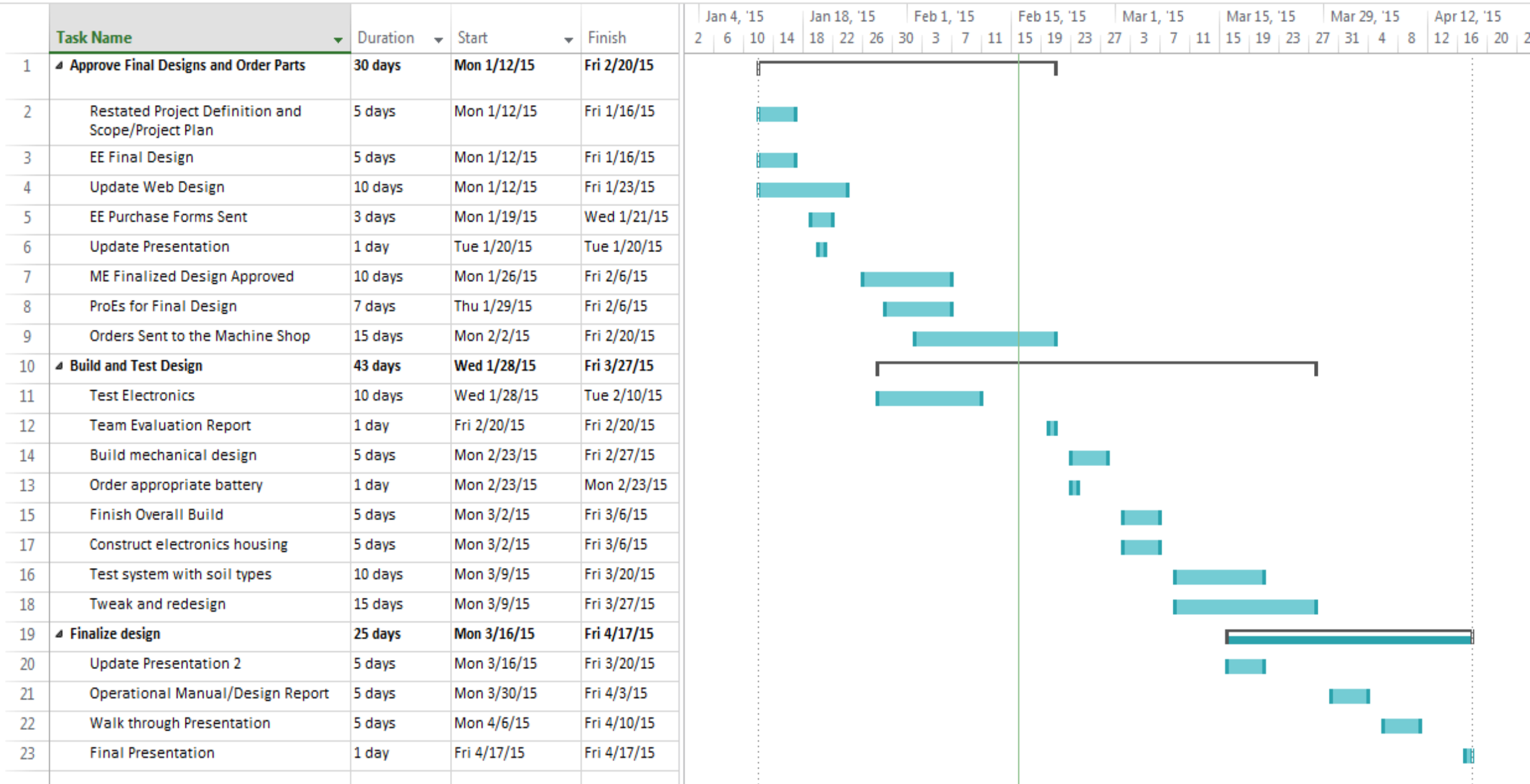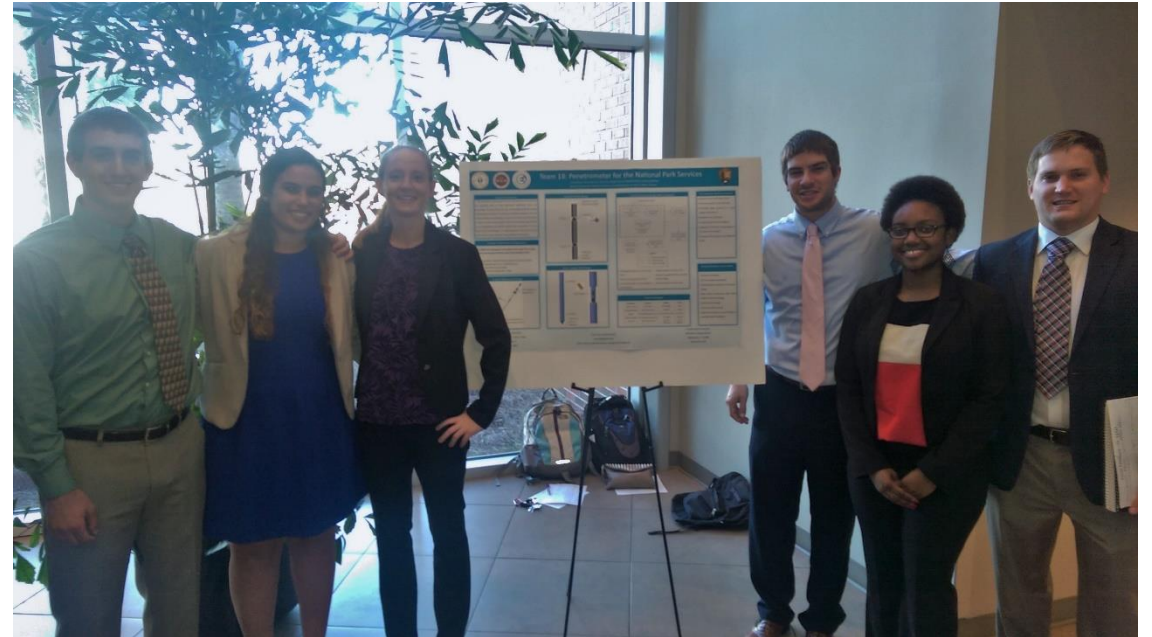| #	Task Name	Duration	Start	Finish
1	Approve Final Designs and Order Parts	30 days	Mon 1/12/15	Fri 2/20/15
2	Restated Project Definition and Scope/Project Plan	5 days	Mon 1/12/15	Fri 1/16/15
3	EE Final Design	5 days	Mon 1/12/15	Fri 1/16/15
4	Update Web Design	10 days	Mon 1/12/15	Fri 1/23/15
5	EE Purchase Forms Sent	3 days	Mon 1/19/15	Wed 1/21/15
6	Update Presentation	1 day	Tue 1/20/15	Tue 1/20/15
7	ME Finalized Design Approved	10 days	Mon 1/26/15	Fri 2/6/15
8	ProEs for Final Design	7 days	Thu 1/29/15	Fri 2/6/15
9	Orders Sent to the Machine Shop	15 days	Mon 2/2/15	Fri 2/20/15
10	Build and Test Design	43 days	Wed 1/28/15	Fri 3/27/15
11	Test Electronics	10 days	Wed 1/28/15	Tue 2/10/15
12	Team Evaluation Report	1 day	Fri 2/20/15	Fri 2/20/15
14	Build mechanical design	5 days	Mon 2/23/15	Fri 2/27/15
13	Order appropriate battery	1 day	Mon 2/23/15	Mon 2/23/15
15	Finish Overall Build	5 days	Mon 3/2/15	Fri 3/6/15
17	Construct electronics housing	5 days	Mon 3/2/15	Fri 3/6/15
16	Test system with soil types	10 days	Mon 3/9/15	Fri 3/20/15
18	Tweak and redesign	15 days	Mon 3/9/15	Fri 3/27/15
19	Finalize design	25 days	Mon 3/16/15	Fri 4/17/15
20	Update Presentation 2	5 days	Mon 3/16/15	Fri 3/20/15
21	Operational Manual/Design Report	5 days	Mon 3/30/15	Fri 4/3/15
22	Walk through Presentation	5 days	Mon 4/6/15	Fri 4/10/15
23	Final Presentation	1 day	Fri 4/17/15	Fri 4/17/15

SUMMARY

- Create a user friendly penetrometer for NPS

- 30% Budget remaining

- Standard steel sizes

- Load cell output resolution to DAQ

- Efficient data manipulation displayed on a tablet

Speaker: Sean Kane

Penetrometer

ANY QUESTIONS?

Visit Our Website

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

Carren Brown, Deneuve Brutus, Peter Hettmann, Sean Kane, Natalie Marini, Mitchell Robinson, Maritza Whittaker

Penetrometer