Civil Talk

Look inside and find out more about....

Nauvoo Study Published

Several years ago, Dr. Kyle Rollins was awarded a grant from the Religious Studies Center at BYU to investigate how the early saints went about draining Nauvoo and what effect their efforts likely had on the swampy conditions. Rick Smith, a graduate student, assisted Dr. Rollins and they eventually enlisted the help of Dr. Jim Nelson and Dr. Brett Borup in conducting the study. After drilling boreholes across Nauvoo to evaluate soil and groundwater conditions, the researchers used modern Civil Engineering methods to evaluate changes in groundwater and surface water runoff patterns after the construction of an interceptor drain at the base of the bluff in Nauvoo. BYU's WMS software was used to analyze surface water runoff patterns with and without drains and finite element seepage analysis software was used to investigate changes in groundwater levels before and after drainage. The results of this study were recently published in BYU Studies with the title "Transforming Swampland into Nauvoo, The City Beautiful-A Civil Engineering Perspective" (BYU Studies, Vol. 45, No. 3, p. 125-157). An abstract of the paper is provided below.

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Elder Scott Speaks at Sympsoium

March 1 & 2, 2007 the Ira A. Fulton College of Engineering & Technology, in conjunction with Religious Education, hosted a symposium "The Gospel: the Foundation for a Professional Career - Moral Character in Professional Life". The symposium included speakers from Religious Education as well as engineering faculty. Other speakers were Mary Peery, King Husein (BYU alumni), and Elder Richard G. Scott. In conjunction with the symposium, a reception and dinner was held to honor Elder H. Burke Peterson for his contribution to family, the church, and his profession.

EMRL spins off Aquaveo

There has been a major restructuring of the EMRL. Alan Zundel and nine full-time staff have moved off-campus to a new company called Aquaveo, LLC. They are located near the County Building in downtown Provo. Professors Jones and Nelson have pondered the future of the down-sized EMRL. It is their desire to capitalize on the legacy of the EMRL and continue to pursue a strong collaborative research environment related to modeling. As a result, Professors Hotchkiss and Williams have been invited to join EMRL and both have accepted. Both of the faculty have strong research experience in environmental modeling and are already collaborating on several projects. The mission statement of the EMRL has always been

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Brigham Young University
Department of Civil & Environmental Engineering Annual Newsletter
Summer 2007

Message from the Chair

Dear Alumni and Friends

It has been a great year in the Department of Civil and Environmental Engineering. As you all know, our department is a very exciting and dynamic place. Students and faculty continue to make strides and bring distinction and recognition to our alma mater. The demand for our graduates remains extremely high with both graduating students receiving numerous job offers and undergraduates being sought after for summer internships. Our ASCE student chapter again received national recognition by receiving the Region 8 Governor's award, and Professor Borup was recognized as the Region 8 faculty advisor of the year. Our classrooms are truly blessed by devoted master teachers who continue to share their experiences and skills with the student body and our capstone class is developing into a truly significant professional design experience. The external research grants received in the department topped $3,000,000 this year. Perhaps the most significant event was the special symposium held in which Elder Richard G. Scott spoke to our student body, and our college had the honor of recognizing Elder H. Burke Peterson for his assistance with our programs.

I would like to give special recognition to our Scholarship Society. The endowed scholarship funds now stand at well over $2,000,000. We are truly grateful to Doug Ferrell and the inspirational leadership he has given to this effort for the past several years. Doug has now been asked to serve on the College Advancement Committee for Engineering and Technology, and Neil Anderson has graciously accepted the challenge to be the president of the Scholarship Society. Neil has the vision of increasing the endowments to $5,000,0000. New and exciting directions are coming from this group and I encourage you to participate fully in these opportunities.

A few of the highlights of this year's activities are described on the pages of this issue of Civil Talk. As you will quickly see, the department is becoming very involved with global issues. Professor Nelson's excellent study abroad program continues to offer our students an opportunity to address the significant water resource problems facing Mexico using state-of-the-art water modeling tools. This program is a life changing activity for the participating students. Professors Balling, Christiansen, and Schultz had the opportunity to visit major civil engineering projects that are currently underway in China. Their experiences will translate very quickly into new visions and opportunities for both our students and alumni. I had the pleasure to take a group of students to Romania and conduct workshops focused on Engineering Ethics. This trip provided a wonderful opportunity for a significant exchange of ideas between diverse faculty and students who are concerned about proper ethical conduct in our profession. Some of our students have also participated in college sponsored study abroad programs in China and France and have broadened their education as a result of these opportunities. Professor Jensen's recognition of his innovative invention by Modern Marvel's segment of the The History Channel is most welcome and well deserved.

The department welcomes your continued interest and support. Please feel free to come visit and provide us with information which you think might be important, and, most importantly, stay connected with us. I wish you the best in all that you do.

Sincerely,
Steve Benzley

Faculty Awards

M. Brett Borup - 2007 Region 8 Faculty Advisor of the year from ASCE
Hank N. Christiansen - 2007 Exceptional Educator Award
Rollin H. Hotchkiss - 2007 College Excellence in Education Award, Best Presentation ASEE Rocky Mt. Section Annual Conf.
Norman L. Jones - 2007 Utah Engineering Educator of the year from ASCE
E. James Nelson - 2007 Department Outstanding Faculty Award, 2007 College Global Awareness Fellowship
Mitsuru Saito - ASCE Fellow (*see page 12),* 2007 College Global Awareness Fellowship

College of Engineering & Technology Trip to China for Faculty

The Ira A. Fulton College of Engineering & Technology took a group of 27 faculty, and some spouses, to China to scope out the possibility of doing a study abroad program for engineering students. Three Civil Engineering faculty had the opportunity to go and share a few thoughts on their experience.

Rick Balling:

This was my first trip to China. My wife, Cindee, went with me. We enjoyed the company of the other professors in the college and their wives. We found the people of China to be very friendly. The frenetic pace of construction in China is overwhelming. I was really turned on to the impressive buildings and bridges. Many of the world's tallest skyscrapers and longest bridges are in Shanghai and Hong Kong, and several future record-breakers are under construction. With the summer Olympic games coming to Beijing next year, there are many interesting structures under construction. I was able to see these structural engineering marvels up close. I wish our students could see these structures. The picture below shows the Jin Mao building (4th tallest in the world), the Shanghai World Financial Center under construction (will be the tallest in the world), and the Oriental Pearl Tower (third tallest tower). None of these structures existed 15 years ago.

Shanghi Skyline

Hank Christiansen:

Modern day China is something that you have to see to believe. I had been there twenty-two years ago and all that looked familiar was the Great Wall and Forbidden City. The construction in Beijing was astounding. Approximately 1,000 major new buildings are under construction. Down by Hong Kong the population of the adjacent region was 200,000 twenty-seven years ago. Today that region has 11,000,000 people! The most amazing statistic is that last year China actually lost manufacturing jobs! The lowest level jobs are now going to Vietnam, India, Malaysia, and Cambodia. The United States and Japan have already gone through the period of losing most of the manufacturing jobs and China is quickly following in our footsteps.

Grant Schultz:

In the fall of 2006, the Ira A. Fulton College of Engineering and Technology announced a program aimed at providing opportunities for faculty to become involved in the ever expanding global engineering world and to understand the people and cultures that shape the engineering profession in the 21st century. In this, the first year of the program, faculty had an opportunity to apply for and participate in a trip to mainland China. The objectives of the trip were: 1) to help faculty develop an awareness of the engineering and technology activities and progress in China, 2) to initiate and/or strengthen ties with corporate and university colleagues in China, 3) to better understand how faculty might design educational experiences for students involving collaboration with and/or travel to groups in Asia, and 4) to gain an increased appreciation for the people and culture of China. Each of these objectives were met as the faculty was able to spend time in China learning more about the people and culture, while establishing important ties with universities and corporations.

As one of those privileged to participate in this experience, I was amazed at the beauty and progress of this once untouchable nation. We began our trip in Beijing where we were greeted warmly by the Chinese people. During our stay in Beijing we were able to gain a love for the people and the culture through visits to Tiananmen Square, the Forbidden City, the Great Wall, and the Hutong. I was also able to begin to develop ties with Professor Yang Xiao Kuan of the Transportation Research Center at the Beijing

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History Channel's 'Modern Marvels' honors BYU invention, professor

The History Channel's tech-savvy show, Modern Marvels, gives behind-the-scenes glimpses into innovations of past and present and recently announced the year's top inventions. A panel of inventors, technologists, and industry experts selected the semifinalists from among more than 2,200 independent inventors and over 3,300 inventions. Among the 25 semifinalists is a machine invented by one of our own civil engineering professors that automates the production of lightweight composite 3-D lattice structures. Inventor David Jensen, a BYU Professor of Civil Engineering and Director of the Center for Advanced Structural Composites, has been developing IsoTruss® structures and the unique continuous fabrication process for nearly a decade.

The Invention

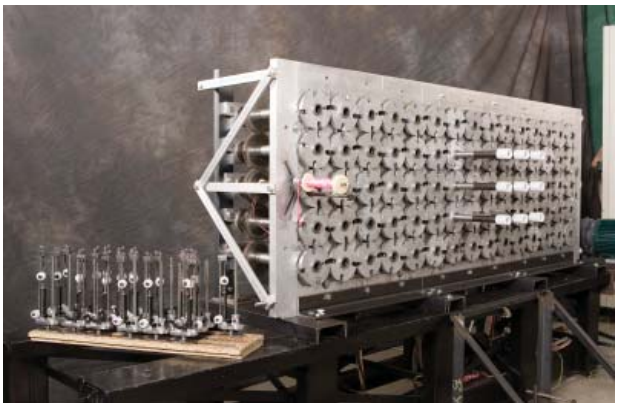
The invention is an automated process for continuously manufacturing IsoTruss® and other innovative open-lattice fiber-reinforced composite structures with highly consolidated members more quickly, more predictably and more consistently than existing fabrication methods.

Historical Problem

Existing hand and filament winding processes for manufacturing composite grid structures are slow, costly, labor-intensive, inconsistent and unable to properly consolidate individual members or create advanced (complex, more efficient) geometries. To further complicate the traditional methods of producing filament-wound composite structures, an expensive geometry-specific mandrel is required for each configuration. Even a slight change in geometry usually requires a new mandrel. Using the existing methods to manufacture IsoTruss structures proved to be a barrier to commercialization of the IsoTruss technology. The new process overcomes these historical barriers.

Road to Development

A trip to China inspired the idea of switching from batch to continuous fabrication modes in the manufacturing of IsoTruss structures. Difficulty manufacturing these structures had slowed their adoption into the marketplace. The purpose of the trip to China was to find a company with inexpensive labor that could cost-effectively manufacture the advanced composite grid structures. While observing the challenges of labor-intensive manufacturing methods employed by the Chinese in making a variety of products, Dr. Jensen realized that successful fabrication of IsoTruss structures with individually consolidated members could best be achieved using a continuous manufacturing process. Over the last several years, with an exceptional team of engineering students, the team developed and demonstrated the automated IsoTruss manufacturing technology. "The machine creates IsoTruss structures at a higher volume and lower cost with a continuous process that doesn't require hand assembly," Jensen said. "It also enables new customized structures to be created without having to design an entirely new mandrel for each new configuration, employing instead an automated external cylinder shaping system."



Potential Impact on Civil Engineering

Although numerous potential applications, ranging from bicycle frames to meteorological towers, exist for this technology, one of the most significant impacts of this invention on society could be the potential reduction of soil and ground water contamination caused by toxic chemicals inherent in all wood utility pole installations. Light-weight composite IsoTruss poles could cost-effectively replace wood poles, while simultaneously saving energy in shipping, simplifying installation and reducing failures caused by high winds. Utilizing a continuous process enables the creation of complex patterns that incorporate interwoven members with individually braided sleeves around each member. In-situ consolidation eliminates costly, labor-intensive, and ineffective batch consolidations methods.

To learn more about Jensen's invention, visit http://www.history.com/invent/ and click on "2007 Winners" and then on his name. The Web site for his BYU research lab is www.isotruss.org.

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Abstract

When the Mormons first arrived in 1839, Nauvoo was a disease-infested swampland choked with underbrush and timber. By hard work and perseverance throughout their stay, they largely transformed this swampy area into "Nauvoo, the City Beautiful" before their departure in 1846. The "flats" in Nauvoo are surrounded by the Mississippi on the north, west, and south and by bluffs which rise 60 ft to the east. Nauvoo is underlain by horizontally bedded limestone which is relatively impervious in the vertical direction but allows horizontal water flow. Drill holes indicate that the overlying fine-grained soil tapers from a thickness of about 12 to 16 ft at the base of the bluffs to about two feet near the Mississippi River. Due to surface water runoff and groundwater flow, the volume of water increases as it moves westward on the flats; however, the impervious limestone layer traps the water in a progressively smaller volume leading to swampy conditions. A critical component of

the effort to drain the swamps was the construction of an interceptor ditch at the base of the bluffs along Durphy Street. This ditch, which extended to the limestone bedrock and was typically about 50 feet wide at the ground surface, eventually extended about 3000 ft south to the Mississippi River. The Durphy ditch intercepted both groundwater flow and surface runoff from the streams which drained the bluffs, thereby reducing the potential for standing water in the flats. Hydrologic analyses indicate that this ditch would have reduced the runoff of surface water onto the flats by about one-third. Groundwater analyses indicate that the ditch would have significantly lowered the water table in the flats. Construction of the drain likely moved the intersection between the water table and the ground surface downslope by about 1500 ft. Historical records and modern surface water analyses indicate that the Durphy drain alone would have been insufficient to prevent ponding of water in typical rainstorm events. Therefore, additional shallower ditches would likely have been constructed on the main streets running in the south and west directions to handle runoff of surface water. These ditches would probably have been constructed as a community effort. In addition, individual property owners constructed ditches on their property which would drain into the main ditches and then into the Mississippi. Therefore, as additional land was inhabited and improved, the overall conditions would improve.

Dr. Saito Advances to ASCE Fellow

Mitsuru Saito, a BYU Civil Engineering professor in transportation engineering has been advanced to Fellow in the American Society of Civil Engineers (ASCE). ASCE is the professional organization that deals with a wide range of Civil Engineering issues. The distinction of Fellow is the second-highest membership grade next to Honorary Member within the organization. His advancement is based on his dedication to education and research in the transportation field of Civil Engineering and his contributions to numerous ASCE sponsored activities.

Dr. Saito has been a dedicated educator and researcher since he obtained his doctorate degree from Purdue University in 1988. He first taught and conducted research at the City College of New York from 1988 to 1997. He joined the faculty of the Civil & Environmental Engineering (CEEn) Department of BYU in 1997 and was advanced to the rank of professor in fall 2001. As of December 2006 he had published 50 technical papers, many of them with his research assistants, in the field of traffic engineering, traffic flow theory, traffic safety, urban transportation planning and infrastructure management.

Dr. Saito has been a member of ASCE since 1978 and has been active in national-and international-level ASCE activities. He has been an active member of the Infrastructure Systems Committee (ISC) since 1990. He was the chair of ISC for two terms (for four years) from 1996 to 2000. Recently he was invited to become a member of the Scientific Committee of the 10th AATT international conference, which will be held in Athens in May 2008.

Dr. Richards Does Research

Dr. Richards' research focus is seismic performance of steel buildings. Recent activities of his team include full-scale testing of connections for buckling restrained braced frames and refined-mesh computer simulations of buildings under earthquake loads.

Connection testing in structures lab

Buckling restrained braced frames (BRBF) are a relatively new seismic system, with the first U.S. application in 2000. BRBFs are becoming increasingly popular and two notable projects in the Provo/Orem area utilize the system: Midtown Village in Orem (400 S State St), and the Gordon B. Hinckley Alumni Building (on campus). Standard beam-column-brace connections in BRBFs require field welding and do not perform well at large deformations. Dr. Richards and Brad Coy (MS 2007) performed full-scale experimental testing of a new connection design which requires no field welding. Experiments indicate the connection can withstand large deformations during an earthquake without requiring repair afterwards. The validated connection will result in more economical construction of BRBFs and improved seismic performance.

Other projects involve computer simulations of buildings subjected to earthquakes. Since strong earthquakes occur infrequently, computer models are an important tool in understanding how new structural systems will respond to major events. Traditional computer models of buildings with standard beam, brace, and column elements cannot directly predict material fatigue or simulate gusset plate damage in braced frames. Dr. Richards' team is using more advanced models with shell/solid elements in connection regions to study these issues as well as the effects of multi-directional loading.

Hinckley Alumni Building during construction (white members are buckling-restrained braces)

Don't forget you can sign up to receive "Civil Talk" via email at www.et.byu.edu/ce

Uni *China continued from p. 4*

versity of Technology. I was able to spend several hours with Professor Yang strengthening ties and identifying ways to share information and to collaborate on research and teaching. From Beijing we traveled to Nanjing where we were able to attend a BYU study abroad class at Nanjing University. The ties between BYU and Nanjing University are very strong and the opportunities are great. In Shanghai we were able to continue to learn about the people and culture of China through visits to the Yu Garden and Old Chinatown while experiencing the great marvels of Civil Engineering and transportation that the City has to offer.

We continued our trip by traveling from Shanghai to Shenzhen where we visited ATL and the Zhuhai Yueke Jinghau Electronic Ceramics Company to better understand the processes involved in manufacturing that is occurring in the country. From Shenzhen we traveled to Hong Kong where we were able to enjoy the beauty of the City as well as the beauty of the Hong Kong Temple. What a wonderful experience it was to know that the gospel is true no matter where we travel throughout the world. I am truly grateful for the opportunity that I had to participate in this trip. Being able to see, to feel, to smell, and to participate in a small measure of what China has to offer was truly an incredible experience and one that I will never forget!

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