

An Interdisciplinary Educational Program in Rail Systems Engineering

Ye-Ee, Wu¹ and Zong-Ching Lin²

¹Dept. of Mechanical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, ROC, <http://www.ntust.edu.tw>

Tel:(+886) 2-27376451, Fax:(+886) 2-27376460, albertwu@mail.ntust.edu.tw

²Dean office, College of Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, ROC, <http://www.ntust.edu.tw>

Tel:(+886) 2-27376455, Fax:(+886) 2-27376429, zclin@mail.ntust.edu.tw

Abstract: In the 90' s, the government of ROC has inaugurated a large-scale construction plan on railroad systems to relieve the severe traffic delay and congestion occurred all around the western corridor of Taiwan. Such a plan requires vast multitudes of engineers with background of rail systems engineering. To meet this demand, a special project was launched by the government at 1977 to evaluate the amount and the qualification of engineering manpower required to accomplish this complicated plan. An outline of educational program at the college level was established from this project. Following this outline, an interdisciplinary, Certificate-based, educational program in Rail Systems Engineer was established in the College of Engineering at NTUST to support the railway competence of Taiwan. This educational program is made up of two sub-programs, "Electrical and Mechanical Systems for Railroad Engineering" and "Rail Track Engineering". Both graduate and undergraduate program are offered. The "Electrical and Mechanical Systems for Railroad Engineering" program is designed for students with background in electrical/mechanical engineering, while the "Rail Track Engineering" program is designed for student with background in civil/construction engineering. Three core courses are required for undergraduate students who wish to complete this educational program. They are: "Introduction to the Rail Systems", "Introduction to the Electrical and Mechanical Systems for Railway Systems", and "Rail Track Engineering". At the graduate level, two out of three core courses, "The Electrical and Mechanical Systems for Railway Systems", "Railway Vehicles", and "Power Supply System Control and Operation for Railway Systems", are required for students taking "Electrical and Mechanical Systems for Railroad Engineering" program. Two core courses, "Rail Track Mechanics" and "Structural Dynamics", are required for students taking "Rail Track Engineering" program.

Keywords: interdisciplinary, program, railroad, rail systems, track

1. Introduction

All around the world, the consequences of ever increasing automobile traffic had resulted in traffic congestion and severe environmental damage. Taiwan is of no exception. With the development of economy and the increasing population in Taiwan cities, the transport situation in the big cities is getting worse. The ever-growing attractiveness of the private car has even worsen this situation. Therefore, a long-term traffic planning for Taiwan is needed to reduce the traffic congestion and the environmental pollution of inner-urban transportation, as well as the general traffic situation of inter-city transportation. New traffic plans were drawn in the end of 80' s, the spirit of these transport plans was to minimize the private car traffic and to increase the usage of public transportation systems.

In the 90' s, the government of ROC has inaugurated a large-scale construction plan on railroad systems to relieve the severe traffic delay and congestion occurred all around the western corridor of Taiwan. In this plan, a high-speed railroad of 345 kilometers long, several metro-rapid transit systems and light-rail systems are planned for

construction, in addition to the modernization of existing railroad systems. Such a plan requires vast multitudes of engineers with background of rail systems engineering. To meet this demand the Ministry of Education, incorporated with the Ministry of Economic Affairs and the Ministry of Transportation and Communication had launched a project at 1997, administrated by National Taiwan University of Science and Technology (NTUST), to evaluate the amount and the qualification of engineering manpower required to accomplish this complicated plan. An outline of educational program at the college level was established from this project, and was sent to all universities and institutes in Taiwan to serve as a reference guideline.

Following this outline, an interdisciplinary educational program in Rail System Engineering was initiated by the College of Engineering at NTUST at Spring 1999, and was approved by the Ministry of Education at Summer 1999. The key objective of this educational program is to provide students having different engineering backgrounds with a broad understanding of engineering technology as applicable to railway systems.

2. Program Overview

The purpose of this interdisciplinary educational program in rail systems engineering is to provide talents for Taiwan railway industry to enhance their engineering competitiveness. This interdisciplinary educational program is designed to support the different businesses within the railway operating industry, the railway supply industry and the public bodies in charge of rail regulations.

The railway industry provides one of the most challenging environments for engineers and scientists, because of the scale of technologies being used. Modern rail systems rely on advanced engineering techniques for the design of structures (such as tunnels, viaducts, bridges, . etc.), and on the most modern electronic devices for the control and communication systems needs to perform safe and efficient operation (such as GPS, ATC, IGBT. etc.). Almost any aspect of engineering work and materials science can find its application in the rail systems, resulting in an exciting professional environment where engineers and managers have to handle projects and products in a totally holistic manner. Railway operations are also unique in the close link between the quality of service provided and the high level of expectation from the customer. Therefore, engineers working in the rail industry not only need to understand the rail technologies, should also be equipped to manage projects that include activities outside their immediate area of expertise.

The design and operation of today' s rail systems require far more than just technical knowledge and know-how. Engineers working in the railway industry must manage large teams, be able to make strong financial cases, and be aware of environmental and social issues. They must be familiar with all aspects of railway engineering and can communicate with all the groups participated in developing and running a rail transport system. In addition, they must use new technologies and system management approaches to meet crucial time and commercial constrains. When new expertise is introduced while existing expertise is to be maintained in the railway field. Only highly qualified engineers with a broad background can provide the vision and the leadership required to produce the integrated solution needed today.

To equip students with the fundamentals and some requisites for railroad engineers, a special educational program is needed to fulfill this purpose. A steering group, which consists of representatives from several engineering departments of NTUST, was formed to design an interdisciplinary educational program to support the railway competence of Taiwan. Following the reference guideline set by the early study, this educational program is a Certificate Program administrated by the college of Engineering. This program is made up of two technical-oriented sub-programs each representing one or more disciplines within the field of rail systems engineering. These two sub-programs are: "The Electrical and Mechanical Systems for Railroad Engineering" and "The Rail Track Engineering". Both graduate and undergraduate educational programs are offered, and are aimed at students with backgrounds in electrical, mechanical, and construction engineering.

"The Electrical and Mechanical Systems for Railroad Engineering" program is designed and coordinated for students with background in electrical/mechanical engineering. "The Rail Track Engineering" program is design and coordinated for students with background in civil/construction engineering.

Free-admission policy is adopted in this educational program to any students who is willing to make a career in railway industry. No formal application for admission is required. A certificate will be issued to students who have fulfills all the course requirement set by any one of the two sub-programs upon application. The qualification of each applicant will be examine and verified by a committee at the end of each semester.

3. Graduate Program

Graduate students of any engineering major can be admitted to this program. In order to receive a Certificate of this program, the student must fulfill the course requirement of a sub-program. In addition, at his/her last semester in school, an application form along with a copy of transcript must be submitted to the College of Engineering for qualification approval. Given below is the course requirement of the sub-programs.

3.1 The Electrical and Mechanical Systems for Railroad Engineering.

- (1) Core Courses: Students are required to undertake any two of the following courses.

The Electrical and Mechanical Systems for Railway Systems.

Railway Vehicles.

Power Supply System Control and Operation for Railway Systems.

- (2) Technical Electives: Students are required to undertake any two of the following courses.

Signaling and Operation Control Systems.

Environmental Control Systems for Station and Tunnel.

Electromagnetic Interference and Electromagnetic Compatibility.

Workshop Facilities.

Traction System and Bogies of Railway Vehicles.

Braking System.

3.2 The Rail Track Engineering

- (1) Core Courses: required by all the students.

Rail Track Mechanics.

Structural Dynamics.

- (2) Technical Electives: Students are required to undertake any two of the following courses.

Finite Element Method.

Financial Management.

Project Control.

System Simulation.

Business Policy and Decision-Making

Advanced Rail Track Engineering.

Environmental Control Systems for Station and Tunnel.

4. Undergraduate Program

Students of any engineering major can be admitted to this program. In order to receive a Certificate of this program, the student must fulfill the course requirement of a sub-program. Prior to his/her graduation, an application form along with a copy of transcript must be submitted to the College of Engineering for qualification approval. Given below is the course requirement of the sub-programs.

4.1 The Electrical and Mechanical Systems for Railroad Engineering.

- (1) Core Courses: required by all the students.

Introduction to the Electrical and Mechanical Systems for Railway Systems.

Introduction to the Rail Systems.

Rail Track Engineering.

Special Topics of Electrical and Mechanical Systems for Railway Systems.

- (2) Technical Electives: Students are required to undertake any three of the following courses

Dynamics.

Electromagnetic.

Power Electronics.

Mechanics of Materials.

4.2 The Rail Track Engineering

- (1) Core Courses: required by all the students.

Introduction to the Rail Systems.

Introduction to the Electrical and Mechanical Systems for Railway Systems.

Rail Track Engineering.

Construction Surveying.

Rail Track Engineering Lab.

Soil Mechanics()

- (2) Technical Electives: Students are required to undertake any two of the following courses, one of them must be offered by electrical or mechanical engineering department.

Structural Steel Design.

Project Management.

Foundation Engineering.

Design of Pre-stressed Concrete Bridge.

Reinforced Concrete ().

Rail Track Mechanics.

Applied Electronics.

Electric Machinery.

Automation.

Circuit Theory.

5. Summary

An interdisciplinary, Certificate-based, educational program in Rail Systems Engineer was established in the College of Engineering at NTUST to support the railway competence of Taiwan. This educational program is made up of two sub-programs, "Electrical and Mechanical Systems for Railroad Engineering" and "Rail Track Engineering". Both graduate and undergraduate program are offered. The "Electrical and Mechanical Systems for Railroad

Engineering” program is designed for students with background in electrical/mechanical engineering, while the “Rail Track Engineering” program is designed for student with background in civil/construction engineering.

Three core courses are required for undergraduate students who wish to complete this educational program. They are: “Introduction to the Rail Systems”, “Introduction to the Electrical and Mechanical Systems for Railway Systems”, and “Rail Track Engineering”. At the graduate level, two out of three core courses, “The Electrical and Mechanical Systems for Railway Systems”, “Railway Vehicles”, and “Power Supply System Control and Operation for Railway Systems”, are required for students taking “Electrical and Mechanical Systems for Railroad Engineering” program. Two core courses, “Rail Track Mechanics” and “Structural Dynamics”, are required for students taking “Rail Track Engineering” program.

6. Acknowledgement

The authors wish to thank the Ministry of Education for their support and approval of this educational program. Special thanks go to Prof. Nanming Chen and Prof. Ching-Hwang Wang at NTUST for their assistance in designing and planning of this educational program.