Team 18: Penetrometer for the National Park Services

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Purpose: "Design an instrument that can identify midden and differentiate soil types at various depths."

Executive Summary

The Southeast Archeological Center and National Park Services are surveying various field sites to find ancient artifacts. One of the ways they find artifacts is by searching for midden which is archeological remains in soil. Team 18 is to create a penetrometer that can scientifically identify this composition of soil. The sponsor, with liaison Dr. Michael Russo, is looking for a portable, wireless, and more reliable system to use than the previous prototype. Team 18 built a drop weight penetrometer to complete the task.

Problem Statement and Objectives

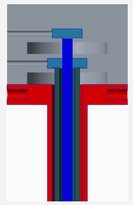
"It is difficult to distinguish soil midden levels apart from other organic and mineral soil levels when field testing on site."

- No more than 2 people should be needed to operate the device
- Minimize the diameter of the cone tip
- Strong material to withstand repetitive compressive load
- Device must be able to identify midden and how deep it runs
- Device must provide scientifically reliable data
- The data must be relayed to a device that shows the results on site
- The cost must not exceed $2000 dollars
- Must weigh less than 50 lbs.
- Device should be very portable

Testing Methods

- Test penetrometer in buckets with different soils
- Compare load cells values with each other by graphing the data over depths
- Create a soil classification chart to characterize soil types based on the calibration of the penetrometer
- Field test the penetrometer with NPS

Current Mechanical Design



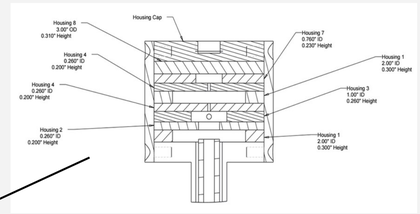


Figure 1. Housing for Load Cells and Shaft Alignment

- F_t—Force from drop weight
- F_μ– Friction force
- F_c– Force felt by cone tip from soil impact

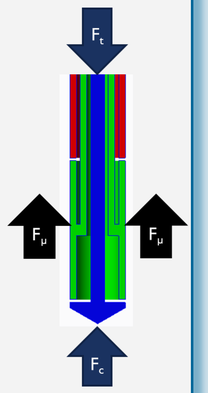


Figure 3. Force DIagram

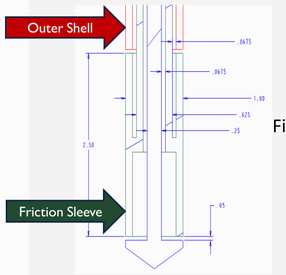
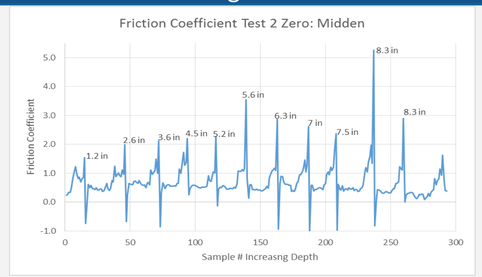


Figure 2. Shaft Arrangement

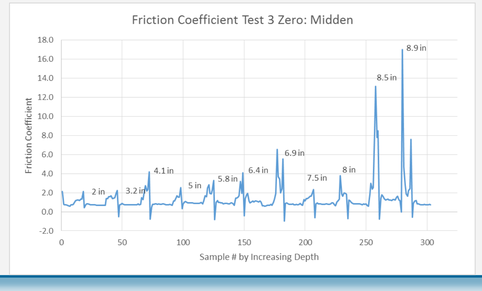
Electrical Specifications

- Li-ion Battery Pack
  - 22.V
  - 7.8Ah Capacity
- Op-amp
  - +/-5 V Output
  - 10kHz Bandwidth
- Voltage Regulator
  - 15 V Output
- DAQ—BTH-1208LS
  - -4 12-bit DE analog inputs
  - -Transmits Data through BT

Testing Results



Midden tests shown have very close range values for the friction coefficient! Classification can be done based on this range.



Current Electrical Design

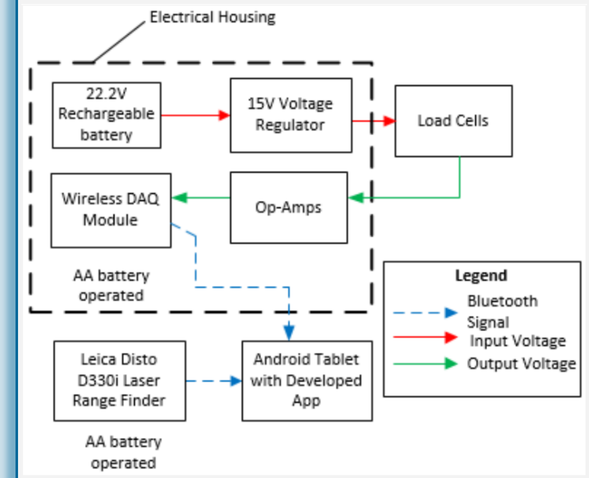


Figure 4. Electrical Block Diagram

- Rechargeable battery for easy replacement
- Electrical housing for protection
- Laser Range Finder measures depth of penetrometer
- Voltage regulator maintains 15V
- Bluetooth capable DAQ measures output voltage
- App developed to record and display results

Future Recommendations

- Testing accuracy after weather conditions vary in the field
- Further minimizing the shaft diameter
- Automate the drop weight
- Make a lighter design
- Improve the android application interface further

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