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Research: Determining Thermal Properties of Proposed Sand Particulate as a Thermal Medium for Concentrated Solar Power

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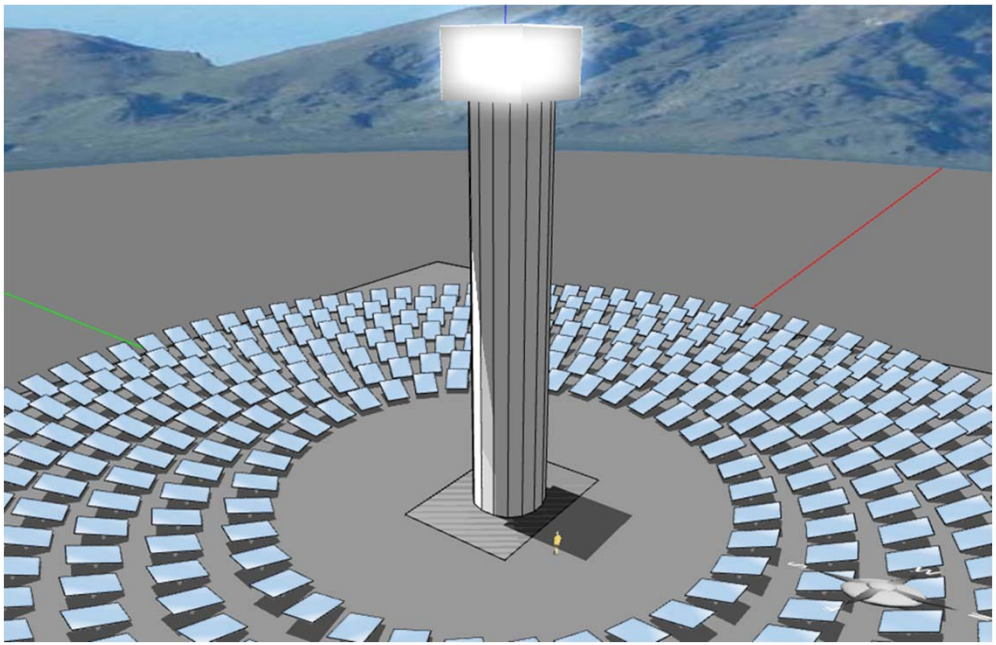
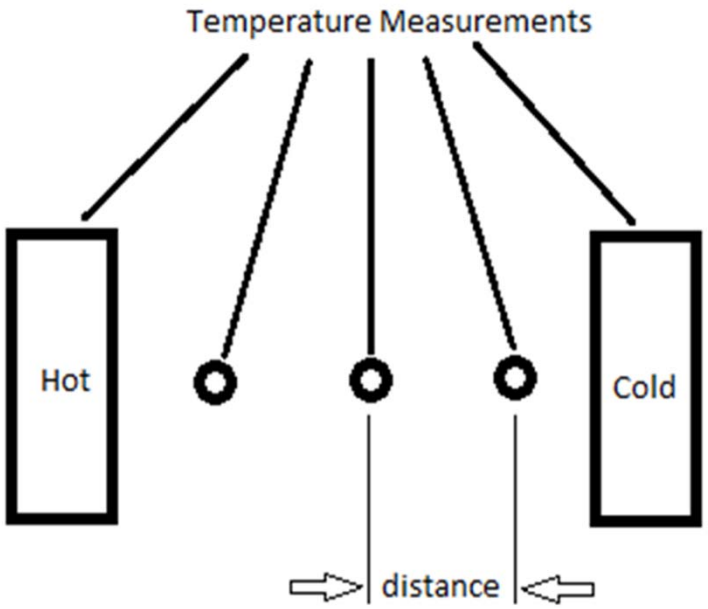
Background

- CSP (Concentrated Solar Power) is an alternative energy that involves heating a thermal medium via solar radiation, insulating the thermal medium until peaking times, and then converting the stored thermal energy to electricity
- Thermal mediums for this technology have traditionally been molten salts or molten metals which can corrode the storage system
- This project's proposed sand particulate thermal medium can hypothetically be used in place of the reactive molten salts and metals
- Thermal properties of these particulate are not well-documented



Static Testing



Fourier's Law: $\dot{Q} = -k \cdot A_c \cdot \frac{dT}{dx}$

- The basic principle of the GHP (Guarded Hot Plate) is that multiple temperature sensors are spaced over a specimen with an induced temperature gradient
- This can provide data to determine bulk conductivity, specific heat, and interface resistance of the particulate at operating temperatures

Dynamic Testing

- In CSP, hot particulate flows downward via gravity over a heat exchanger to transfer heat to a working fluid that converts thermal energy to usable work via power cycle
- The purpose of the dynamic test is to determine heat transfer coefficients for particulate flowing in similar conditions to the proposed heat exchanger design
- Other considerations of this test include hopper design to provide proper flow restriction as well as the development of a mechanical device to bring the particulate to the top of the tower after it has fallen through the system