

Development of a Unique Highway-Safety Curriculum

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The Federal Highway Administration (FHWA) determined in early 1976 that no comprehensive and in-depth study program existed that would adequately address the highway-safety training needs of federal, state, and local transportation agencies. This paper discusses a contract undertaken between FHWA and Northwestern University to develop a program that would meet the immediate needs of transportation agencies for safety training and, beyond that, to develop training materials that could be used by educational institutions to increase the emphasis given to safety in their transportation curricula. Northwestern University developed an 11-week program aimed at providing concentrated graduate-level study in highway safety for engineers and safety managers who work in the area of highway safety and traffic engineering. The objectives of the program were to sensitize participants to their responsibilities for improving highway safety and to help them acquire knowledge of the latest technology available to effectively carry out their safety programs. This paper discusses the content of this unique program, the participants who have attended, the results of follow-up evaluations, the use being made of the materials by other schools, the plans for updating course materials, and the effectiveness of the program in meeting its intended objectives and at the same time helping to improve the working relationship between the educational community and FHWA.

In early 1976, the Federal Highway Administration (FHWA) determined that no comprehensive and in-depth study program existed that would adequately address the highway-safety training needs of federal, state, and local transportation agencies. Between 1972 and 1976, FHWA had awarded approximately 140 fellowships, each for one year of safety-related study. Follow-up evaluation indicated that these grants were successful in preparing recipients for increased responsibilities in the field of highway safety. However, the study programs that were being offered by most schools did not concentrate on highway safety and moreover many agencies were unwilling to let employees leave their jobs for a full year of study.

It seemed highly probable that the effectiveness of safety programs could be greatly enhanced if university study programs were oriented more directly toward highway safety and traffic engineering. However, efforts to persuade the schools to strengthen their safety programs met with only limited success. The schools could not devote the necessary faculty to developing and presenting safety courses. During this period, there was much national concern about making the highways safer.

On the basis of these circumstances, FHWA determined that the national safety program would be greatly strengthened by a concentrated comprehensive safety and traffic study program developed by a contract expressly to meet the training and educational needs of transportation agencies. Consequently, FHWA contracted with Northwestern University to develop such a program. Northwestern had an outstanding reputation in the field of highway safety and traffic engineering built on graduate programs offered by the Technological Institute as well as on popular one-week to three-week courses given regularly by the Traffic Institute. These two institutes, by working cooperatively, had demonstrated a unique ability to merge their separate resources to produce challenging high-level programs.

Three long-range objectives served as the basis for the initial contract:

1. To develop a comprehensive highway-safety curriculum for a course of approximately 12 weeks' duration,
2. To conduct two training sessions that would

be attended by about 20 employees of highway and transportation agencies who were charged with duties directly related to highway safety, and

3. To provide complete instructional and student materials to other educational institutions to assist them in increasing the emphasis given to safety in their transportation curricula.

The manner in which these objectives were accomplished is the framework for this paper.

CURRICULUM DEVELOPMENT

Various program lengths were discussed when the amount of subject material to be presented and the amount of time employees could be spared from their jobs were compared. It was agreed that a concentrated course 11-12 weeks long would be the most suitable option. With this in mind, FHWA asked Northwestern to develop a comprehensive highway-safety curriculum oriented principally toward highway safety and traffic operations and toward the highway-safety standards that pertained to and impinged on the highway and its environment. The curriculum was to support the national safety program administered by FHWA and was to be oriented particularly to the needs of state and local highway-safety programs. The curriculum was to emphasize at least these functional and topical areas as they apply to safety:

1. Planning (safety considerations of rural and urban planning);
2. Design [by using a publication of the American Association of State Highway and Transportation Officials (1)];
3. Operations (including traffic through work zones);
4. Traffic studies and statistics (theory and application to planning, design, and operation);
5. Data analysis;
6. Interdisciplinary study;
7. Administration, management, and legal considerations;
8. Human factors;
9. Research-and-development accomplishments;
10. Interaction between private and public transportation;
11. Hazard recognition; and
12. Areas emphasized by FHWA.

Northwestern was to develop a curriculum that was practical to carry out and at the same time heavily focused on highway safety through all phases of highway development and operations. Northwestern was responsible for identifying the most recent research-and-development studies and those concepts that were still evolving and for incorporating the most relevant materials into the program. Instructional guides and student notebooks were to be prepared that used available references, texts, and other materials. These were to include, as a minimum requirement, lesson plans that specified training objectives, lecture notes, references, visual aids, problems, and means of testing or evaluating student achievement.

The curriculum was to be aimed at an audience of engineers, planners, and safety managers that had had sufficient mathematics, science, and engineering

Table 1. Highway Safety and Traffic Study Program course participants.

Employer	Course Date				Total
	Jan.-March 1978	June-Aug. 1978	June-Aug. 1979	June-Aug. 1980	
Government agency					
Federal	7	4	7	-	18
State	9	7	7	8	31
City	1	6	3	2	12
County	-	3	-	-	3
University	-	-	2	-	2
Total	17	20	19	10	66

background to qualify them for admission to graduate study in civil, traffic, or transportation engineering. Consideration was also to be given so that certain professionals, who might not have qualified for graduate study, could enter the program. It was desirable (although not essential) that the program yield graduate credit for those participants who met Northwestern's graduate school admission requirements.

The comprehensive curriculum, entitled Highway Safety and Traffic Study Program, prepared by Northwestern represents the most extensive compilation of highway-safety training material known to exist. The program is divided into 34 modules (module 31 no longer exists as a separate unit):

1. Program Objectives and Framework;
2. Accident Phenomena--Epidemiological;
3. Systems Framework for Highway Safety;
4. Statistics;
5. Evaluation Methodology;
6. Accident Reconstruction;
7. Historical Overview of Accident Prevention and Severity Reduction;
8. Human, Vehicular, and Roadway Factors;
9. Traffic Characteristics and Studies;
10. Traffic Stream Flow and Capacity;
11. Intersection Performance and Capacity;
12. Uniform Traffic Control Devices;
13. Traffic Signals;
14. Traffic Operational Controls and Treatments for Safety;
15. Accident-Reducing Potential of Traffic Controls;
16. Freeway Surveillance and Incident Management for Safety;
17. Maintenance Management for Safety;
18. Traffic Management in Construction and Maintenance Zones;
19. Traffic Management of Land Development;
20. Basics of Geometric Design;
21. Geometric Design of Highway Facilities;
22. Design Techniques;
23. Special Techniques and Tools for Safe Highway Design;
24. Urban Transportation Planning;
25. Statewide Transportation Planning;
26. Police Traffic Management;
27. Laws and Legal Considerations;
28. Motor Vehicle Administration;
29. Education and Other Programs;
30. Accident Information Systems;
32. Identification and Treatment of High-Hazard Locations;
33. Evaluation Systems in Highway Safety;
34. Management of Highway-Safety Programs; and
35. Highway-Safety Issues and Practices.

Nearly all the modules are designed to include a combination of lecture and laboratory sessions, which may be supplemented by problem sessions, guest lectures, and field trips. Because of the concen-

trated nature of the course, it was anticipated that a great deal of independent reading and study would be required outside of class.

An important aspect of the program as designed by Northwestern was the opportunity for participants to study independently and to prepare a paper on a current highway-safety issue relevant to their interests and to those of the other course participants. Although this paper was not intended to be a thesis, it was anticipated that the participants would devote about 60 h to researching the topic and preparing the paper.

TRAINING SESSIONS

A total of four presentations of the 11-week Highway Safety and Traffic Study Program was conducted by Northwestern--two under the original contract and two more through contract modifications. Table 1 shows the number of participants who attended each session by type of employer.

All participants admitted to the program were supported by educational grants from FHWA. Participants who received grants were selected on the basis of their potential to contribute to their employer's highway-safety programs, their relevant experience, and their academic and professional achievements.

All applicants were also screened by Northwestern to determine whether their academic background would qualify them for admission to the program and whether they would be eligible to receive graduate credit. Approximately 38 percent of those who attended did receive graduate credit, which was equivalent to four courses or one-third of the credits required for a master's degree. Grant amounts for all sessions covered tuition, fees, and study materials and included a living stipend. For the first session the maximum stipend was \$1500; thereafter the maximum was raised to \$3500 for those participants who were not receiving salary support from their employers.

Before being admitted to the program, all participants were required to sign an agreement to work in public service for a specified length of time on completion of their training. Participants were also required to agree to respond to brief questionnaires designed to assist in program evaluation during the study period and for three years after.

So far, the first annual follow-up evaluations have been received from participants who attended both the first and second sessions of the course. A review of these evaluations indicates overwhelming support of the program by the students and placement of very high value on the benefits of knowledge gained during the course. Approximately 70 percent of the participants are now in positions that include heavy responsibility for programs related to highway safety. An additional 20 percent, although not directly responsible for highway-safety programs, are in positions in which safety factors must be considered on a routine basis.

One important benefit of the course is the increased sensitivity participants now feel toward their highway-safety responsibilities. Nearly 85 percent of the participants indicated significant shifts in their attitudes and many have a much stronger desire to improve the safety of highways beyond the minimum standards.

DISSEMINATION OF CURRICULUM MATERIALS

FHWA administers the College Curriculum Program through which educational materials developed for FHWA-sponsored training courses are made available for inclusion in the curricula of technical institutes, colleges, and universities. On request, complete sets of student and instructional materials are provided to schools at no charge. The intent is that schools that offer transportation-related curricula will adapt much of this latest state-of-the-art material to their own programs and thereby enhance their course offerings.

The third and longest-range objective of the Highway Safety and Traffic Study Program was to compile all student notes and instructor materials (including lesson plans, instructor and student objectives, laboratory problems, and all visual aids) used by Northwestern to conduct the course. Copies of these materials were then to be made available through the College Curriculum Program and thus the materials would be obtained by a large number of college faculty at a nominal cost. The success of this activity has greatly exceeded the initial expectations.

In January 1979, a special briefing was held in conjunction with the Annual Meeting of the Transportation Research Board to acquaint college faculty with the program and to let them know that materials from the course would be made available to them at a later date. In January 1980, a special bulletin was prepared to advise faculty that sets of materials that contained approximately 3500 pages of text and 920 35-mm slides were ready for distribution. Since that time, 61 complete sets of the materials and 91 partial sets have been sent out. The distribution of these materials is as follows:

Recipient	Number of Sets	
	Complete	Partial
U.S. college	51	9
Foreign college	3	2
State highway agency	1	1
Military installation	--	1
City	2	--
County	1	6
Regional planning commission	1	--
Consulting engineer	1	5
Course participant	--	66
Private individual	--	1
Total	60	91

There was some concern that it might take several months for professors who were working independently to review all the material developed by Northwestern and to incorporate the relevant subject matter into the curricula of their own schools. In order to shorten this time as much as possible, a 3-week College Faculty Overview Session was conducted with the regular 11-week session during the summer of 1980. Faculty who represented 19 schools were selected to attend the special session and each received a \$1000 grant from FHWA to cover their living expenses while they were at Northwestern.

In addition to becoming thoroughly familiar with the course materials, the faculty members who attended the session were asked to participate on various panels to discuss ways in which the safety materials could be used in (a) extension and/or in-service training programs, (b) existing transportation and highway engineering courses, and (c) creation of graduate and undergraduate safety courses.

Another panel discussed the need for keeping the course materials up to date and ways in which this could best be accomplished. The material prepared by Northwestern represents a significant investment in time and resources and it is important that the investment be protected for as long as is practical. The potential value is great but it will be considerably diminished as technology changes. Much of the material was originally compiled between 1976 and 1978 and since the state of the art of safety is changing rapidly, some of the material needs to be revised. The modular fashion in which the course material has been assembled lends itself to an efficient updating process. At this time the recommendations of the faculty panel, along with several other alternatives, are being considered.

Initial feedback has indicated that most of the schools that received course materials plan to update and expand their existing course offerings at both the graduate and the undergraduate levels and at the same time to substantially increase the emphasis on highway safety. Several schools also plan to develop short courses by using this new material as the nucleus.

Although the primary objective of the special three-week session was to assist the faculty members in becoming familiar with the course materials, other important benefits will most certainly also be derived. Many of those who attended the session were leaders in the highway-safety research field as well as in the teaching field. This session provided an excellent opportunity for them to get together and exchange ideas with others who shared common interests and to become familiar with related work being performed that may have an impact on their own teaching and research activities. It was also anticipated that, by conducting this special session, the working relationship between FHWA and the educational community would be greatly enhanced.

CONCLUSIONS

The total cost of this project to FHWA from 1976 to 1980 was approximately as shown below:

Category	Cost (\$)
Curriculum development, presentation of four 11-week sessions and one three-week session, and tuition, fees, and study materials	448 000
Living stipend grants for 66 eleven-week participants and 20 three-week participants	166 096
Duplication of materials for distribution through the College Curriculum Program	24 400
	<u>638 496</u>

The total cost to the government and to the taxpayers seems quite large at first glance. However, its significance is greatly reduced if we look at the potential savings possible through improved highway-safety programs.

Sixty-six students have attended the full 11-week sessions of the Highway Safety and Traffic Study Program and, as shown earlier in this paper, a high percentage have returned to assume responsible safety-related positions with their employers. To

that we must add the immeasurable but still predictable benefits of the three-week College Faculty Overview Session and of providing sets of the instructional materials to schools and other agencies through the College Curriculum Program. If we assume that each of the 60 schools now in possession of the course materials trains only 10 students, another 600 users will have been reached. It is expected that planned follow-up evaluations will yield a much higher total.

When this information is in the hands of such a large audience of potential users, it is expected that numerous improvements will be made in the safety of existing and planned highways throughout the nation. Since the attitude that seems to prevail now in this country is to "sue for all you can get" if involved in any sort of an accident, it is not uncommon for single highway-related accident settlements to exceed \$1 million. If only one such accident and subsequent lawsuit against a public agency can be prevented, the taxpaying public will have been well compensated for the expense of this project.

ACKNOWLEDGMENT

Success of any project of this magnitude must by necessity be attributed to the ideas and dedicated efforts of many individuals. I served as contract manager for FHWA during the final year of the project and would like to express my appreciation to all who have contributed so generously, especially

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REFERENCE

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Railroad Engineering Education at the Undergraduate Level

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At one time, courses in railroad engineering could be found in almost any civil engineering curriculum. Today, the opposite is true. As a result of the decrease in recruiting by the railroads during the 1950s and 1960s, emphasis in engineering education shifted away from railroads to other specialties. Because of the current growing interest in revitalizing the U.S. railway system, a few universities have begun to offer railroad engineering courses. During the decade of the 1980s, it is estimated that one-half of the railroad industry's current workforce and about two-thirds of top and middle management personnel will retire. The need for replacement personnel coupled with the increasing sophistication of railroad engineering activities has led to a growing need for highly trained engineers. To be most productive these engineers should have some education related specifically to railroads. Bucknell University has responded to this need by developing two courses and other educational activities oriented toward the railroads. The railroad education program at Bucknell has four objectives: (a) to stimulate student interest in the railroad industry, (b) to improve the student's understanding of the railroad industry and dispel common misconceptions, (c) to teach the fundamentals of railroad engineering, and (d) to discuss new concepts in railroad engineering and management. So far, response to the program from both the students and the railroad industry has been good. The university plans to continue improving the program as resources permit.

At one time, courses in railroad engineering could be found in almost any civil engineering curriculum in this country. Today, the opposite is true. In the 1950s and 1960s there was a decrease in recruiting on college campuses by the railroads; the result was that the emphasis in engineering education

shifted from railroads to other specialties. With the exception of a few isolated courses and programs, the colleges and universities in the United States are no longer preparing engineering graduates specifically for entry into the railroad industry. This trend is in marked contrast, for example, to the 53 accredited undergraduate programs in aeronautical or aerospace engineering that were documented in the 47th Annual Report of the Engineer's Council for Professional Development (Sept. 30, 1979).

As the emphasis in engineering education shifted away from railroads to other specialties, the normal basis for the continuing evolution of courses and programs disappeared. Faculty interest shifted; courses were discontinued; no new textbooks were written. In the 1960s and early 1970s, the educational community was virtually isolated from the railroad industry.

With the current growing interest in revitalizing the U.S. railway system, a few universities have started to offer courses and conduct research in railroad-related areas. Although some progress has been made, it is difficult and expensive. As a result of the almost complete break in continuity of faculty and course development, the colleges and universities face a most difficult challenge.