

OPPORTUNITIES

Railway Transportation (Engineering and Operations) Areas of Study

University of Kentucky



Rail uniquely
combines
speed and
energy
efficiency



*Plus
environmentally
Friendly



Introduction

Railway Engineering and Operations, a branch of civil engineering, has a 180-year history of employment opportunities for civil engineers to — plan, design, construct, maintain, manage and operate our nation's rail systems. From the 1830s through the mid-1900s the demand was strong; this was mostly due to the development of our basic rail system during the period when rail was essentially a monopoly and the dominant transportation mode throughout the United States.



During the early to mid-1900s, improvements in the highway system aided competition from the trucking industry; resulting in the erosion of much of the freight traffic. In addition, private automobiles and public airlines attracted most of the passenger business. Furthermore, the railway industry was burdened with excessive regulatory practices that resulted in difficulties in optimizing management practices to compete with other freight transportation modes.

Entrenchment actions were enacted by freight railroads to reduce passenger service deficits and duplications of resources during the 1950s, 1960s and 1970s. Deregulation in the 1970s and 1980s made it possible for the freight railroads to compete with the other transportation modes. Since then the nation's railways intercity freight business has grown to record levels and the capacity of the fixed infrastructure is being expanded to accommodate the increased tonnages and traffic. The intercity passenger business is growing steadily. Many cities are building and expanding rail transit, light rail, and commuter rail systems and it appears that this growth will continue. Currently medium distance high-speed intercity passenger routes are being planned for several high population corridors.

The energy efficiencies of rail transportation, the benefits to the environment (greening of America and reducing carbon footprint), and the desire to decrease highway congestion have influenced the continuing growth of rail freight systems and the projected renaissance of rail passenger systems in the U.S. These expansions are being supported by various public/private partnerships as the public realizes the desirability to achieve the benefits accruing from rail transportation.

This growth has increased the demand for Civil Engineers in the railway industry. Also, during the downsizing and retrenchment years—particularly from the 1960s through the 1980s—the railroad industry employed very few civil engineers. Thus, the demand is not only strong due to recent rail industry growth, but there is also a significant gap in middle-age engineering managers. This enhances the possibilities for rapid advancement in the industry for young engineering graduates.



Above: Reconstruction of the foundation for a railroad track

Areas of Employment

Three basic areas of activities are performed by civil engineers in the Railway Industry. The classic highly technical and most commonly known area is **Engineering Design and Construction**. This area mostly emphasizes new and expanded freight lines, intercity passenger lines, commuter lines and urban rail transit lines. In addition, since the freight lines are also expanding, and will continue to expand, engineers are needed for installing capacity improvement and other expansion projects along heavy volume corridors.

The second area is **Maintaining and Rehabilitating** freight and passenger/commuter/transit rail systems. This area plans and manages both the freight and passenger lines to make sure that track and other structures adequately support and accommodate the trains so that travel is safe and efficient. This requires both management and engineering skills.

Finally, **Operations and Management** challenges engineers to design and operate rail systems that efficiently, economically, and safely move our nation's intercity freight and passenger traffic, which significantly impacts the overall quality or life of our citizens. This requires high levels of expertise to effectively plan, execute, and manage railway operations.



Sources of Employment

Employment opportunities are available with a wide variety of companies, firms, and government entities. One generally views a civil engineer in the railway industry as employed directly by a railway company. This is and has been a major source over the years. However, this is only one of many possibilities.

Major (Class I) Freight Railroads—The United States freight rail system is presently composed of seven extremely large rail companies. These railroads account for the majority of the mileage and particularly the tonnage handled in this country. Each company employs a significant number of civil engineers in engineering, maintenance, management, and operations.

Regional and Short Line Railroads—These comprise hundreds of smaller railroads and their needs for civil engineering activities are similar, although at a reduced level, to those of the large Class I freight railroads. Normally a civil engineer will provide and supervise a wide range of activities with a smaller company, which many engineers prefer.

Commuter and Transit Systems—These passenger systems are normally operated by governmental agencies in urban areas. Many of these employ a significant number of in-house civil engineers to design, maintain, and operate the rail systems. Others may employ consultants for a portion of the civil engineering activities. These activities are quite complex in the congested urban areas requiring high levels of engineering expertise.

State and Federal Governmental Agencies—States are involved in rail activities, particularly highway/rail intersections and other common interests. Several states own significant mileages of branch lines. These are normally leased to operators, but require management and funding actions by the states.

The federal government and several states are involved with developing and managing safety programs and monitoring new research and development programs. Civil engineers provide significant input to these agencies. Amtrak, the intercity rail passenger operation, also employs civil engineers.

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Consulting Engineering Services—Most of the large Transportation and Civil Engineering consulting firms provide a wide range of engineering expertise to the rail industry. Many smaller firms cater exclusively to the rail

industry. The services are specialized and often unique which require the highest levels of engineering expertise. Many of the largest and most difficult engineering projects are performed by specialized consultants in cooperation with railway company engineers.

Construction Firms—The majority of new construction projects and substantial portion of the major rehabilitation/maintenance projects are performed for the railroad companies by construction contractors. In addition, practically all construction/rehabilitation/heavy maintenance of rail systems owned by governmental agencies are contracted to private contractors. Civil engineers are involved with many phases of the construction industry.

Materials and Equipment Suppliers—The rail industry consumes significant amounts of various types of materials which comprise the fixed facilities such as track, bridges, buildings, signal systems, locomotives, cars, etc. These are largely consumable and must be replaced periodically. Development of better materials for specific application is an ongoing engineering task. Various types of equipment are used for maintaining and operating the rail systems. Civil engineers are often involved with the research, development, and sales of new and improved materials and equipment.

Opportunities at the University of Kentucky



The Department of Civil Engineering is one of nine departments in the College of Engineering at the University of Kentucky. Currently 400 undergraduate and 100 graduate students are pursuing degrees in the various technical areas of civil engineering. The Civil Engineering Building is shared with the Kentucky Transportation Center, providing stimulating study and research atmospheres for both the students and faculty.

The Department has 19 faculty members, all of whom are actively engaged in teaching, research, and professional service. In addition, ten part-time adjunct faculty members, assist with instruction in the more than 60 courses that are taught each year.



Several classes addressing Railway Transportation are taught at the University. **CE 433**, “Railway Freight and Passenger Operations and Intermodal Transportation” is taught each fall semester. This course concentrates on the Operational aspects of the industry, and less on the Engineering aspects, with additional emphasis on the emerging Intermodal and Passenger Rail areas.

CE 533, “Railroad Facilities Design and Analysis” is taught each spring, and concentrates on the Fixed Infrastructure aspects of the industry, involving Construction, Maintenance, Structures, Geotechnical, Geometrics, Track, and Engineering Management.

CE 599, “Urban Mass Transit” introduces concepts and methodologies in the Operations and Planning of Urban Mass Transit systems. Topics include, urban passenger transportation modes, transit networks, service planning, system evaluations and transit demand analysis.

In addition, each semester a lecture on the Railway Industry is provided to the **CE 120** Freshman level “Introduction to Civil Engineering” class and the **CE 331** Junior level required “Transportation Engineering” class.

Research Opportunities

In addition to classes, research is available to undergraduate and graduate students pursuing Railway Engineering and/or Operations careers. During the past fifteen years **Research Support** has totaled nearly \$1 million and has provided funding for several projects involving over thirty graduate students and several undergraduate students.



Basic experimental and applied research projects have been performed with concentration on experimental research and analysis, involving on-track instrumentation and measurements. Over forty publications have emanated from the research studies.



The track structural design program KENTRACK is used internationally as a modern performance based rational design system. A significant amount of research effort is directly applicable to the emerging high-speed rail initiatives. The National Cooperative Rail Research Program was recently formed and the Federal Railroad Administration recently advertised a \$25 million Broad Agency High-Speed Rail Research program.

Our emphasis has been to provide civil engineering students the option of taking Elective Courses in the Railway Engineering and Operations areas and providing Support for Graduate Students wishing to concentrate their Research Efforts in the Railway area.

Railway Engineering and Operations is a sub-area of study in our broad Civil Engineering curriculum. Our course offerings serve as electives for students to use in fulfilling their civil engineering curriculum requirements. Approximately one-fourth of our undergraduate students and selected graduate students will take one or more Railway courses. The remaining courses are chosen from the geotechnical, materials, transportation, construction, structures, environmental, hydrological and other areas. The research projects generally involve one or more additional civil engineering specialties in concert with railway emphasis and application.

Additional Information:

For more information about Civil Engineering at the University of Kentucky go to: www.engr.uky.edu.



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