**Engineering Physics Design Process**

1. **Define a Problem**
   * Geogrids (which provide soil reinforcement in soil embankments) are stressed and stretch over time, rendering them useless; they must be health-monitored to know when to replace/repair them.
   * The option currently available is using a strain gage, but this is not the most ideal method of health-monitoring
   * The project’s goal is to find an alternative health-monitoring system for geogrids
2. **Brainstorm**
   * A coating for the geogrid that would allow for health-monitoring, without affecting the function of the geogrid
   * The conductivity of conductive-filled polymers vary with tensile strain and could used for the coating
   * Possibilities include different types of carbon black or carbon nanotubes
3. **Research**
   * The professors and grad students who have worked on this project have used other research as reference and conducted their own and written papers that are being used in the continued research.
   * Research on the conductivity of carbon black supported this choice as the material used in the polymer coating
4. **Identify Criteria and Specify Constraints**
   * The solution should very accurately indicate the health of the geogrid
   * It should be relatively simple to monitor the health of the geogrid and the coating cannot affect the function of the geogrid itself
   * The solution should not be ridiculously expensive to manufacture (that is to manufacture geogrids with this coating)
   * There should be a way/alternative method of attaching it to pre-existing geogrids
5. **Explore Possibilities**
   * Coating: carbon black (varying types), carbon nanotubes
   * Adhesive
6. **Select an Approach**
7. **Develop a Design Proposal**
8. **Make a Model or Prototype**
   * We’re making polymer samples using the various types of filler; they were previously tested to find their optimal concentration for strain-sensitive conductivity
   * We will have made/will make coating samples and samples of the coated geogrid of the various materials to test
9. **Test/Evaluate Design**
   * This is the current and longest stage of the process
   * We are testing various types of samples under various conditions
   * We are also testing the affects of different methods of making the samples
   * It is also necessary to design testing methods to simulate actual conditions to which the material will be subjected
   * Test under cyclic loading, monotonic loading, and creep
10. **Refine the Design**
    * In my time with the project, we have experimented with various mixing methods, types of contacts to test conductivity (silver, copper, alternatives to alligator clips), volume vs. surface conductivity, different amounts and types of filler (carbon blacks and now carbon nanotubes), etc.
11. **Create or Make Solution**
12. **Communicate Processes and Results**
    * Various papers have been published through the department to communicate the project’s progress