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Monday, December 09, 2013

Educating the future of railway engineering

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A UK class and several of the AREMA RailCats touring NS's John Sevier Yard/Terminal in Knoxville, Tenn.

retire. A wealth of knowledge is retiring with them and railroad engineering programs are helping to prepare students to fill those spots in the industry.

AREMA

"Engineering education programs are critically important to the future of the industry," explained Michael

Railroad engineering education programs, both established and new, are offering a variety of courses and training opportunities for the young and growing workforce.

The railroad engineering workforce continues to pass the torch to the younger generation of railroaders, as the men and women who have served this industry for many years

Pochop, P.E., vice president of Hanson Professional Services Inc. and past chair of Committee 24 – Education & Training. "The projected retirements of experienced staff requires a significant hiring of graduates and those new to the industry will need to acquire knowledge quickly. Education programs are part of the needed response, along with post-secondary education and transfer of experience within the individual companies."

AREMA, whose technical committees develop and advance the knowledge and recommended practices for railway infrastructure, has a key role in this knowledge acquisition, along with universities and the industry itself. AREMA delivers this knowledge through its publications, seminars, webinars and annual technical conference.

"Experienced railroaders and newcomers learn from the great networking opportunities of AREMA," noted Pochop. "This can be an organized format, such as the Training Cooperative and LinkedIn Group and informal networking that occurs between events or at a booth at the annual conference. The best way to be at the forefront of railway education and training is to join one of AREMA's 30 technical committees and steering teams."

AREMA is contributing to the education of future railroad engineers by its established 16 student chapters, sending speakers to student events, providing mentors, funding scholarships and providing university professors the content and network they need to expand railway education. AREMA says its technical committees are annually increasing its seminar and webinar offerings and that the best place to see AREMA's expanding education offerings is at www.arema.org, which has links to the committees, publications, events, programs and opportunities.

REB

The Railway Educational Bureau (REB), a sister company to RT&S, offers self-paced distance learning, workshops and on-site training. REB says Basic Principles of Track Maintenance, Advanced Principles of Track Maintenance and FRA Track Safety Standards are cost-effective, self-paced distance learning courses that bring new employees up-to-speed fast.

"Employees now have the convenience of submitting their answers through our website, which provides immediate feedback," explained Brian Brundige, director of REB.

Additionally, REB hosted a three and a half day Track Safety Standards workshop in October with plans to offer more in the future and said instructor-led workshops are a great learning opportunity.

"We can bring a workshop to a site and tailor it to very specific needs," he stated.

The FRA's proposed Part 243 will bring a lot of changes to training for the entire industry once it is finalized, he says.

"We're working on some exciting changes in order to meet these upcoming regulations," added Brundige.

UIUC

The University of Illinois at Urbana-Champaign (UIUC) Rail Transportation and Engineering Center's (RailTEC)

The University of Illinois at Urbana-Champaign (UIUC) Rail Transportation and Engineering Center's (RailTEC) mission is rail education through excellence in rail teaching, research and public service. By teaching courses and offering a curriculum in rail engineering and transportation, RailTEC seeks to educate, inspire and mentor future leaders of the rail transportation profession and society that are prepared to meet 21st Century challenges in a global economy. RailTEC also seeks to make students of other civil engineering disciplines aware of rail design requirements so that they can better interface with and utilize the rail mode in their future design careers.

"RailTEC performs forward-looking research, both applied and theoretical, that will positively impact and improve our rail transportation profession and society," explained Christopher Barken, Ph.D., director of the UIUC rail engineering program. "While furthering our understanding of the critical research issues in rail transportation and developing practical, effective solutions, RailTEC acts as a source of rail knowledge and expertise to colleagues, industry, government and the public."

During the past 24 months, five new rail classes have been introduced to the railway engineering curriculum, bringing the total number of rail classes to 11. One major area of expansion has been in the area of high-speed rail (HSR). UIUC has expanded the HSR curriculum to cover the full engineering life-cycle of a HSR project with two new courses: High-Speed Rail Planning and High-Speed Rail Construction Management. Another course, High-Speed Rail Operations and Maintenance, is under development and should be offered for the first time in spring 2015. Other new courses are now offered, as well.

Two additional rail courses are under development and should be offered for the first time within the next 18 months. Advanced Track Engineering will examine mechanistic track design concepts and the detailed design of individual track components and special trackwork. Railway Operations & Terminal Design will cover network planning, operations, capacity and the design of railway classification yards, intermodal facilities and bulk terminals.

"UIUC is the lead institution of the National University Rail Center (NURail), the first U.S. Department of Transportation University Transportation center dedicated to rail research and education. The NURail consortium members (UIUC, University of Illinois at Chicago, Michigan Technological University, Rose-Hulman Institute of Technology, Massachusetts Institute of Technology, University of Kentucky and University of Tennessee-Knoxville) all have active rail education programs with a diverse set of course offerings," said Barken. "NURail is exploring opportunities to best take advantage of this diversity of course offerings to give students a more complete rail education at each consortium campus and those of NURail affiliate universities. NURail hopes to establish common educational materials and distribute them via a railway engineering education portal. Although some course material has been shared already, the present rail courses at each campus evolved independently and even the basic railway engineering courses have varying emphasis depending on the interest and the expertise of the individual faculty. To help the rail industry understand what a student with an introductory railway course on their transcript was taught, NURail is also seeking ways to establish guidelines and standards for the content of basic railway engineering courses."

University of Delaware

The objective of the University of Delaware's Railroad Engineering and Safety program, which was launched in

August 2012, is to educate students and advance the railroad and transit engineering fields using a three-part approach.

One, undergraduate and graduate courses in railroad engineering with a goal of developing concentration and long-term degree programs at the undergraduate and/or graduate level; two, professional training and education for working railroad, transit, government, supplier and consulting professionals in the field and, three, research activities addressing key areas of interest and need in the field.

The university currently offers two full, three-credit courses that are given at the senior/graduate student level. These courses include Introduction to Railroad Engineering, a three-credit senior/graduate course, which is taught by Allan Zarembski, Ph.D., PE, FASME, honorable member of AREMA, research professor and director of the Railroad Engineering and Safety Program at the University of Delaware, during the fall semester; Railroad Safety and Derailment Engineering, a three-credit senior/graduate course, which Dr. Zarembski teaches during the spring semester and a new course planned for the 2014-2015 academic year, Advanced Railroad Engineering. This will also be a three-credit senior/graduate course and will allow the university to offer a certificate in railroad engineering as part of its master's degree program.

Other professional courses introduced by Dr. Zarembski include Rail Problems, Rail Maintenance and Rail Grinding, a two-day course with CEU credit and Railroad Safety and Derailment Prevention course, a two-day course with CEU credit.

The university has an active advisory committee chaired by David Staplin, deputy chief engineer, track, Amtrak and with representatives of BNSF, CSX, Norfolk Southern, Union Pacific, New York City Transit, Southeastern Pennsylvania Transportation Authority and Washington Metropolitan Area Transportation Authority, as well as the Federal Railroad Administration, Association of American Railroads and Railway Tie Association. The school works with this committee both in the development of courses and in research directions.

"I see a resurgence of railroad engineering after a long hiatus," noted Dr. Zarembski. "I am watching the growth of new railroad programs across the country. I see the development of specialization, with some programs focusing on railroad engineering, others on management, etc. (I am constantly being asked by prospective students about different areas of specialization that are available.) I see the introduction of a new generation of students to the railroad industry (I am pleased to be able to contribute to this, as I see my own students take positions at different railroads). There is a strong need for this new generation of trained engineers and managers and I see university programs helping to fill that need."

UK

The University of Kentucky provides its undergraduate and graduate students with two courses in railway engineering and operations to complement course offerings in the transportation engineering area.

"This also serves to interest our students in the railroad industry and to seek employment with a railroad company, a consulting engineering firm, a contractor/supplier catering to the railway industry or a governmental agency involved with railway engineering and operations," explained Jerry G. Rose, Ph.D., P.E., University of Kentucky, College of Engineering, Civil Engineering Department. "It also provides basic instruction

University of Kentucky, College of Engineering, Civil Engineering Department. "It also provides basic instruction in railway engineering and operations for both undergraduate and particularly graduate students involved with research studies. We have maintained a rather large rail research program for several years.

The university offers two classes, Railway Freight and Passenger Operations and Intermodal Transportation, which has been taught each fall semester since 1999 with about 15 to 20 students per year and Railroad Facilities Design and Analysis, which has been taught each spring semester since 1983 and consistently has about 20 to 25 students per year.

"Early on, CSX was very instrumental in the program," said Dr. Rose. "Since then, BNSF, Norfolk Southern and, to a limited extent, Union Pacific, have been involved, plus several shortline railroads in the vicinity. Guest speakers from these railroads and engineering firms are common parts of the classes, in addition to field trips to rail terminals."

Dr. Rose believes that rail programs will grow slowly and that only a select few schools will develop full-fledged rail programs.

"It is a specialty in civil engineering and few schools will have more than one or two courses dedicated to just rail," he noted. "Many civil engineering courses are applicable to rail engineering and operations and provide the basic instruction for the senior and graduate courses dedicated to rail."

Michigan Tech

"Our vision is and, has been, to provide a service to both the rail industry and our students," explained Pasi Lautala, director of Michigan Tech's rail transportation program. "We offer an interdisciplinary program in railroad engineering and urban rail transit that provides opportunities for our students and faculty to participate in the development and operation of rail transportation today and into the future. We try to match industry and educational needs to provide our students with the background they will need to succeed, a challenging task with the fast pace of change in the industry today."

Michigan Tech offers a basic program for students from various departments. Available courses include Railroad Engineering, Track Design and Engineering, Public Transit Planning and Engineering and Rail Transportation Seminar. This fall, Michigan Tech's School of Business and Economics has also introduced a course in Transportation Logistics and Management. Lautala says the school is also putting great emphasis on getting its undergraduate students to work on externally-funded real-world problems through its Senior Design and Enterprise programs.

The school has students working with Union Pacific to develop a sensor system to display the sand level in locomotive traction sand tanks; Norfolk Southern and Union Pacific to investigate development of intelligent railroad crossing signal maintainer; Escanaba & Lake Superior Railroad to repurpose an existing centerbeam rail car for a new life in the rail car fleet; the Michigan Department of Transportation to develop recommendations for inspection and construction of highway-rail grade crossing surfaces and the Technical Expert Network to provide marketing and system operations information to a client interested in the developing train control market.

These projects involved students from the school's electrical, mechanical and civil engineering programs and also students from its business programs. Lautala says the school believes in hands-on education and is continuously looking for opportunities to partner with the rail industry in projects like these.

"We have excellent relationships with the Class 1 railroads in the U.S. and Canada, as well as with industry consultants, manufacturers and suppliers," Lautala noted. "We also work with shortline railroads in our area and with rail maintenance and repair companies. We seek industry input on a regular basis and often invite industry speakers to guest lecture in our courses and for our Railroad Engineering and Activities Club. We work with AREMA Committee 24 - Education & Training and have had a member on the committee for 10 years. Our AREMA relationship has been extremely helpful in identifying critical areas of knowledge and in assisting with development of course materials. This year, we are establishing a Railroad Advisory Board to provide a more formal industry input into our curriculum and program development."

As the rail workforce ages, the need for bringing in new, highly-qualified personnel is exploding, explains Lautala and he says the industry also needs a new breed of employees to handle all of the high-tech communications and systems integration equipment.

"At the same time, our prospective student base is becoming more diverse and is coming from a wider region," he noted. "Online learning may prove an effective way to provide some of our educational and training requirements. We piloted a test online rail learning system (<http://rail-learning.mtu.edu/>) with the support by the Federal Railroad Administration this year to help establish a platform where some of that learning might take place."

Lautala says Michigan Tech is exploring some of those opportunities within the NURail consortium.

"We also believe that it's important to be interdisciplinary, as today's world requires managers who are capable of moving smoothly between different business areas and finally, in keeping with the increasingly global marketplace we need to be more active with our international colleagues. At Michigan Tech, we have great relationships in Europe and Asia and are exploring opportunities with India. It's an exciting time in the rail education business and there is certainly no lack of project and course opportunities."

UT Knoxville

The objective of the University of Tennessee, Knoxville, rail program is to turn out students with some basic knowledge of the rail mode with a focus primarily on the civil engineering aspects of railways, though there are students with an interest in industrial engineering, particularly operations research. The program targets students at the Master of Science level, since undergraduate students have few elective choices. However, seniors are able to take a rail class if they have the proper prerequisites.

"We have quite a robust non-credit continuing education program aimed at railway professionals," shared David Clarke, Ph.D., P.E., director, Center for Transportation Research, University of Tennessee, Knoxville. "Our university students are welcome to attend these courses when their schedules permit."

Clarke is working on a new class in railway operations and is seeking opportunities for course exchanges with other universities having a railway focus area. Such opportunities would allow students access to a broader portfolio of courses than what the University of Tennessee, Knoxville, can develop in-house. Affiliation with NuRail has been a definite help in this regard, he says.

"We do not have a partnership with any specific railroad; however, we do work with individuals having railway experience to develop course content," he said. "Railways have been very cooperative about providing guest speakers and facility tours for classes."

According to Clarke, compared with European and Asian counterparts, there is a distinct lack of railway education within U.S. universities. Through AREMA-sponsored initiatives, such as the Railway Engineering Education Symposium, universities are starting to build capacity in railway civil engineering, he notes.

"However, our universities lack equivalent programs in mechanical and electrical engineering, both important in the railway professional workforce," Clark explained. "I believe that we should also look at railway operations in the business side of academe. Programs today are supply-chain focused and provide little on carrier operations and management."

Track Guy Consultants

"We are extremely grateful for the opportunities that have been thrown our way during the past 39 years," explained John Zuspan, president of Track Guy Consultants. "Now that we are in the consulting business, I feel a tremendous need to give back to the industry that has given me and my family a good quality of life. It is important for us to share our experiences and mistakes so others can learn. Our mission is to educate and share experiences in order to build, maintain, inspect and design railroad track correctly. Our primary purpose is to show others so our track systems can be safe with human lives on board. There are so many tricks of the trade that must be shared and that is what inspired us to also write seven handbooks on constructing different types of track and managing the work."

Along with the company's assortment of programs consisting of Basic Track 101, Means and Methods for Building Track, Thermal Forces and FRA 213 Track Safety Standards, it has added a three-day program on Managing Railroad Track Projects. Additionally, Track Guy Consultants offers classes on American Public Transportation Association Track Safety Recommendations and Federal Transit Administration Track Safety Guidelines. Track Guy has also built custom programs for contractors such as a three-week management program for Project Managers, Superintendents and Foremen.

Zuspan credits safety as being priority number one.

"Years ago, safety was not number one and was deemed to affect production and be an annoyance," he noted. "A message of 'we will lose money if we have to do this stuff' was sent out to the troops. We cut corners; we jeopardized the wellness of ourselves and others around us. Over the past couple of decades, railroad workers are heavily trained in the safe way to perform their activities. It is very refreshing to walk on a jobsite and see workers doing a morning briefing, stretching, wearing their PPE and have an overall safety culture that starts at the CEO level. Today, it goes like this, 'If you don't work safely, you will be fired'."

the CEO level. Today, it goes like this, 'If you don't work safely, you will be fired.'"

Track Guy Consultants programs offer the nuts and bolts, as well as sound engineering principles that were developed 150 years ago, Zuspan says. These principles or standards have been enhanced over the years and revised to accept new technology and new knowledge.

"Track Guy Consultants takes pride in the fact that we keep up-to-date with changing technology, as well as educating ourselves to be better trainers. We need to continually learn new things until we are six feet under. We must motivate ourselves, challenge ourselves and have a healthy, positive attitude each and every day. Life is so much fun that way."

TTCI

Beginning in the fall of 2013, Transportation Technology Center, Inc., and the Colorado State University-Pueblo (CSUP) partnered together to offer a new Master of Science degree in engineering with emphasis areas in mechatronics and railroad engineering.

TTCI says the objective of the Masters of Science Railroad Engineering (MSRE) program is to provide a well-educated workforce for the North American railway industry.

"The MSRE program offered by CSUP requires the completion of course work focused on track and structures engineering similar to that required by other such railroad engineering programs, but also requires courses covering vehicle/track interaction (railway vehicle dynamics), locomotives and railway power systems, as well as rail vehicle fleet management, which is unique among the railroad engineering programs being offered in North America," explained Robert Florum, vice president of engineering quality services at TTCI.

When designing the program at CSUP, TTCI did survey of the Association of American Railroads member railroads to find out the skills they wanted graduates from the program to possess and built the program around those recommendations.

"Like many industries in North America, the railway industry is beginning to experience the effects of the retirement of the baby boomers and that is creating a significant demand for graduates from railroad engineering programs," noted Florum. "We anticipate an increase in these types of programs around the country within the next few years to address this demand."

UNLV

"The ultimate objective of the University of Nevada, Las Vegas (UNLV) Railroad Engineering program is to become a world-renowned center for railroad education, research and conferences," explained Harry Teng, Ph.D., director of Freight Railroading, High Speed Passenger Rail and Transit. He is also associate professor, Department of Civil and Environmental Engineering and Construction with the Howard R. Hughes College of Engineering at UNLV.

UNLV offers a railroad engineering certificate program that consists of six courses: Introduction to Railroad Transportation, Railroad Engineering, Railroad Operations, Public Transportation, Freight Transportation and

High Speed Rail. Additionally, the school is working with Las Vegas Railway Express, Inc., which is developing high-speed passenger rail service from Las Vegas to Los Angeles utilizing existing freight railroad corridors.

"Our railroad engineering program is developing technologically-advanced course delivery methods that will allow industry professionals located anywhere in the world to enroll in our railroading classes," Teng said. "The students will be able to apply the credits earned towards the UNLV Railroad Engineering certificate program or to degree programs at other schools. In addition, UNLV welcomes proposals from railroads to partner with UNLV to develop specifically-tailored courses on topics of special interest for meeting the education and training needs of that particular railroad. The process has begun to construct state-of-the-art railroad engineering labs on the UNLV campus. The research that will be conducted in those new engineering labs will focus on freight railroad, high-speed passenger rail and transit issues."

UW

The University of Wisconsin – Madison Department of Engineering Professional Development (EPD) offers non-credit professional development and certificate programs serving the rail industry.

"Our mission is to provide training for the railroad industry ranging from Class 1 and Class 3 railroads, consultants and contractors, public agencies and transit authorities and suppliers," explained Dave Peterson, program director.

EPD has provided continuing education courses for the railroad industry for more than 20 years and it has expanded from one course on track maintenance to more than 10 courses per year on subjects such as track design, maintenance, bridges, project management, signaling, crossings, yards and operations.

"EPD has developed a comprehensive competency model for engineers and engineering specialists within the Division of Transportation System Development of a large state department of transportation," noted Peterson. "This model defined performance attributes across a myriad of job roles and functions, ranging from design and construction project management to operations and maintenance; similarly, the model addressed the performance characteristics and contributions of a variety of engineering sub disciplines, including pavement, traffic, environmental, electrical, industrial and materials engineers. Through a grant we are developing a similar model for the railroad industry nationally."

EPD is an affiliate member of NURail and also expects to work with other educational institutions in the United States to help serve both the educational and research needs of the industry.

Training Resources

The National Railway Construction and Maintenance Association (NRC) released its Safety Around Flash Butt Welding and Fall Protection in the Rail Industry DVDs during its annual conference in 2013 and will debut its two newest DVDs, Building a Turnout and Special Trackwork, as well as Handling CWR January 2014 during its conference. The association also offers Roadway Worker Protection training, free to all NRC members.