

Training Programs for Construction and Maintenance Employees of the Illinois Division of Highways

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•THE "good roads" concept has been with us for four generations. Its goal was an all-weather road between every town, village and city. Highway construction organizations began near the turn of the century and have since developed at all governmental levels. Over the years, we have seen constant change and expansion.

Following World War II, the entire national economy began to expand at an ever-quicken pace. Competition for tax revenue and manpower became a new and real problem. Technological advancements were showing more sophistication, thus increasing the need for skilled, well-trained personnel. While the need for competence increased, greater numbers were not finishing their education. Thus, in an era with more jobs for the skilled, there were fewer skilled people available. Simply stated, muscles were and are yet becoming more and more unemployable. Those having skills are much better trained today than in the past and have many more opportunities. Competition for their services has produced higher and higher salaries.

Both the highway industry and the auto manufacturers have bettered their products, making it easier to move about. World War II taught millions of Americans that the world away from their home communities was not such an awesome place. Working forces today are less likely to endure personal discomforts, real or imagined, in one job when their skills are marketable elsewhere. All industries are experiencing higher turnover rates. During the first five months of 1968, the Illinois Division of Highways employed 102 college graduates and lost 101 others who had been employed.

The conditions making it necessary to train employees are not unique to our organization. They apparently exist in all private and public sectors. You must train your personnel to efficiently accomplish your responsibilities or find, in the case of a governmental agency, that there are not enough available tax dollars or, in the case of private industry, you are not competitive.

The advent of the Interstate Highway System forced a decision to recruit and train technical personnel although our chief maintenance engineer had been exploring the need for formally training maintenance field forces since 1948.

In 1956, our technical staff numbered approximately 1,700. Most were civil engineers. Many more were needed to construct the 1,640 miles of Interstate Highway allotted to the State of Illinois for construction in 15 years and, at the same time, continue to improve and maintain our 15,000-mile Primary System.

TECHNICIAN TRAINING

Immediately following the signing of the act creating the National System of Interstate and Defense Highways, plans were formulated to recruit 1957 high school graduates who did not intend entering college that fall. The recruits were, first, to have already completed high school Algebra and Plane Geometry. Second, they were required to pass an aptitude test administered by the University of Illinois. This was a standard test consisting of four parts: School and College Ability Tests (SCAT); Scat Verbal and Scat

TABLE 1
RETENTION OF TECHNICIAN TRAINEES

Year	No. in Class	No. Still Employed	Percent Still Employed	Percent Receiving Additional Education	Percent Obtaining Degrees
1957	183	85	46.5	36.4	9.4
1958	133	50	37.6	42	14
1961	136	49	36	53	8.1
1962	139	70	50.4	41.5	5.7
1963	177	92	52	43.5	0
1964	168	104	62	30.4	0
1965	162	132	81.5	14.4	0
1966	168	136	81	19.1	0
1967	227	209	92	1.9	0
1968	172	164	95.3	0	0

Quantitative Sections; Mathematics; and Mechanical Comprehension. After a personal interview, those found acceptable were signed to a one-year contract ensuring that they would stay in our employ for one year following their training.

A special 11-week course was developed in cooperation with the University of Illinois for the 200 trainees recruited. The course, which was specifically tailored to our needs, consisted of College Algebra, Trigonometry, Surveying, Highway Drafting and Highway Materials Inspection. Thirty-three class hours per week were scheduled between 8:00 a. m. and 5:00 p. m., Monday through Fri-

day. Required, monitored study hall was conducted on the first four nights of each week from 7:00 to 10:00 p. m.

The first class produced 183 graduates, of which 85 remain in our employ. Of those 85, 36 percent have obtained additional college-level education and 9 percent have obtained degrees. The course has been continued each year except for 1959 and 1960. Totally, there have been 1,668 graduates, of which 62 percent are still in our employ. Those presently on military leave will bring the number retained to 74 percent when they return. Table 1 gives a year-by-year retention score and the percentage of those obtaining additional education. These men are considered permanent employees. They are given an educational leave when they enter college and are welcomed back each summer to assist during the construction season. Upon graduation, each is reclassified to a technical title and his salary adjusted accordingly.

Presently, technician trainees are paid \$350 per month while enrolled in the course. Their tuition is paid but they must buy their own books and supplies and pay for room and board in regular University housing facilities. Upon completion of the course, salaries are adjusted to \$375 or \$400 per month, depending on scholastic record. The trainees are then integrated into district construction activities.

SPECIFIC TASK CONSTRUCTION TRAINING

Several years ago, in-depth inspections, in cooperation with the Bureau of Public Roads, revealed the need for corrective action in many minor facets of construction inspection. It had always been the responsibility of the resident engineer on each project to ensure that inspectors had a basic knowledge of specification requirements for the particular task being inspected. In years past, this approach proved satisfactory, but the large turnover today in engineering technician classifications makes training an almost impossible task for the resident engineer. Such things as specification requirements, proper testing methods, and record-keeping are considered so fundamental that many older resident engineers may not look upon them as important. But, these are the very kinds of things that appear as problems during in-depth inspections. Most of the problems were found to be simple errors or omissions, each of little consequence by itself. However, it became apparent that the same error or omission occurred over and over again when the inspection task was performed by the same individual. A lack of training appeared then to be the root of our problem.

In light of these findings, the decision was made to train our technicians to perform the specific tasks involved in each construction inspection area. Thus was formulated our Illinois Program for Specific Task Training. As the name implies, classes are set up that in one day will teach an employee to perform the tests required in a specific construction operation. Among others, our program provides training in such items as bituminous concrete lay down, portland cement concrete paving, pipe culvert installation, earth density determination, and concrete testing.

TABLE 2
SPECIFIC TASK CONSTRUCTION TRAINING
LIST OF COURSES

Portland Cement Concrete Paving Field Inspection
I-11 Bituminous Concrete Field Inspection
Pipe Culvert Installation
Earth Density Determination
Portland Cement Concrete Testing
Portland Cement Concrete Proportioning and Testing
Bituminous Concrete Proportioning
Earth Excavation and Embankment
Stabilized Subbase and Shoulders (BAM)
Concrete Structures (Including Bridge Decks)
Erosion Control
Piling
Pavement Patching
Storm Sewer
Documentation

If one of our district engineers needs an inspector for portland cement paving and finds he does not have an experienced man available, he can send a technician to our classroom in Springfield where in one day he can be taught the basics necessary to perform this specific inspection task.

A program of this type is particularly of value in summer when many temporary inspectors are employed to meet our construction needs. The majority of our temporary employees are undergraduate college engineering students. It would not be economical to give them a long period of training. Each student can be trained in one specific task and then kept at that task all summer. The greatest booster of this program is the resident engineer. He is now relieved of the former on-the-job training he provided in the field. Also eliminated is the possibility that little or no instruction will be given because the resident

engineer is too busy or does not have the ability to convey properly the necessary information.

The first of the specific task classes was held in late April 1966. Classes are limited to 30 students and are provided three days each week, three weeks out of every month. The instructors use the intervening time to update their class outlines, keeping them current with changes in specifications, material changes, and construction methods. Examinations are given at the close of each class.

A list of the classes being periodically taught is given in Table 2. Most of these classes are of one-day duration, but a few are comprehensive enough to require two or three days. Currently under development are a series of classes that will teach our project and resident engineers the "why" of construction inspection. Present classes teach the "how." It is felt that if everyone understands the reasoning behind specifications, compliance will be easier to obtain. In the 2½ years the program has been running, 4,700 men have received 40,000 man-hours of training. The result has been better construction, fewer citations, and an overall saving of money both for our contractors and the people of the State of Illinois.

MAINTENANCE TRAINING

During 1961, an administrative change in the state required the employment of an entirely new force to handle our maintenance and traffic field activities. It became quite obvious that methods formerly employed at this time for instructing new employees in their duties were far from ideal. Our maintenance organization began planning a formal training program that could be put into play at the outset of any subsequent wholesale personnel change. Although the new force had been working approximately three years by the time the training program was fully developed, it was felt a gain could be made by giving the program to those existing employees. This was done, first, for the sake of evaluating it; second, to give the maintenance field engineers experience in teaching; and, finally, to cover the possibility that some of the men might become acquainted with a point or two that had been overlooked in earlier training.

While we were preparing the maintenance training program, which consists of 2,000 thirty-five millimeter slides set in a sequential pattern and a syllabus explaining each of the slides, the maintenance field engineers were given basic management training and a course in teaching methods and principles. These two courses proved to be very helpful to the men when they began their periods of instruction. Presently, we are developing a series of classes for maintenance personnel like our specific task construction programs. These will, by sound moving picture or slides with recorded tape, show how specific maintenance tasks are accomplished.

Our maintenance field forces number approximately 4,300. All of them have been given the series of training courses that show the work in which they will be involved each season of the year and the duties that are required of them in many recurring situations. We feel that this program has greatly benefitted the existing force. Currently, we are involved with a change of administration, which hopefully may not again result in a complete change of our field forces.

MANAGEMENT TRAINING

Increased construction costs and manpower turnover dictated that we make sure our management processes were functioning in an optimum manner. Our organization, headed almost entirely by men with educations in engineering, had been exposed to little in the way of management training.

In 1958, the Division began a series of management seminars. Three-day seminars were held at locations remote from the University of Illinois campus. Instruction was given by University professors. Our district engineers and central bureau chiefs were in the initial class with other management levels following. Appendix A is a copy of the program for that first seminar. Due to promotions and retirements, it was not until 1965 that all of our administrative people completed the initial three-day course.

That same year, a second-level course was initiated. It was designed to give both depth and breadth to the material taught in the first course. To date, more than 400 people have received these two courses. A copy of the program from the second-level management series is included as Appendix B. Introduction to management as a profession has prompted many of our engineers to begin formal study in the area.

During 1967, a third-level course was begun to which only the district engineers, bureau chiefs and their assistants were invited. This course was designed to give these men a better perspective of their roll in the national and international frame. We are continuing this course at the same management level with the introduction of new subjects each year. Appendix C is a copy of the program presented in 1967.

SAFETY TRAINING

Though many formal programs are devoted entirely to personal and vehicular safety, training in safety is made an integral part of all instruction. Our central bureau and district safety representatives are given time during construction, design and materials seminars each year to emphasize the hazards incident to the many operations. The Defensive Driving Course developed by the National Safety Council has been revised to include our own accident records, statistics, and material unique to highway department operation such as snow removal and ice control, slow-moving maintenance operations and "backing accidents." Fifty-one men have been trained as instructors. To date, they have given "defensive driving" to 8,000 of our 9,000 employees.

EMERGENCY PLANNING

Recognizing that our statewide network of highways gave the Division a more complete coverage of the state than other organizations and that we had an obligation to keep the system as entirely open as possible in an emergency, it was natural that we prepare for the eventuality of natural disaster or nuclear attack.

Presently, in each of our districts and in our central bureaus, we have at least two radiological monitoring instructors and one radiological defense officer. These men have given 7½ hours of instruction to more than 2,300 men in radiological monitoring. A refresher course has been given to approximately 2,000.

The pilots of our aerial survey plane and our helicopter and two photographers have been trained in aerial radiological monitoring. Included in this training were five pilots of state-owned aircraft from other Departments.

STAFF DEVELOPMENT

Full-time employees wishing to take advantage of college-level courses, either related to their employment or leading to a degree, may do so and receive a limited

reimbursement of their tuition. Participation in advanced educational programs is encouraged as a part of career development. We look to those willing to spend their time in study as potential management staff. Beginning this past fall, a team of instructors was sent to the districts to begin the orientation of young graduates in management concepts. Advanced programs will be fielded each year so that by the time these men become well groomed in highway work, we will have discovered which are qualified for advancement.

CONCLUSION

Training is a basic need in both organization planning and staffing. These are ever-changing areas; therefore, continual training is necessary to ensure future staff and administration. Coupled with that need is the additional training required to keep current with changing practices and to properly orient new employees. It is our goal to provide the needed training to employees. We have come a long way toward reaching this goal, but there are many areas that have not as yet been touched. Future efforts in training will cover highway planning, design, and traffic safety. In crossing the threshold into these new areas, we will be feeling our way. Many computer applications yet untried will doubtlessly evolve.

The Illinois Division of Highways operates through 10 widely separated district offices. In past years, there was not much opportunity for an interchange of ideas between district personnel. An additional benefit derived from our training programs is that personnel, statewide, now are acquainted and have become vastly more aware of their rolls as members of the family. By getting together, they have found that many of their personal problems are, in reality, general problems.

Our further goal of inducing competency in administration and efficiency in operation is certain to be met.

Appendix A

ILLINOIS DIVISION OF HIGHWAYS

MANAGEMENT CONFERENCE

ROBERT ALLERTON PARK, NOVEMBER 16-19, 1958

PROGRAM:

Sunday, November 16, 1958

5:30 p.m. Registration

6:00 p.m. Buffet Supper

7:00 p.m. Introductory Remarks:
R. R. Bartelsmeyer, Chief Highway Engineer

Keynote Address: "Movement to Management"
Dr. Robert G. Seymour, Director, Executive Development
Center, University of Illinois

Monday, November 17, 1958

7:45 a.m. Breakfast

8:30-10:00 a.m. The Job of Management: An overall look at the basic functions of the administrative process and how these functions apply to highway management.
Irvin L. Heckmann, Jr., Associate Professor of Management, University of Illinois

Reading Assignments:

"An introduction to Management Theory," Manual, p. 5.
 "The Basic Functions of the Administrator," Manual, p. 21.
 "Skills of an Effective Administrator," Manual, pp. 21-27.
 Newman: "Administration - A Basic Social Technique,"
 pp. 1-9.
 Drucker: "The Role of Management," pp. 3-17.

10:00-10:15 a.m.

Coffee Break

10:15-11:15 a.m.

Management by Objectives: Setting Goals and Objectives
 for Highway Management. Irvin L. Heckmann, Jr.

Reading Assignment:

"Essential Steps in the Organizing Process," Manual, p. 68.

11:15-12:00 n.

Workshop Session: "Putting the Goals of Your Department
 Into Writing." Irvin L. Heckmann, Jr.

12:00-1:00 p.m.

Lunch

1:00-2:00 p.m.

The Role of the Administrator in the Administrative
 Process. Paul M. Dauten, Jr., Professor of Management,
 University of Illinois

Reading Assignment:

Manual, Chapter II, pp. 6-20 - Plus reading assignments
 at the end of this chapter

2:00-3:00 p.m.

Delegating Responsibility and Authority: Emphasis Put
 on the Effective Utilization of your Personnel.
 Paul M. Dauten, Jr.

Reading Assignment:

"Good Management Men Delegate Authority," Manual, pp.
 40-43 - Plus reading assignments on p. 45 of Manual

3:00-3:15 p.m.

Coffee Break

3:15-4:30 p.m.

Case Discussion and/or Role Playing
 Anduluska State Highway Department, Manual, p. 49.
 The Sherman and Haverliff Company, Manual, p. 44.

5:30 p.m.

Dinner

Tuesday, November 18, 1958

7:45 a.m.

Breakfast

8:30-9:30 a.m.

Leadership and the Human Factors in Management: Main
 Emphasis Supervision and Motivation of Personnel.
 Wayne A. Lemburg, Instructor in Business Management,
 University of Illinois

Reading Assignment:

"On Leadership," Manual, p. 30.
 "Three Ways to Lead - and When to Use Them," Manual, p. 31.
 "Problem in Leadership," Manual, p. 32.
 "What Makes People do the Things They do," Manual, p. 70.

9:30-10:30 a.m.

Informal Organization:
 W. A. Lemburg

Reading Assignment:

p. 88.

10:30-10:45 a.m. Coffee Break

10:45-12:00 n. Case Discussion and/or Role Playing: The Calhoun Company -
The South Batavia Highway Department. Wayne A. Lemburg

12:00-1:00 p.m. Lunch

1:00-2:00 p.m. Communications (Both Upward and Downward). Joseph
Litterer, Instructor in Management, University of
Illinois

2:00-3:00 p.m. Case Discussion and/or Role Playing. Bob Knowlton
Case. Joseph Litterer

3:00-3:15 p.m. Coffee Break

3:15-4:30 p.m. Counseling and Case Discussion:
Joseph Litterer

5:30 p.m. Dinner

7:15-8:30 p.m. Personnel Selection, Placement and Evaluation:
Irvin L. Heckmann, Jr.

Wednesday, November 19, 1958

7:45 a.m. Breakfast

8:30-9:30 a.m. Controlling the Administrative Process:
Paul M. Dauten, Jr., Professor of Management, University
of Illinois

9:30-10:30 a.m. Appraisal and Evaluation of Your Activities:
Paul M. Dauten, Jr.

10:30-10:45 a.m. Coffee Break

10:45-12:00 n. The Art of Being a "Top-Notch" Administrator:
Paul M. Dauten, Jr.

12:00-1:00 p.m. Lunch

1:00-2:00 p.m. Training and Developing Your Personnel:
Irvin L. Heckmann, Jr., Associate Professor of Manage-
ment, University of Illinois

2:00-3:00 p.m. Problems Seminar: All Instructors Present for Discussion
of Problems Closely Aligned With Bureau Chiefs' and Dis-
trict Engineers' Duties

Appendix B

ILLINOIS DIVISION OF HIGHWAYS

MANAGEMENT CONFERENCE - "B" COURSE

HOTT MEMORIAL CENTER - MAY 16-19, 1965

PROGRAM:

General Chairman: Richard C. Tussing

Sunday, May 16, 1965

5:00 p.m.	Registration
6:00 p.m.	Buffet
7:00 p.m.	Welcome and Introductions: Richard C. Tussing, Bureau of Business Management, University of Illinois
7:30 p.m.	Orientation: Roger Nusbaum, Assistant Chief Highway Engineer, Illinois Division of Highways
7:45 p.m.	THE JOB OF THE MANAGER - REVISITED A Brief Review of the Functions of the Manager Irwin Cochrun, Director, Bureau of Business Management, University of Illinois

Monday, May 17, 1965

7:45 a.m.	Breakfast
8:30 a.m.	THE NATURE OF CONTROL AND COORDINATION An Analysis of the Necessary Conditions for Effective Organizational Control Joseph A. Litterer, Associate Professor, Graduate School of Business Administration, University of Illinois
10:00 a.m.	Coffee Break
10:15 a.m.	THE APPLICATION - CONTROL A Case Study Joseph A. Litterer
12:00 n.	Luncheon
1:00 p.m.	METHODS AND PROCEDURES IN HIGHWAY NEEDS STUDY An Inquiry Into the Nature of Highway Needs Studies and Their Usefulness in Highway Planning Reed Winslow, Wilbur Smith and Associates
3:00 p.m.	Coffee Break
3:15 p.m.	CASE PREPARATION Small Group Study and Discussion of a Major Case Richard C. Tussing
6:00 p.m.	Dinner
7:00 p.m.	CREATIVITY IN PROBLEM SOLVING New and Improved Ideas Do Not Come From Old Thought Patterns W. H. Higginbotham, Consultant to Management, Clayton, Missouri

Tuesday, May 18, 1965

7:45 a.m.	Breakfast
8:30 a.m.	TOOLS OF PLANNING, I - DISCRIMINATE ANALYSIS A New Statistical Approach to Making Planning Decisions George W. Summers, Associate Professor, Graduate School of Business Administration, University of Illinois
10:00 a.m.	Coffee Break
10:15 a.m.	TOOLS OF PLANNING, II - SPECIFIC PLANNING AND CONTROL DEVICES An Evaluation of Load Charts, Progress Charts, Time and Motion Studies, and Other Tools Used to Increase Scheduling Efficiency L. J. Rago, Associate Professor, Department of Industrial Administration, University of Illinois
12:00 n.	Luncheon
1:00 p.m.	PRE-PLANNING New Dimensions in Management - Planning for Whom - Evaluating Alternative Courses of Action Paul Dauten, Professor, Department of Industrial Administration, University of Illinois
3:00 p.m.	Coffee Break
3:15 p.m.	PROBLEM STRUCTURING AND ANALYSIS The Nature of Planning - What it Means to Analyze - Policy Formulation - Relationship of Planning to Human Relations and Personal Growth Paul Dauten
6:00 p.m.	Dinner
7:00 p.m.	THE APPLICATION - COORDINATION A Discussion of the Case Studied in Small Groups on Monday Joseph A. Litterer

Wednesday, May 19, 1965

7:45 a.m.	Breakfast
8:30 a.m.	LINEAR PROGRAMMING A Brief Review of Relevant Mathematical Tools - Problem Illustrations - Practice Session for Participants Paul Dauten
10:00 a.m.	Coffee Break
10:15 a.m.	MANAGEMENT - A SYNTHESIS A Discussion of the Integrated Approach to Management and the Qualities of the Successful Executive Paul Dauten
11:45 a.m.	Conference Evaluation
12:00 n.	Luncheon

Appendix C

ILLINOIS DIVISION OF HIGHWAYS

ADVANCED MANAGEMENT DEVELOPMENT SEMINAR

HOTT MEMORIAL CENTER - DECEMBER 10-13, 1967

PROGRAM:

Seminar Chairman: Joe Weisenberg

Sunday, December 10, 1967

5:00 p.m.	Registration
6:00 p.m.	Buffet Supper
7:00-8:00 p.m.	<p>Introductions and Orientation:</p> <p>For the University of Illinois: Irwin Cochrun, Director Bureau of Business Management</p> <p>For the Illinois Division of Highways: Virden E. Staff Chief Highway Engineer</p>

Monday, December 11, 1967

7:45 a.m.	Breakfast
8:30-10:00 a.m.	<p>NATIONAL ECONOMIC GOALS AND POLICIES</p> <p>A Picture of the Economic Environment Within Which Decisions Must be Made Today and in the Near Future. Carl T. Arlt, The Bailey Professor of Money, Banking, and Finance</p>
10:00-10:30 a.m.	Coffee Break
10:30-12:00 n.	<p>LEADERSHIP RESEARCH</p> <p>A Review of Current Thinking About Advanced Means and Methods of Leadership and Motivation Which are in Use or are Being Developed Today. Kendrith M. Rowland, Assistant Dean, College of Commerce and Business Administration</p>
12:00 n.	Lunch
1:00-2:30 p.m.	<p>HIGHWAY TRANSPORTATION AND REGIONAL DEVELOPMENT</p> <p>A Discussion of the Impact of Highway Transportation on Spatial Distribution of Industry and Population and of Ways in Which Highway Planning Interacts With Other State and Local Problems. Hugh O. Nourse, Professor of Economics</p>
2:30-3:00 p.m.	Coffee Break
3:00-4:30 p.m.	<p>TAXATION POLICIES</p> <p>A Discussion of the Major Problems of Public Finance With Special Reference to Current Problems of Financing the Construction and Maintenance of Highways. H. Kenneth Allen, Professor of Economics</p>
6:00 p.m.	Dinner

Tuesday, December 12, 1967

7:45 a.m.	Breakfast
8:30-10:00 a.m.	LEGISLATIVE RELATIONS A Look at the Working Relationships Between the Highway Division and the State Legislature. Jack F. Isakoff, Professor of Law Southern Illinois University
10:00-10:30 a.m.	Coffee Break
10:30-12:00 n.	STATE-LOCAL GOVERNMENT RELATIONS A Look at the Working Relationships Between Personnel of the Highway Division and Local Governments. Jack F. Isakoff
12:00 n.	Lunch
1:00-2:30 p.m.	PROFESSIONALISM IN HIGHWAY ENGINEERING Consideration of Means by Which the Capabilities of Professional Engineers Can be Better Utilized to Attain Greater Efficiency and Increase Job Satisfaction. Ellis Danner, Professor of Highway Engineering
2:30-3:00 p.m.	Coffee Break
3:00-4:30 p.m.	COMPLETED STAFF WORK Guidelines for Preparation of Work to be Submitted to Higher Authority and for Work Requested of Subordinates. Irwin Cochrun, Director Bureau of Business Management
6:00 p.m.	Dinner

Wednesday, December 13, 1967

7:45 a.m.	Breakfast
8:30-10:00 a.m.	COMMUNICATIONS A Discussion of This Important Aspect of Effective Management. Robert D. Gieselmann, Acting Chairman Business and Technical Writing
10:00-10:30 a.m.	Coffee Break
10:30-11:45 a.m.	OPERATIONS RESEARCH APPRECIATION A Survey of Some of the Largely Quantitative Methods Which are Being Developed to Provide New Solutions to Complex Old and New Problems. Louis R. Shaffer, Professor of Civil Engineering
11:45-12:00 n.	Evaluation and Adjournment
12:00 n.	Lunch

Note: Session times are flexible, particularly coffee break time and duration, and end of late afternoon sessions. Evenings are purposely left free for discussion or other activity.