RUTGERS
International Student
Engineering Experiences

2011 Summer School in

Civil Engineering for a Sustainable Future

Kyung-Hee University

International Student Engineering Experience (ISEE)

July 5th – July 29th, 2011

Rutgers, The State University of New Jersey

Introduction

The 2011 International Student Engineering Experience (ISEE) at Rutgers University hosted 22 students from Kyung-Hee University in Korea. The primary goal of the program was to cover concepts in structural engineering with a focus in sensor technology and monitoring, as well as expose the students to instruction, practice, and the culture of engineering in the United States.

This year's program added two key features in addition to the engineering instruction: housing for the students in Rockoff Hall (Rutgers student housing) and the Program in American Language Studies (PALS). Rockoff Hall in downtown New Brunswick, NJ enabled the students to enjoy all of the amenities available to Rutgers students such as the campus bus system, shops, and restaurants. In their free time, the students also had access to destinations in the New Jersey/New York area via the NJ Transit rail station located within walking distance of Rockoff Hall.

The engineering instruction focused on the newly emerging area of using sensor technologies for real-time health monitoring and management of critical infrastructure. Smart sensors coupled with computer modeling, which are currently used to enhance and sustain operations, safety, and security in various types of facilities, such as bridges, tunnels, roads, and traffic control, were discussed and experimented with.

The engineering lab program, as an important component of 2011 summer school, introduced advanced structural analysis and monitoring technologies such as computer modeling, structural monitoring using smart sensors, and featured a mini-scale bridge construction and testing competition for the students. Via this program, the students learned the basic principles of computer structural modeling, structural design, and structural monitoring and testing.

Students were taken on two field trips; a recreational trip to Philadelphia, Pennsylvania which allowed the students to enjoy the architecture and cultural history of the city. A second trip was made to Six Flags Great Adventure, a large amusement park located in Jackson, NJ. There the students met with a roller coaster technician who explained the engineering involved in a roller coaster, following which the students were free to enjoy the amusement park for the rest of the day.

At the conclusion of the program, student groups made project presentations and received individualized English proficiency assessments and certificates of completion. A banquet was held to celebrate the end of the program at Rutgers University.

Schedule of Lessons and Activities

Kyung Hee University Summer Session, July 2011						
Sunday, July 03	Monday, July 04	Tuesday, July 05	Wednesday, July 06	Thursday, July 07	Friday, July 08	Saturday, July 09
Legend *Busch Campus, CoRE Building* *Livingston Campus, PALS*		Arrival, Transport from Airport to Rutgers Rockoff Hall	**9:00am - 12:00** PALS Placement Test & Essentials of English Language ***12:30pm*** *Welcome Lunch & Introductory Event* *Open period*	**10:00am** Introduction to Civil Engineering Lab ***11:45am*** *Lunch* **12:30 - 4:00 pm** PALS Language Lab, Writing & Vocabulary Building	**9:30am - 12:30** PALS Speaking Effectively & English Sounds ***12:30 pm*** *Lunch* **1:30pm** Engineering Faculty Lectures & Discussion	
Sunday, July 10	Monday, July 11	Tuesday, July 12	Wednesday, July 13	Thursday, July 14	Friday, July 15	Saturday, July 16
	9:30am Engineering Lab 1 - Balsa Bridge Fundamentals ***12:00pm*** *Lunch* **1:00pm** Engineering Lab 1 - Balsa Bridge Fund.	**9:30am** Engineering Lab 2 - Balsa Bridge Design ***11:15am*** *Lunch* **12:00 - 4:00 pm** PALS Language Lab, Speaking Groups & Workshop	**10:20 - 11:40 am** PALS Discussion ***11:45am*** *Lunch* **12:30 - 3:00 pm** PALS Vocabulary & Grammar *Work/study period*	**9:30am** Engineering Lab 3 - Balsa Bridge Constr. ***11:45am*** *Lunch* **12:30 - 4:15 pm** PALS Discussion & Culture Workshop	**9:30am** Engineering Lab 3 - Balsa Bridge Constr. ***12:00pm*** *Lunch* **1:00pm** Engineering Lab 4 - Balsa Bridge Testing	**Recreational Trip to Philadelphia, PA**
Sunday, July 17	Monday, July 18	Tuesday, July 19	Wednesday, July 20	Thursday, July 21	Friday, July 22	Saturday, July 23
	8:40 - 11:40 am PALS Discussion & Writing Class ***11:45am*** *Lunch* **1:00pm** Engineering Lab 5 - Mini-Scale Truss Bridge Construction	**9:30am** Engineering Lab 5 - Mini-Scale Truss Bridge ***11:15am*** *Lunch* **12:00 - 4:00 pm** PALS Language Lab, Speaking Groups & Workshop	**10:20 - 11:40 am** PALS Discussion ***11:45am*** *Lunch* **12:30 - 3:00 pm** PALS Vocabulary & Grammar *Work/study period*	**9:30am** Engineering Lab 6 - Engineering Projects ***11:45am*** *Lunch* **12:30 - 4:15 pm** PALS Discussion & Culture Workshop	**Field trip to Six Flags Great Adventure**	
Sunday, July 24	Monday, July 25	Tuesday, July 26	Wednesday, July 27	Thursday, July 28	Friday, July 29	Saturday, July 30
	8:40 - 11:40 am PALS Discussion & Writing Class ***11:45am*** *Lunch* **1:00pm** Engineering Lab 7 - Tech. Presentations	**9:30am** Project & Presentation Preparation ***11:15am*** *Lunch* **12:00 - 4:00 pm** PALS Language Lab, Speaking Groups & Workshop	**10:20 - 11:40 am** PALS Discussion ***11:45am*** *Lunch* **12:30 - 3:00 pm** PALS Vocabulary & Grammar *Work/study period*	**9:30am** Project & Presentation Preparation **12:00pm** PALS SPORTS DAY	**10:30am** Engineering Project Competitions ***1:00*** *Lunch* **2:00pm** Final Presentations, Awards & Banquet	

Program in American Language Studies (PALS)

The students attended the Program in American Language Studies (PALS), the formal English training program of Rutgers University. The key features of the program were as follows:

- The students attended a total of 50 hours with PALS. As their stay was shorter than the typical program, a customized intensive curriculum was developed.
- Students were given a placement test immediately upon their arrival (July 6) and divided into groups based of their linguistic needs.
- The students attended one PALS regular course and each student placed according to his/her level in one of the six courses offered in that discipline. They got to work with other students and at the same time, their specific needs were met. This included the *Language and Culture Workshop* and *Collaborative Communication Workshop*.
- In addition, the students attended a 2 hour communication workshop in smaller groups.
- On Thursday July 28th, PALS sports day was held, a recreational day with other students outdoors.
- On the last day of the English Language Training, the students filled out a self-assessment form as well as a course feedback form. They then received a personalized report from PALS about their progress, listing of areas in which they need to continue working, and recommendations for how to do so.
- Students were presented with this proficiency assessment and a certificate of completion in the English program upon the conclusion of the program.

Engineering Lab Instruction

The following shows the rigorous schedule the students followed during the engineering lab program, and details some of the instructional material used for the engineering lab program

1. Engineering Instruction Schedule

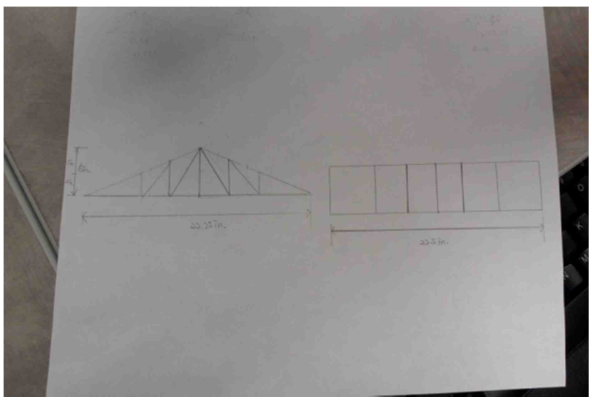
Lecture 1: Introduction to Engineering Lab Work

This introductory lecture covered the overall program and the purpose of testing as well as the laboratory goals of the program. Students were introduced to the fundamentals of structural analysis and monitoring, while also being given a glance at the future projects they will experience.

Lecture 2: Balsa Bridge Fundamentals

The instructor introduced basic concepts of computer-aid modeling. Background information as well as various finite element software were also introduced.

In this lecture, types and principles of truss bridges were reviewed on example sections. The Instructor discussed various bridge design alternatives and options include truss, arch, and frame type of structure. The procedure of the balsa wood bridge design and construction were explained and all materials and components introduced. Instructors worked with the students on a sample balsa bridge to illustrate how to design, build, instrument with foil strain gages, and apply loading to test the bridge until complete failure.



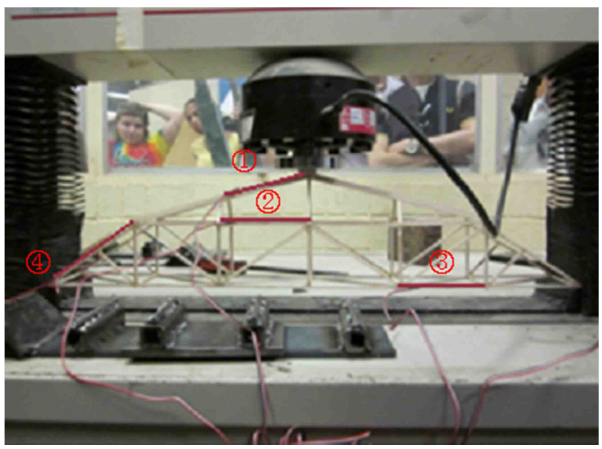
Lecture 3: Balsa Bridge Design/Construction

This lecture session took place in the computer lab where the students had access to the finite element and stress analysis computer software SAP2000. The students were divided into 5 groups to perform their own design and testing. Instructors provided assistance on how to create a computer model and how to perform the analysis on their proposed design alternative. Then each group worked on optimizing their bridge model in order to create a more efficient design. The main purpose of this lecture was to

finalize the truss model and dimensions for construction. The optimized configurations of bridges were used to build the balsa wood bridge as well as mini-scale bridge.

Lecture 4: Balsa Bridge Design/Construction

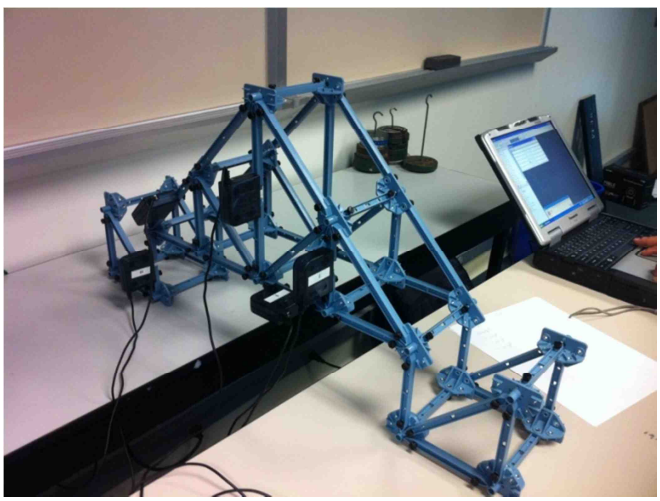
Students first prepared a full scale drawing of their bridge design on engineering draft papers and shape the balsa wood members accordingly. Each group then built the truss bridges, and installed foil strain gages on the critical members.



Lecture 5: Balsa Bridge Testing

The bridges were tested under a point load until failure occurs. During the test, strain and deflection measurements were recorded for each bridge. Each group included this structural response data of their bridge in their final presentation.

Lecture 6: Mini-Scale Truss Structure Construction

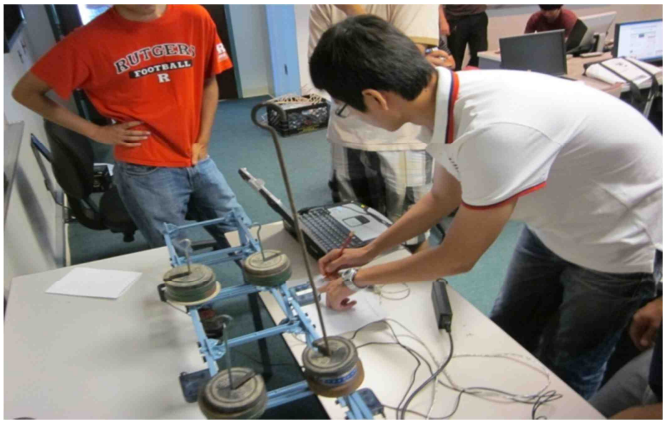


Three different types of truss structures including inverted truss bridge, triangular bridge, and roller coaster structure were selected and built on a mini scale using Pasco Bridge set. The students were divided into 3 groups to perform the testing. Similar to the Balsa wood bridge design, the required outcomes were taken from bridge model using SAP 2000 software for comparison with testing results.

While building the truss bridge, 2” to 10” long I- beam sections were used. Critical truss members were instrumented with load cells and the distribution of loads analyzed.

Lecture 7: Review of the Performed Engineering Projects

The students worked on how to prepare the final presentations. The emphasis in this lecture was the importance of producing a complete final product that includes experimental set-up, data collection and processing, analytical modeling, and test results. Students were assisted in using computer software such as Microsoft Word, Power Point, etc. while finalizing their reports and presentations.



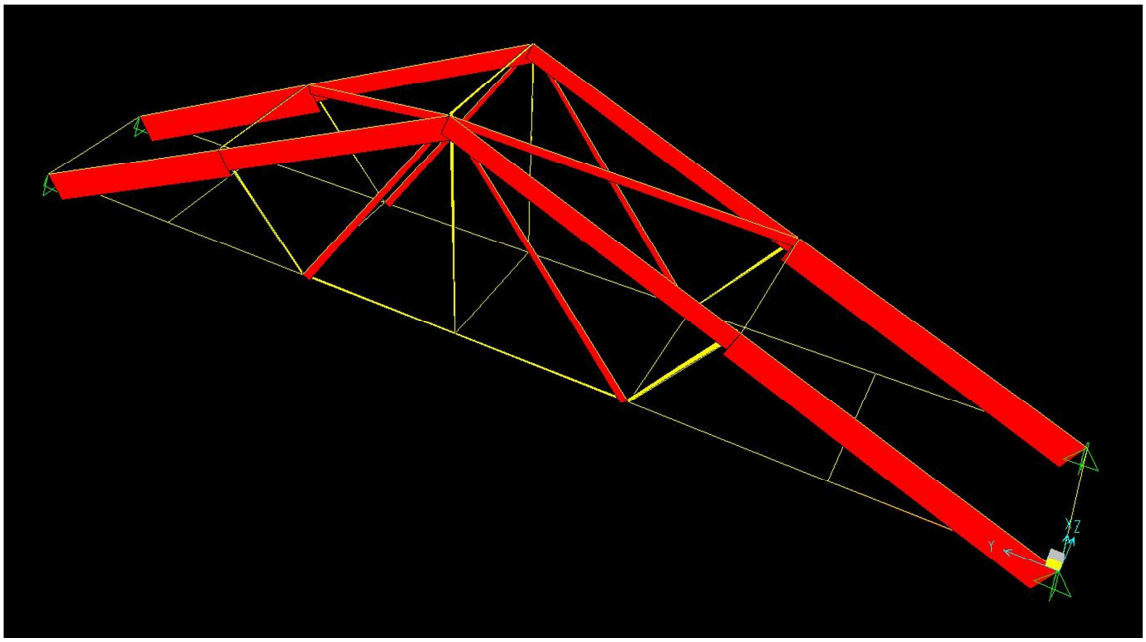
Final Presentations

Each group gave a final presentation regarding the Balsa bridge design/construction, mini-scale bridge construction. The presentation included the objective, design procedure, construction procedure, testing results, and conclusion.

2. Introduction to Computer Structural Modeling

Computer modeling is a mature and advanced technology to design and analyze various structures. This lecture session took place in the computer lab where the students had access to finite element and stress analysis computer software SAP2000.

Background information as well as various finite element software were introduced. The instructor provided assistance on how to create a computer model and how to perform the analysis on their proposed design alternative. Each group of students worked on optimizing their bridge model in order to create a more efficient design. The main purpose of this lecture was to finalize the truss model and dimensions for construction. The optimized configurations of bridges were also used to build the balsa wood bridge as well as a mini-scale bridge.



Typical Bridge Model Created using SAP 2000

3. Balsa Wood Bridge Building and Testing Competition

Balsa Wood Bridge

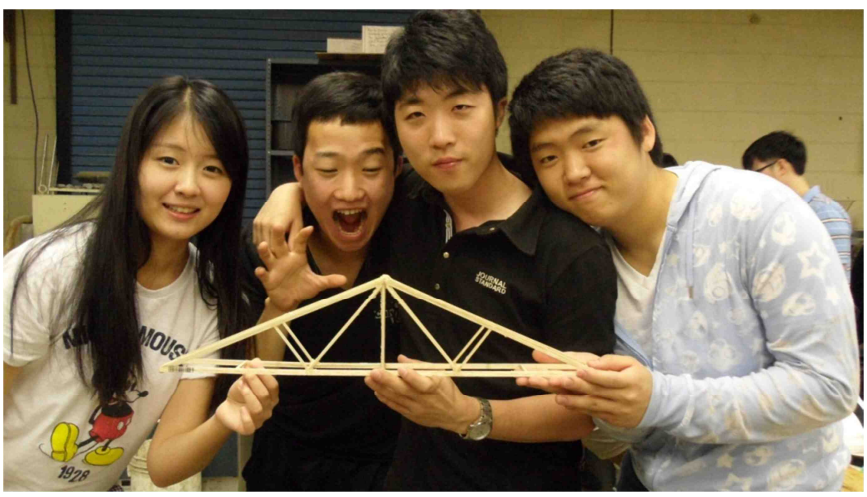
Following the instruction, the students, in teams, participated in a bridge construction competition to design and build a lightweight balsa wood bridge. The overall winner will have the bridge with the greatest live load to dead load ratio, LL/DL.

The students used SAP2000, a structural modeling program, to analyze potential bridge designs. Students identified the most loaded members and revised the design to reduce compressive loads that may cause buckling. The final design will be optimized to carry the most live load while having the least dead load. Internal bracing will be detailed to prevent global instability and racking. Construction quality will also be an important factor. Well constructed bridges allow even load distribution and predictable behavior.

Competition Rules:

1. Design a lightweight balsa wood bridge to be simply supported on a 22.25" span (diagram will be provided). The completed bridge must fit within a box measuring 3" wide by 5" high (above support), by 22.75" long. The bridge must be stable and rest on the load fixture prior to application of load. No part of the bridge will extend below the level of the supports.
2. The completed bridge must allow a 2"x2" block to freely pass along the span simulating the clearance required for traffic passage.
3. Construct your bridge using the given 8 pieces of 1/8" x 1/8" x 36" balsa wood strips and Loctite super glue. The completed bridge will consist of only balsa wood and glue.
4. The live load will be applied by means of a 3" diameter circular plate on the top of the bridge at midspan.
5. Bridges will be tested to failure. Failure will be defined as follows: (1) the load drops below half of the maximum load OR (2) the midspan deflection exceeds 0.75".

Competition Results:

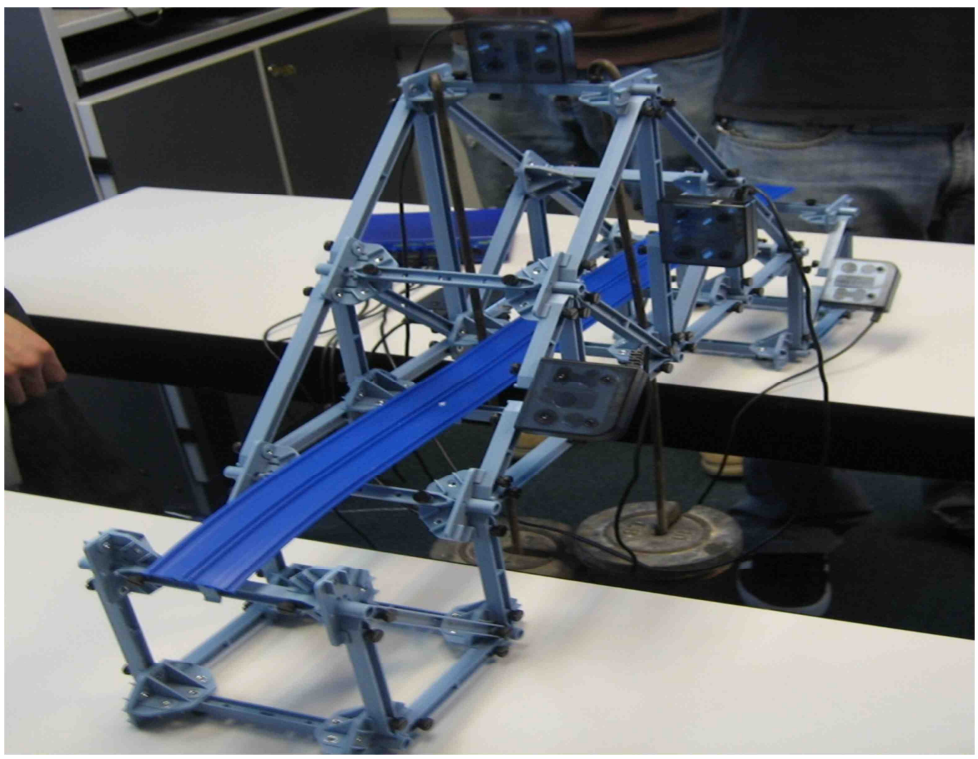


The Winning team was Group E: Yoohan Jeon, Eunkang Hur, Jungwoong Woo, and Hyejung Han.

4. Mini-scale Truss Structure Construction and Testing

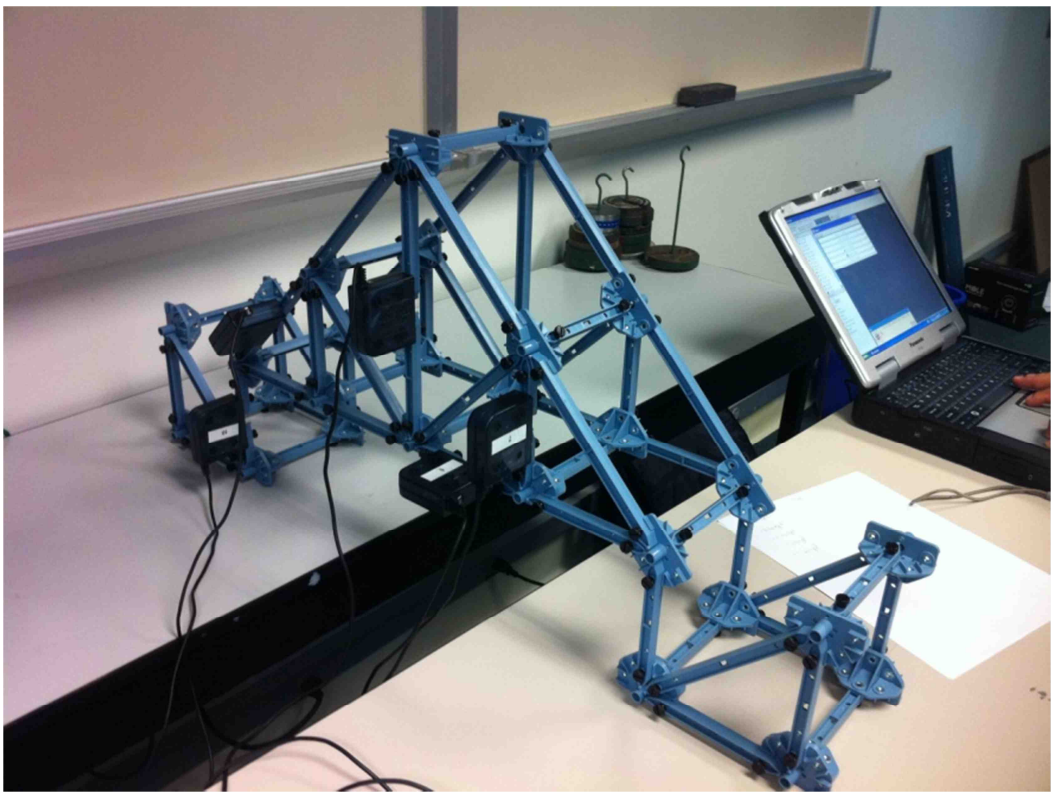
Pasco Bridge set is a mini-scale bridge set can be used to build any variety of truss bridges and explore the properties of I beams

In this lecture session, three different types of truss Structures include inverted truss bridge, triangular bridge, and roller coaster structure were selected and built on a mini scale using Pasco Bridge set. The students were divided into 3 groups to perform their own design and testing. Similar to the Balsa wood bridge design, each group built their bridge model using SAP 2000 software and obtained the required outcome for the comparison with testing results. While building the truss bridge, 2" to 10" long I- beam sections were used. Critical truss members were instrumented with load cells and the distribution of loads analyzed. The testing results were compared with the analytical results from FE model.



Example Bridge Built using Pasco Bridge Set

Inverted Truss Bridge Model with students



Triangular Bridge Model

Roller Coaster

	Test(lb)	Sap2000(lb)	errors
sensor1	3.04	3.31	8%
sensor2	-6.24	-6.63	5.8%
sensor3	-3.63	-3.32	9.3%
sensor4	3.12	3.31	5.7%

Typical Comparison

5. Lectures

In addition to the hands-on instruction, students were given a lecture by Professor Hani Nassif and Professor Kaan Ozbay of Rutgers University Department of Civil and Environmental Engineering.

Advanced Technical Lecture by Professor Nassif

Students were also introduced to the exciting research area of transportation engineering and modeling. As structural engineers, much of the work is focused on bridges and transportation structures, thus there is much overlap with transportation engineering. Professor Kaan Ozbay of Rutgers University gave a talk on ITS Technology. The students were then introduced to transportation modeling software such as Paramics and Synchro/Simtraffic for brief introductory demonstrations. The Synchro instruction included a hands-on demonstration where the students were able to experiment with the program in designing a traffic system.

Students were taken on two field trips, to Philadelphia, Pennsylvania, and to Six Flags Great Adventure amusement park in Jackson, NJ. The Philadelphia trip allowed the students to enjoy the architecture and cultural history of the city. Students were free to explore the city on their own and spend the full day in Philadelphia.

A second trip was made to Six Flags Great Adventure, a large amusement park with numerous large roller coasters. There the students met with a roller coaster technician who explained the engineering involved in a roller coaster, following which the students were free to enjoy the amusement park for the rest of the day.

Final Presentations and Banquet

At the program's conclusion, each group presented a summary presentation of their work. At the conclusion of the presentations, each participant was awarded a certificate of completion for both the engineering and English instruction programs, and had a banquet with Rutgers students and faculty from Rutgers University.

Participants of Summer 2011 Program with Rutgers Students and Faculty