City College of San Francisco
College for Kids Summer 2014
88 Fourth Street, Room 618, San Francisco

Structural Engineering Bridge Design
June 16 – June 27, 2014
1:00 PM – 4:00 P.M.

Instructor: Grace G. Imson, EIT, PE-CE

Workshop Description: This class is an introduction to bridge engineering that will allow the student to experience the types of problems a bridge engineer encounters. Students will "think" as an Engineer – i.e. how do simple machines work? How do you build the strongest bridge with the lightest building materials? In this workshop, Students will explore ***basic physics; apply mathematics*** and ***engineering concepts*** (i.e. principles of mechanics and material science) through hands-on activities and projects that will be reinforced by lectures, class discussions, practice exercises, and model making.

Students will work primarily in teams to solve real-world and simulated problems. Case studies of actual engineering projects will be used to demonstrate principles of design. For example, students may analyze the failure of the Bay Bridge to investigate how components in a system function together; significance of manufacturing tolerances; and understanding how inadequate knowledge of materials and insufficient testing can lead to failure.

Students will participate in a catapult design challenge to learn about maximum loading of a bridge to investigate material failure such as supports, beams, truss, analyzing torque, shear, compression, tensile forces, load analysis, structural design, and moments in free body diagrams. Students will carefully analyze data they collect, write technical reports about their projects, submit written reports for review, design and build bridge models, and learn how to hypothesize and experiment in order to interpret physical phenomena.

Workshop Goals: As a part of the engineering design process, students will create decision matrices that will help them weigh economic and ethical considerations, as well as technological ones. They leave the class with a broader view of the field of engineering and a deeper understanding of the day-to-day work of engineers. Moreover, they leave with skills and knowledge that they will be able to apply in developing innovative solutions to real-world engineering challenges in their own lives and communities. By the end of the course, students will acquire an understanding of major concepts in physics; apply mathematics and an enhanced ability to work in groups as well as individually to solve problems in the physical sciences.

Required Materials:

- 3-hole binder, 10-graph paper, 10-clear paper, 15-binder paper
- Pencil or Mechanical pencils with extra lead
- 1 Eraser, glue stick,12" ruler (straight edge)

Classroom Policy:

- Be on time and be prepared;
- When you complete an assignment, move quietly onto the next assignment
- Respect yourself, your classmates, your teacher, and the classroom;
- Write down all assignments and take good notes;
- Speak only when recognized by the teacher AND listen to the person speaking;
- Ask questions when you don't understand;
- No food or beverages in the classroom; water is okay in a non-glass container;
- All electronics must be turned off and stashed away;
- Clean up classroom area before leaving class;
- No misbehavior is allowed – student will be referred to the Director;
- Acceptable student behavior is defined by state law, CCSF Rules and Regulations and SFUSD;
- Please complete Student Agreement on Classroom Policy, expectations and contact

Workshop Calendar

Monday, June 16	Tuesday, June 17	Wednesday, June18	Thursday, June 19	Friday, June 20
• Introduction Activity Students/Teacher • Math Assessment • Video: Engineer principles: need, vision, delivery • Case I:Tsin Ma Bridge, and the Bay Bridge Part I • Worksheet on slope, right triangle, proportions • Video: The Project. **HW:** • Decide on your project • Bring pictures**/**draw	• Think like an Engineer • Experiment on Simple machine • Worksheet on simple machine • Analysis of simple beam • The Beam Reactions • ASSHTO • Shear/Moment Diagram • Groups are chosen • Review Group rules s • Video: Bay Bridge Part 2 **HW:** • Simple beams and AAHTO 44 Truck l scale: 2'=1cm	• Homework Presentations • Materials Vocabulary • Center of Gravity • Maximum Loading **HW**: • Worksheet on Resolving Problems	• Structural Analysis WS • Steel sections of a Bridge • Making the structural analysis of your project **HW:** • Isometric view of your project.	• Material Science • Testing Material • Material Decision • Steel Beam Sections **HW:** • Research for the bridge trivia
Monday, June 23	**Tuesday, June 24**	**Wednesday, June 25**	**Thursday, June 26**	**Friday, June 27**
• Mechanics of forces • Trigonometry Functions • Force Vector analysis • Forces on Truss bridge • Force on Truss Member • Forces at supports **HW:** • WS on Vector	• Shear, Moment and torque, stresses • Stress diagrams • Assigning your project dimensions **HW:** • Draw final diagram of your bridge	• Bridge Load analysis • Critical load position • Draw the critical load of your project **HW:** • Draw critical load position on your project bridge-360 kilo Newton AASHTO	• Professional Ethics • Real-life on-job Decision Making, professionalism, Critical thinking, apply rules and ethics • Finalization of your Project Report ***Last day of project, prepare for display*** **HW:** • Simple beams; draw shear and moment diagram • Prepare your bridge presentaion	**1 PM – 1:30 PM** • Prepare your Bridge Display for judging **1:30 AM – 10:30 AM** • Presentation of your bridge • Testing your bridge's strength ***Visitor's Day*** ***3:00 PM –3:30 PM*** • Visitor's Game **3:30 PM – 4:00 PM** Clean-up and Farewell

Guidelines to writing your veritable technical report:

(1) Purpose (objectives) – Use Engineering Principles (Need, Vision, Delivery)
(2) Method (materials, processes—don't reproduce what is already in the description
(3) Results (measurements, discussions)
(4) Errors (sources, estimates, propagation)
(5) Conclusions (relate to your purpose; significance of results)