TEAM 18: PENETROMETER

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

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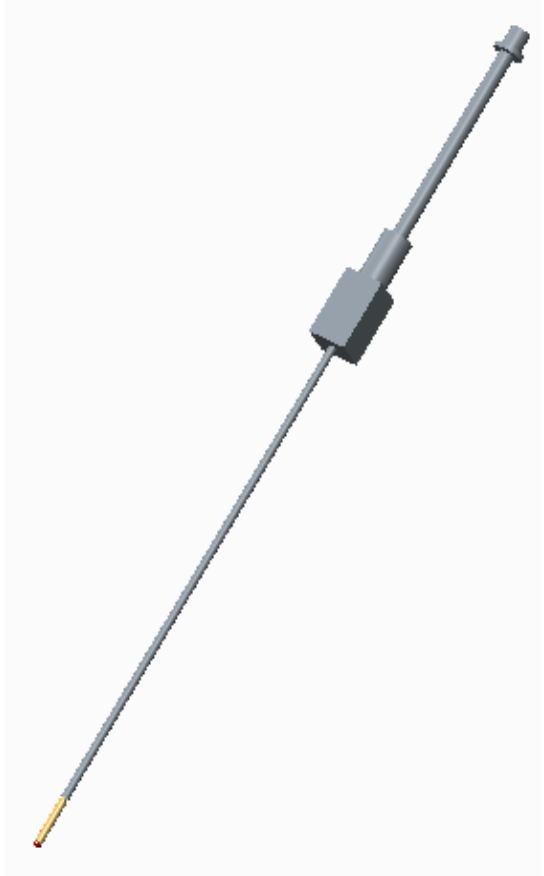
MARITZA WHITTAKER - ME

PROJECT SCOPE

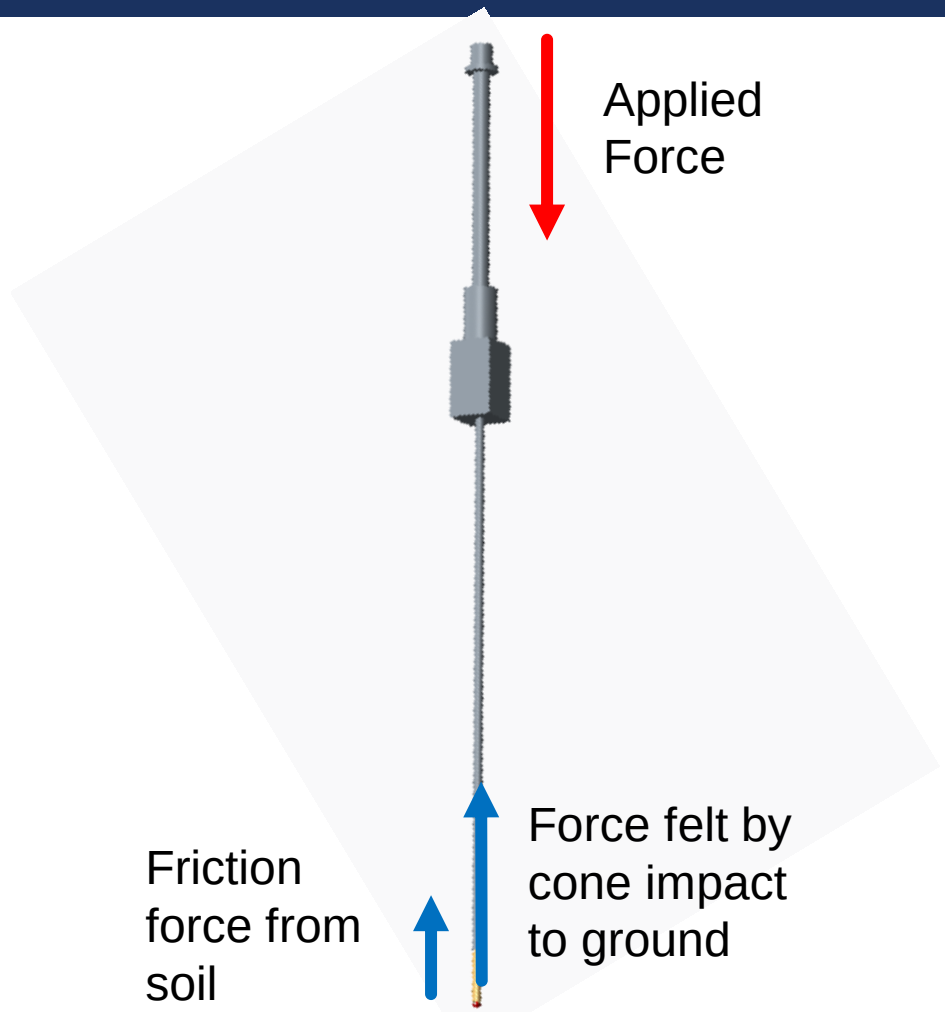
- National Park Services – Dr. Michael Russo
- Need for this penetrometer
  - Identify midden levels in soil
- Current design – user friendly device



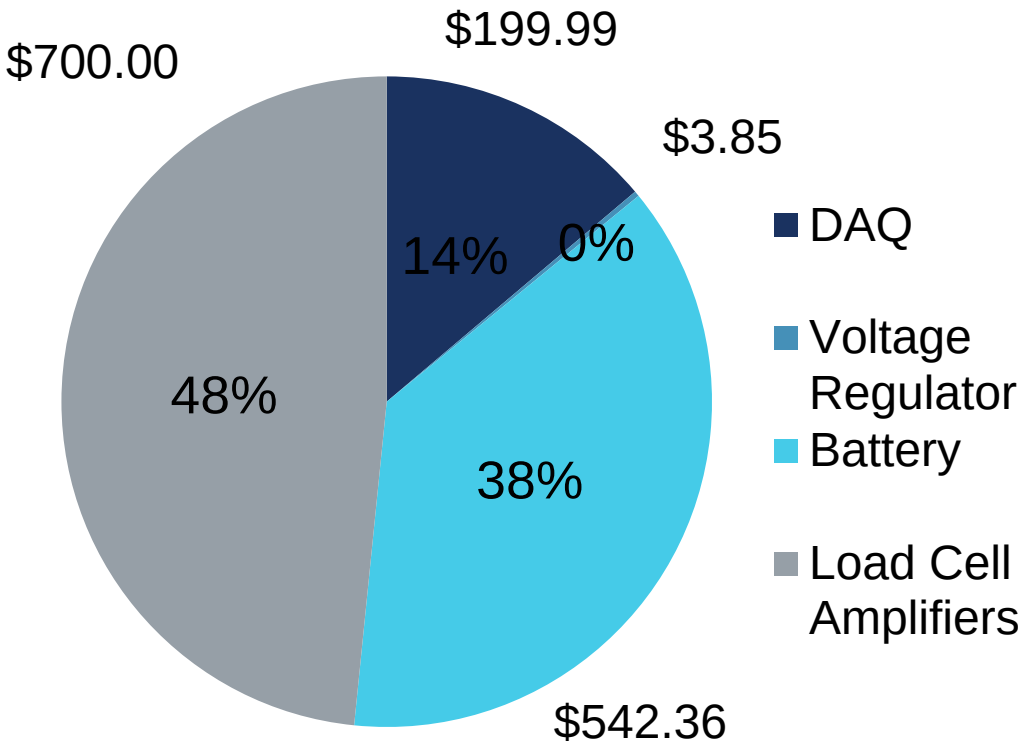
PROJECT OVERVIEW

- 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
  - Transmit reliable data

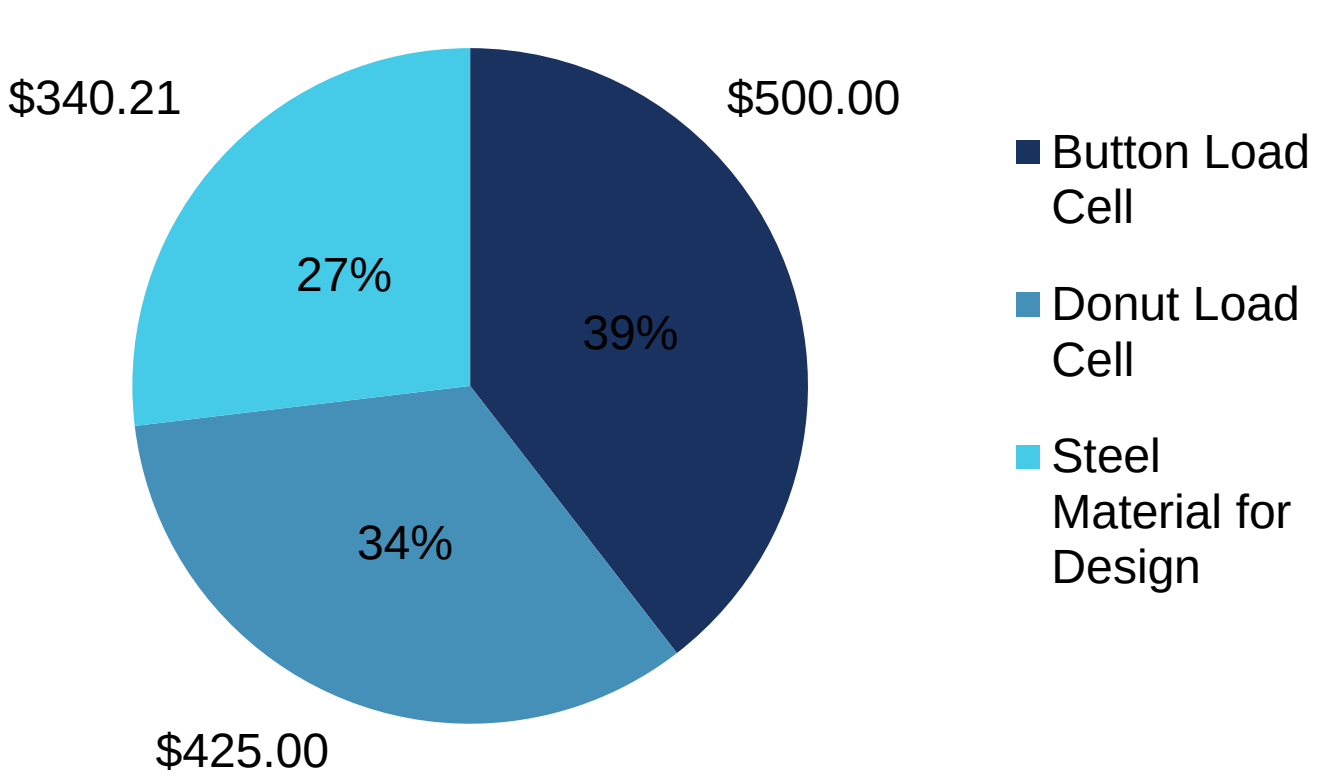
FORCE DIAGRAM



PROCUREMENT

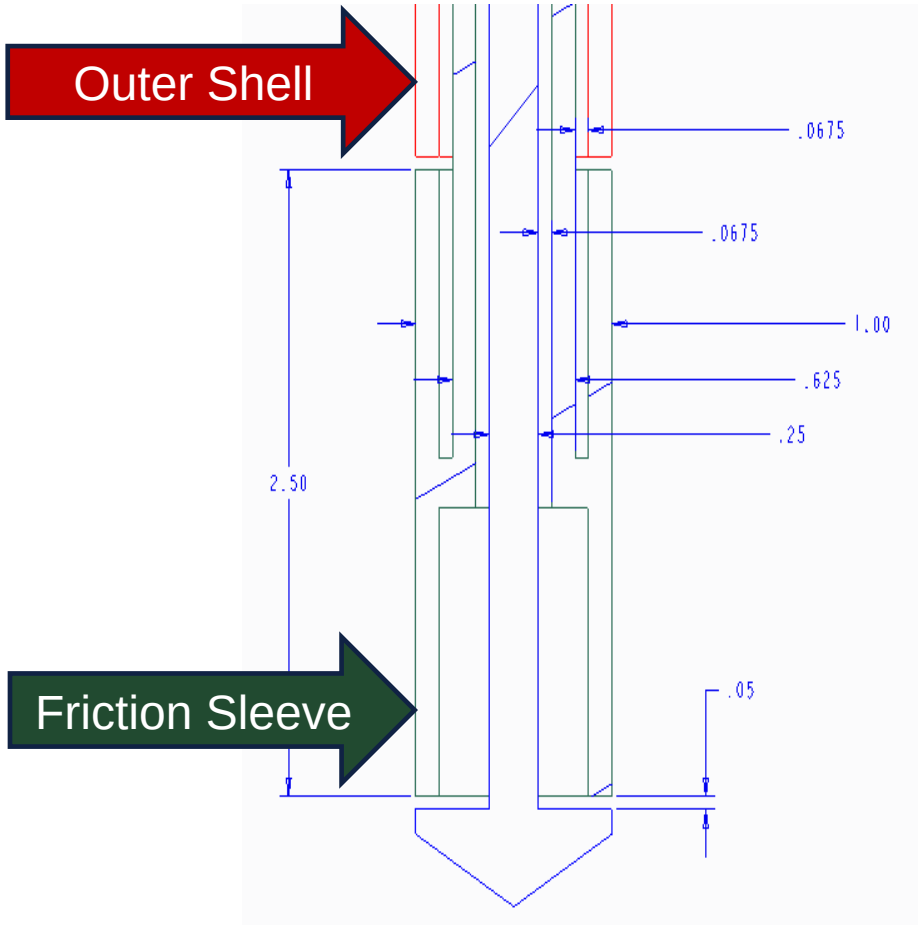


Electrical Components

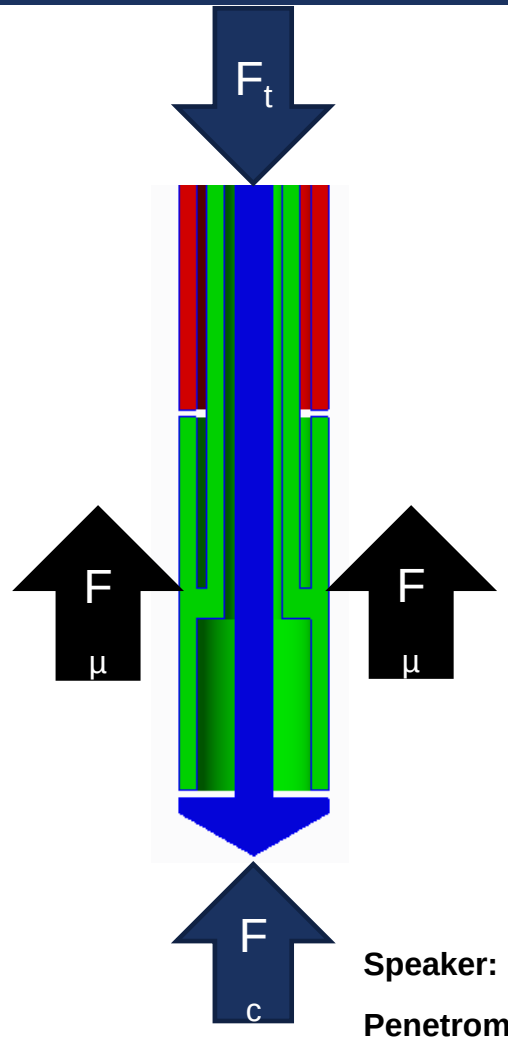


Mechanical Components

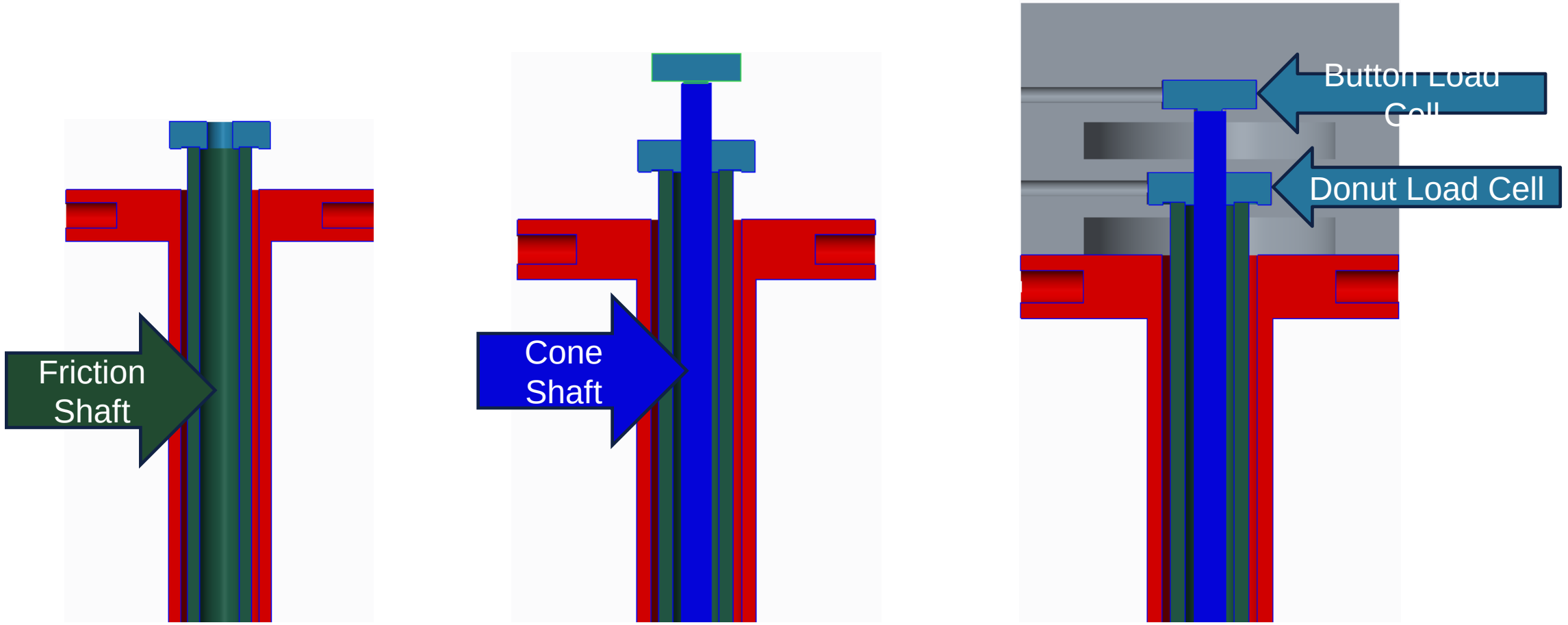
MECHANICAL SHAFT DESIGN



- Total Force = F_t
- Cone Tip Force = F_c
- Soil Friction Force = F_μ

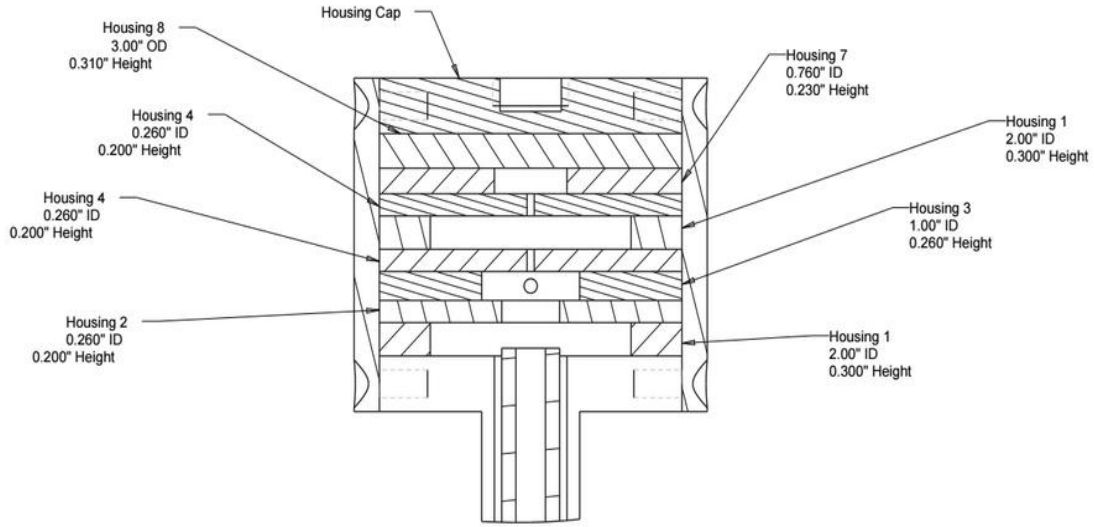


LOAD CELL ARRANGEMENT



MANUFACTURING: MECHANICAL SHAFT

- Sent to machine shop: 2/25
  - Been in the shop for 3 weeks as of yesterday
- Assemble within two days of receiving parts
- Time Estimation: 2 hours
- Tasks Remaining:
  - Check tolerances
  - Seal friction sleeve with heat gun
  - Test results with electrical components



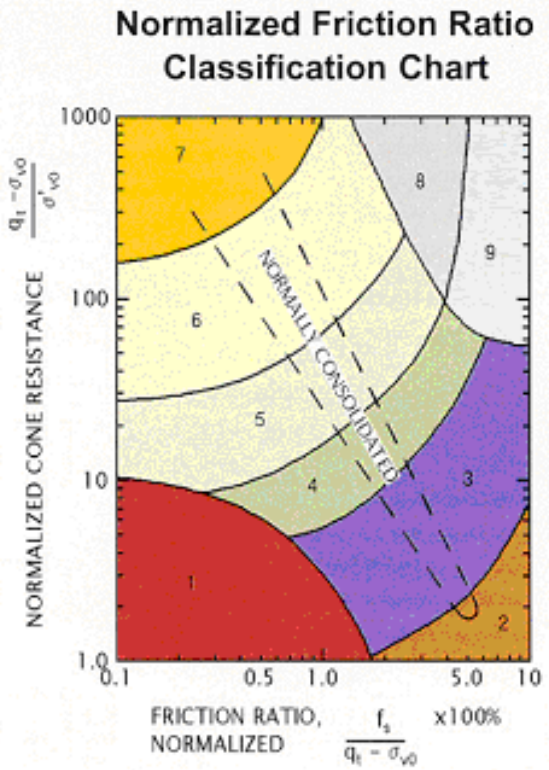
TESTING PROCESS

- Perform multiple bucket soil tests
  - Clay
  - Sand
  - Top Soil
  - Wet Sand
  - Midden
- Use results to calibrate the system
- Test for accuracy and measurability

SOIL CLASSIFICATION

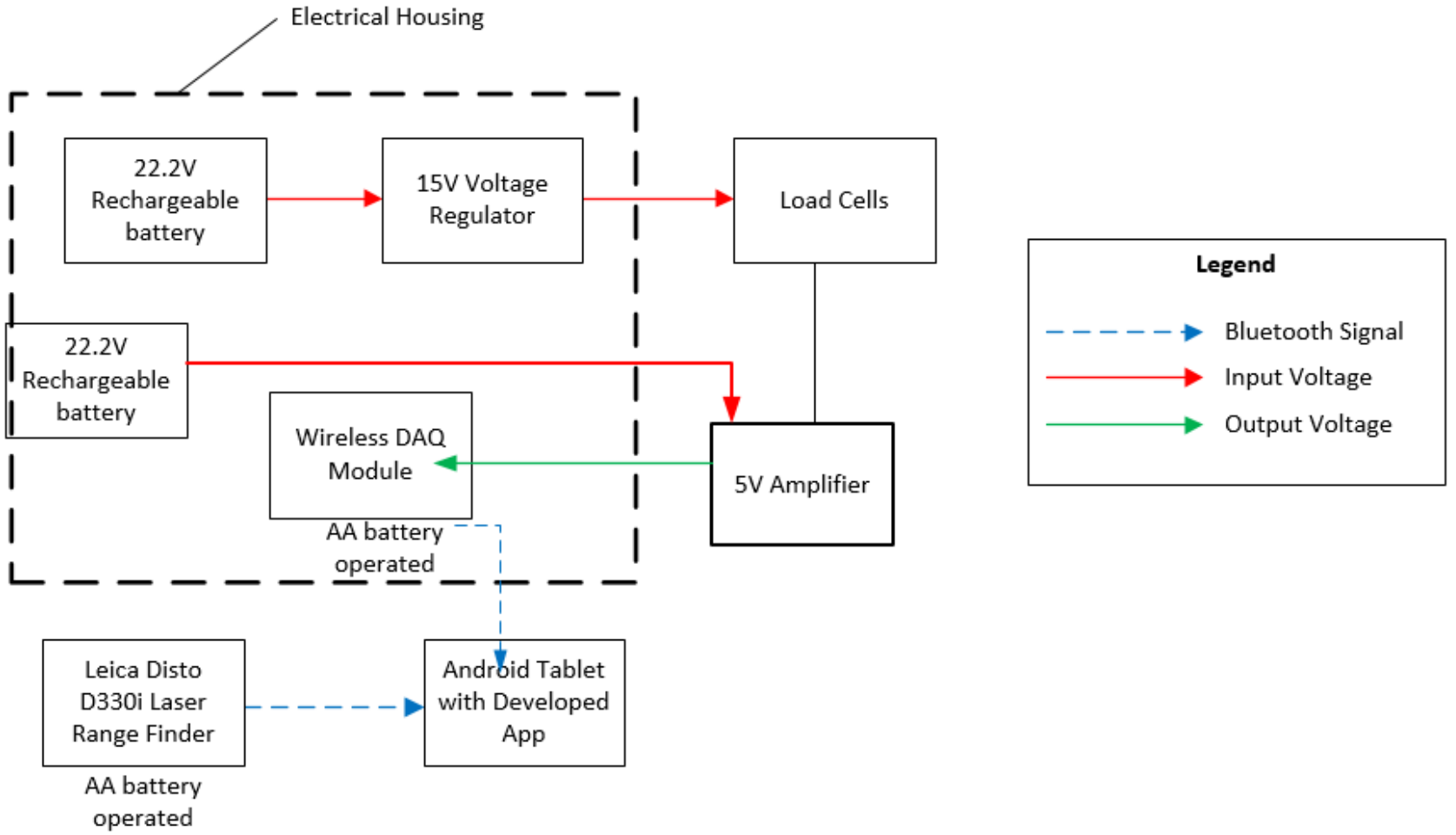
Zone	Q_t/N	Description
1	2	Sensitive, Fine Grained
2	1	Organic Soils-Peats
3	1.5	Clays-Clay to Silty Clay
4	2	Silt Mixtures-Clayey Silt to Silty Clay
5	3	Sand Mixtures-Silty Sand to Sandy Silt
6	4.5	Sands-Clean Sand to Silty Sand
7	6	Gravelly Sand to Sand
8	1	Very Stiff Sand to Clayey Sand *
9	2	Very Stiff, Fine Grained *

(*) *Heavily Overconsolidated or Cemented*



- Make a Classification Chart
  - Plot Friction Ratio vs. Cone Resistance
  - Can determine soil type based on these ratios

POWER SYSTEM



LI-ION BATTERY PACK

- Composed of 2.6Ah cylindrical 18650 Li-Ion cells
- Capacity: 7.8 Ah
- Voltage: 22.2 V
- Weight: 1.9 pounds
- Over current detection: 7~10 A
- Cut-off Voltage: 18 V
- Built-in IC chip to prevent battery pack from over charge and discharge

CSG110 LOAD CELL AMPLIFIER

- Designed for any full-bridge strain gauged sensor with a mV/V output
- 10 kHz bandwidth
- Output: ± 5V or ± 10V
- Power supply: 14V – 26V
- Typical Current draw: 30mA

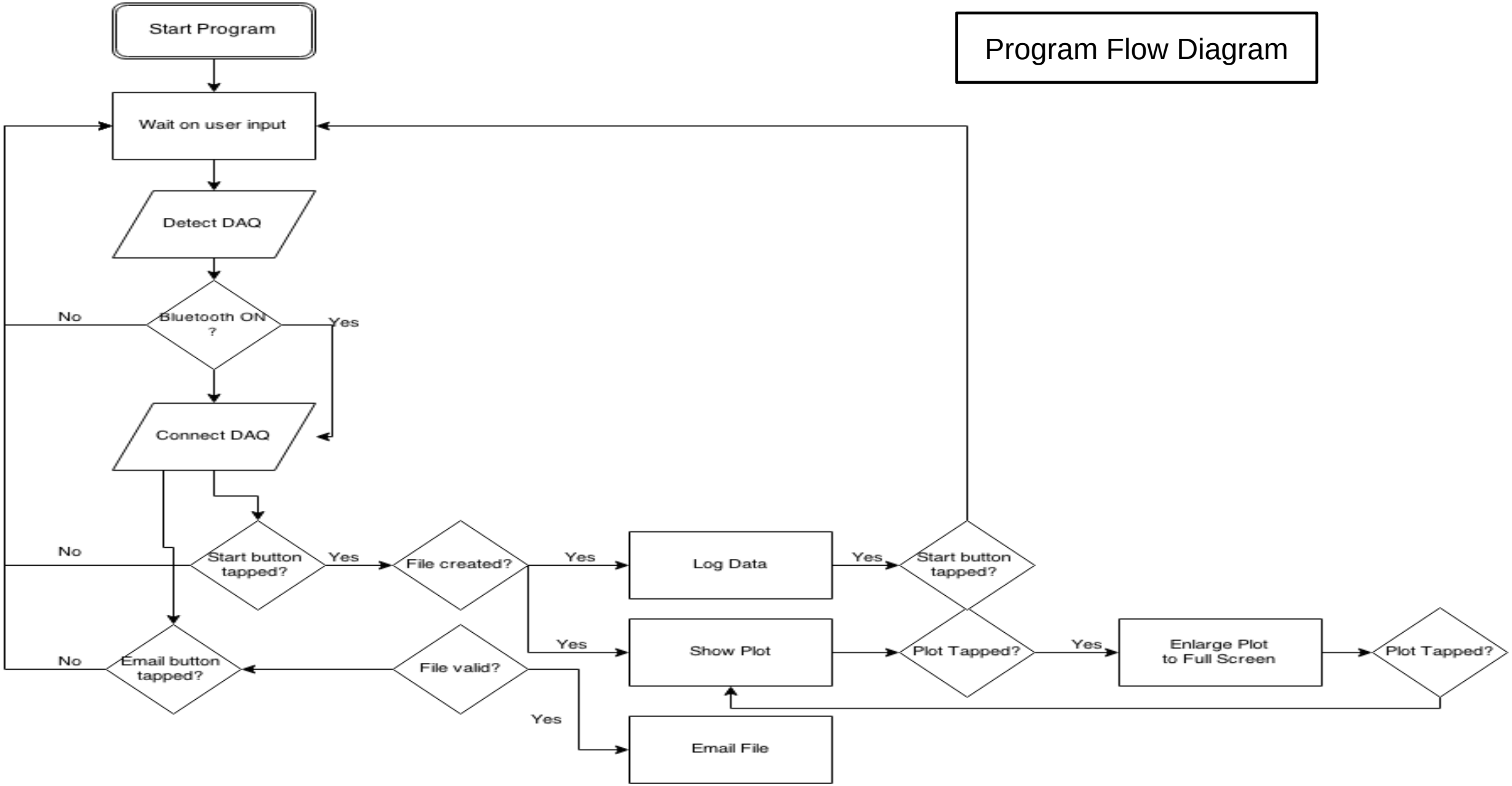
TI780-15 VOLTAGE REGULATOR

- Minumum Input Voltage: 17.5V
- Output voltage: 15V
- Max Output Current: 1.5A
- Over current and reverse voltage protection

PROGRAMMING AND SIMULATION

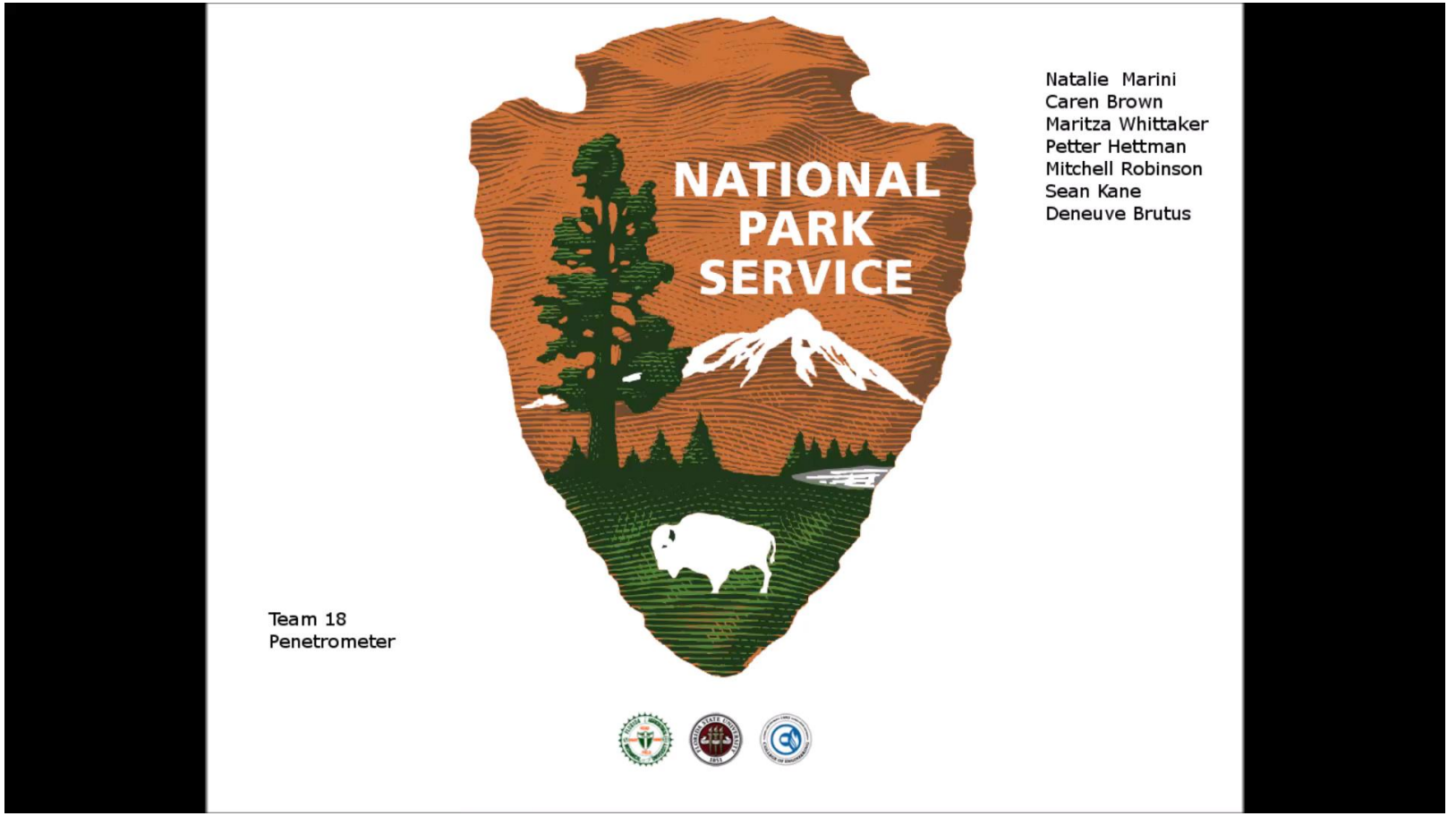
- Changes from last UI
- Flowchart

Program Flow Diagram



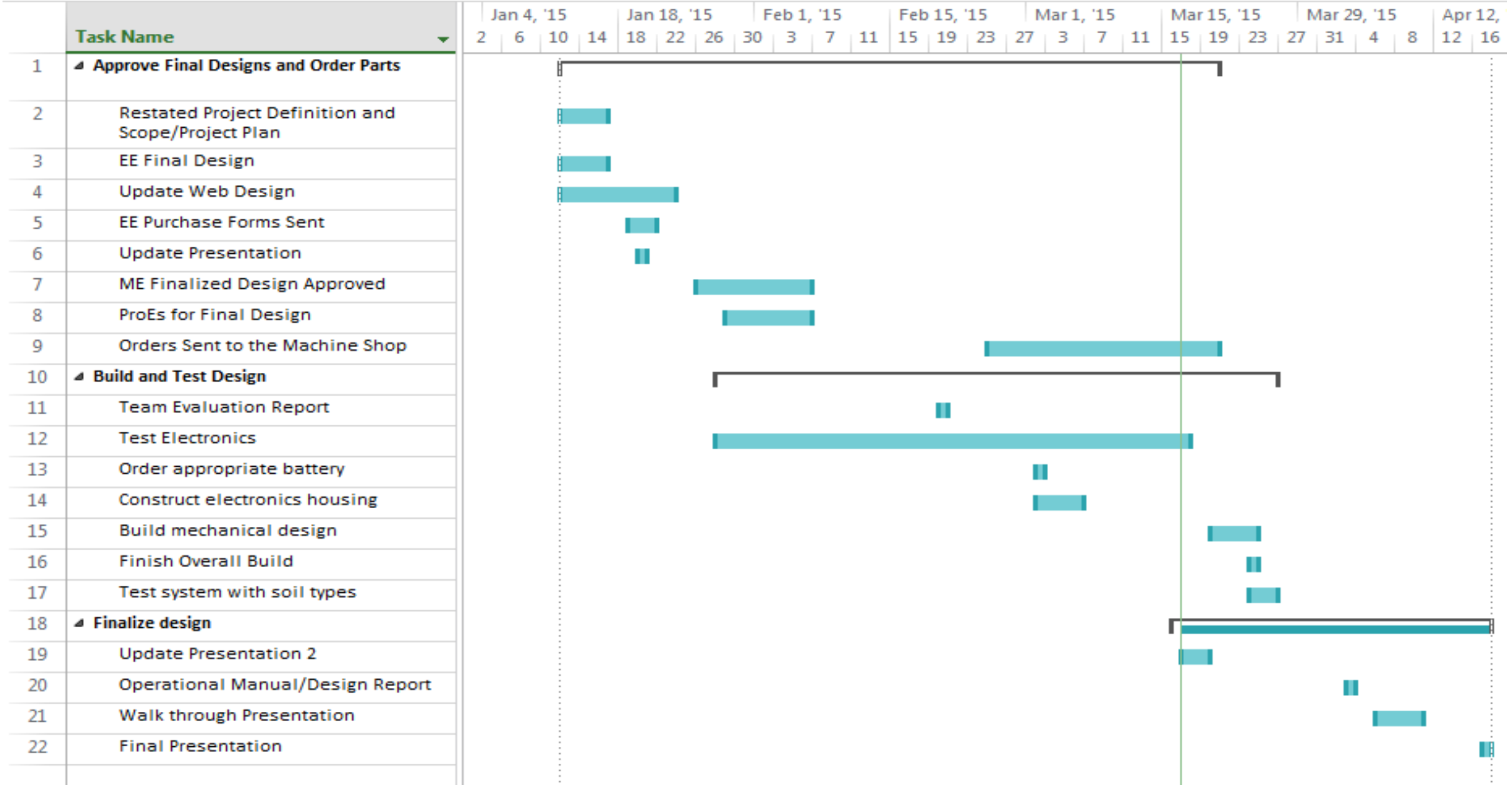
PROGRAMMING AND SIMULATION

- Demonstration



CONCERNS AND CHANGES

- Changes
  - 10V power supply to 15V power supply
  - Futek 5V/10V op amp
- Concerns
  - Integrating range finder into system
  - Amplification of noise



Group Number 18

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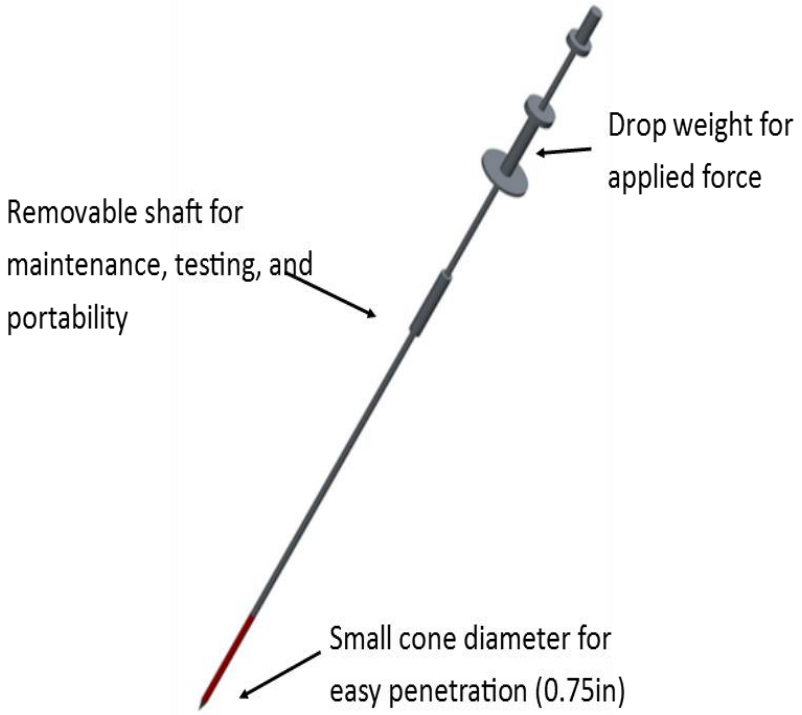
Speaker: Mitchell Robinson

Penetrometer

SUMMARY

- Create a user friendly penetrometer for NPS
- Top heavy load cell design
- Easily accessed housing
- Portable and light design
- Efficient data manipulation displayed on a tablet



ANY QUESTIONS?

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