

# Wisconsin's Education and Training for Highway Construction Engineering Aides or Technicians

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The rapidly expanding highway construction program will require the training of semi-professional aids and technicians who may be assigned to many job responsibilities now being carried on by professional engineers. The engineers may then be reassigned to professional job responsibilities for which they have been trained.

The Wisconsin System of Vocational Education during recent years has developed technician training programs in a number of fields where the need for semi-professional aids and technicians is increasing markedly. Curricula and minimum standards for the conduct of such training programs have already been approved by the State Board.

When the needs for semi-professional aids and technicians was brought to the Board's attention a program was worked out for cooperation with the Highway Commission in the development of training programs for highway aids in cities of the state where district highway offices are located. The curriculum has been prepared cooperatively by selected vocational school officials and highway and allied construction personnel. Teachers, who in some instances were employed on highway construction during the summer of 1957, made an analysis of the job requirements for highway aids and technicians. Based on this experience, specific courses to meet the training needs have been developed. Professional workers and engineers presently employed in highway construction will be utilized to provide some of the technical instruction.

The training program will be conducted on both a full-time day and part-time evening basis. The day program will emphasize training for initial employment and the evening school program will provide opportunities to employed highway workers to upgrade themselves for increased responsibilities and promotion.

It is believed that this cooperative training effort will to some degree alleviate the shortage of trained semi-professional personnel required for the expanded highway construction program.

●FEW, if any, matters confronting highway administrators who deal with and are interested in highway training and education, are as important, not to say urgent, as those related to and caused by the speed at which highway technological advances are occurring today. Educational changes are slow, although changes in the modern world are rapid. All educational structures and methods are hard put to remain abreast with these worldly industrial changes. In Wisconsin, an attempt has been made to solve the problems in the training of highway skilled workers as quickly and as efficiently as possible.

## THE NEED FOR HIGHWAY AND ALLIED CONSTRUCTION AIDES AND TECHNICIANS

The Wisconsin State Highway Commission has had under way for several years a program designed to substitute trained technicians and engineering aids for engineers

wherever possible. In addition, a trained corps of engineering aids and technicians are being developed to supplement the engineering forces and to extend the capabilities of the limited engineering force.

At the present time the Commission is employing more than 600 engineering aids and technicians, and they expect to increase that number by 50 percent over the next few years. Additionally, to provide for a normal turnover of 10 percent, it appears that about 100 new aids will have to be added to the staff each year to keep their complement up to normal requirements.

A few years ago, with the cooperation of the University of Wisconsin, the department conducted a short-term training course. Approximately 40 selected individuals were housed on the campus and subjected to a six-weeks course in fundamentals of mathematics, surveying, and drafting. The Commission provided the teaching staff which was, to some degree, supplemented by University personnel. At the conclusion of the school, the trainees returned to their respective districts and resumed regular duties.

The experiment, the Commission felt, was very successful in that it proved that men could be reasonably well trained and educated as engineering aids. This venture was not repeated again because the pressures of managing a program increased about three times in size. Inasmuch as the Commission could not afford to tie up as instructors large numbers of badly-needed employees, the formal type of training was abandoned for on-the-job training in the nine districts.

It was decided that the Commission could not provide the teachers and the training because they had neither the teaching skills nor the time. The University of Wisconsin could not, and possibly should not, attempt to do the job because of its over-crowded and over-taxed facilities. Also, it appeared to the Commission that the University may not be fitted to provide the type of teaching and training the highway technician needs. He does not need professional education or training but rather a vocational type of education and training which vocational schools are best fitted to provide.

It was clear that it would be impossible to obtain the trained and reasonably skilled manpower needed if the universities were expected to provide them. On the other hand, there is a large reservoir of untapped manpower which, if given some guidance, basic training, and education, will be able to perform creditably. The need for such manpower is great and the opportunities are abundant for interesting, secure, and remunerative careers in the highway service and related road building industries.

The Commission has set up five engineering aid classifications under civil service to provide an attractive career with a ladder for advancement. The top salary possible at the present time is \$7,704 per year which should be attractive to persons who may have limited formal education.

Thus far, only the needs in the state highway service have been outlined. Although specific needs cannot be cited, it is well known that county and municipal governments in Wisconsin are greatly in need of similar technically trained manpower. It is not unreasonable to assume that these units of government nationwide could use hundreds, if not thousands, of technicians and aids. In view of the multi-billion dollar highway program in this country which will continue at an accelerated rate for at least the next 15 years, the private road building and construction industry too will be looking for such trained manpower.

#### VOCATIONAL EDUCATION AND HIGHWAY AND ALLIED CONSTRUCTION ENGINEERING AID TRAINING

In light of the need for the training of highway aids and the fact that Wisconsin's program of vocational education is specifically geared to provide instruction of a preparatory type for useful employment and extension or supplementary type for persons already employed in trade and industrial pursuits it was natural to work out, between the Wisconsin State Highway Commission and the State Board of Vocational and Adult Education, a program of training engineering aids. Wisconsin's schools of vocational and adult education have, for some years, directed much of their educational planning toward post-high school education of the non-collegiate type. This has resulted in the establishment of many courses of a post-high school, vocational-technical character.

Such courses are presently in operation in all the state's schools of vocational and adult education in cities with a population of 20,000 or more. In some instances, schools in smaller cities have also established such courses.

This basic experience in providing offerings of a post-high school character has been of great value in the development of courses for youth and adults who wish to prepare for positions that require training in the highway and allied construction engineering aid fields. It was therefore logical that Wisconsin's vocational and adult schools provide for the training of engineering aids or technicians for Wisconsin's highway departments. This reasoning is even more evident when one looks at a map of Wisconsin. Highway district offices are located in geographically situated cities. Of the forty-two full-time vocational and adult schools in Wisconsin, nine schools are located in district office cities.

To implement the badly needed program of training engineering aids or technicians, personnel from the State Highway Commission and the State Board of Vocational and Adult Education got together early last spring in an informal session. Those in attendance felt that a concentrated study or an analysis of the training needs should be made in order to lay a proper foundation for over-all state planning.

The conclusions from this meeting and meetings which followed involving many local vocational educators, highway engineers and road-builder representatives, brought forth the need for the consideration of a number of factors. The following factors were incorporated within the plan for the training program: supervision, physical facilities, instructor qualifications, curriculum, student selection and an accrediting or standardizing agency. Any vocational school wishing to establish a State Board approved program of education and training for highway and allied construction engineering aids must fulfill certain standards as based on these factors.

### SUPERVISION

One guiding principle of the Federal vocational acts—and it cannot be too strongly emphasized that this principle apply to every phase of activity under these acts—is "that such education shall be given in schools or classes under public supervision or control."

A school or class is considered to be under public supervision or control, within the requirements of the Federal vocational education acts, when it meets all of the following criteria:

1. It is organized and operated under the direction of a State or Local vocational school board responsible for expenditure of public-school funds for vocational education in the State or community.
2. The teachers are paid from public funds in the same way as other public-school teachers employed by the State or Local Boards of Vocational and Adult Education.
3. Officials on the staff of a State or Local Board of Vocational and Adult Education have full charge of: (a) Selection, salaries, and length of term of the teachers. (b) Qualifications and admission of the students. (c) Content and organization of all courses and curricula with help of cooperating interested persons and agencies. In this case the advisory board members would be selected administrators and engineers from the State Highway Commission, educators from State and Local vocational boards, municipal engineering departments, and representatives from road-builder associations.

It must also be kept in mind in supervising and administering this program that the funds provided for the instruction may be used only for education which is "of less than college grade." The program involving training of engineering aids whether for highway or from other industry, is considered to be of less than college grade when all of the following conditions are met:

1. The objective is to provide training which will be advantageous in entering or continuing in employment in specific occupations or fields of work.
2. Admission is based upon the ability of students to profit by the instruction offered

rather than upon the possession of secondary school credits required for college entrance.

3. The instruction offered is based upon the needs of workers in the occupation for which training is given.

4. The instruction is terminal in nature and not a part of a course which is to be continued in a college or other higher institution.

5. The instruction does not lead to a baccalaureate degree and is not organized to conform to the requirements of a course which does lead to such a degree.

Within the local vocational school, a department head or someone responsible for the success of the program, is assigned time to coordinate and supervise the program. This individual may be the local vocational director himself, a trade and industrial coordinator or supervisor or an instructor or department head who has a knowledge of civil engineering education. This assumes that the supervisor or coordinator works closely with representatives of the highway and allied construction field. In the case of two of Wisconsin's schools where pilot training courses are now in operation, instructors and supervisors worked out a summer cooperative work schedule with the State Highway Commission. These men, working with engineers and engineering aids, were rotated on various jobs. Succeeding weeks in the summer would find them working in mapping, bridges and other structures, materials, testing, design, surveying and other phases of highway construction. This experience on the job contributed greatly to coordinating the technical training of the school with the real needs of the highway program.

#### PHYSICAL FACILITIES

The facilities must and are being developed for the purposes of the highway curriculum. For example, many of the vocational school laboratories, such as drafting rooms, have been geared to train individuals in mechanical design and other areas. In setting up provisions for laboratories in civil engineering aid training it was, and is, necessary to include civil engineering equipment. Adequate arrangements have had to be made for facilities for materials and field testing. All other facilities are usually satisfactory in Wisconsin's vocational schools.

#### INSTRUCTORS

Teachers of technical education programs in the Wisconsin vocational schools are certified under standards set up by the State Board of Vocational and Adult Education. The teaching of subjects ranging from human relations, technical science, mathematics, drafting and surveying require a diversity of types of teachers. Qualifications for these teachers will vary greatly. Most schools are handling the problem of training good teachers. The one area that still poses a problem, however, is getting capable teachers in the field of engineering courses. Some schools are hiring full-time engineers to handle these classes, other schools are employing retired engineers on a part-time basis, and still others are using employed highway engineers to teach these classes after work hours. This latter is especially true of highway extension or supplementary training when done in evening classes.

#### STUDENT SELECTION

Guidance and counseling are vitally important in the success of the highway engineering aid training program. The highest caliber of counseling facilities and techniques is necessary. Most schools do an adequate job of counseling after the prospective student indicates his interest in the program. Many school counselors and assigned individuals are constantly meeting with high school seniors at career days and in other ways presenting the various offerings of the vocational program. But, much can be done yet to encourage high school students to enter these programs. It is felt that the highway construction people, whether private or public, can use their energies in various ways to promote this excellent program.

## ACCREDITING OR STANDARDIZING AGENCY

Under provisions of Wisconsin's statutes the State Board of Vocational and Adult Education is given the responsibility of approving all courses of study carried on by schools of vocational and adult education. Under the approval plan for post high school technical education type courses, the State Board appoints an evaluating committee composed of local directors and local department heads, together with representatives of management and labor. In the case of the highway and allied construction engineering aid program, representatives are from the Wisconsin State Highway Commission, road-builder association groups, municipal and city engineering departments. This evaluating committee has the responsibility of determining whether the qualifications of the instructors, physical facilities, and curriculum meet the minimum standards which have been established by the State Board for the Highway and Allied Construction Technology program.

## CURRICULUM

The curriculum as proposed by the advisory committee and as stated earlier in this presentation, was developed after careful study. The analysis of the field of civil engineering listed many types of jobs for which training could be given. An analysis of the manipulative skills and related technical knowledge a graduate should possess was tentatively developed. After much revision, a curriculum<sup>1</sup> was developed, which appeared to be adequate for fulfilling the employment objective of the Wisconsin State Highway Commission's Engineering Aide II classification. It must be kept in mind, though, that this curriculum is subject to periodic revision at any time in case changes are necessary.

In developing any educational curriculum, consideration should first be given to the purpose of the specific educational training. In vocational-technical education, it is believed that the purpose is to provide training, to develop skills, abilities, understandings, attitudes, working habits, safety practices, and appreciations, and to impart knowledge and information needed by the skilled workers to enter and make progress in employment on a useful and productive basis.

Keeping these general purposes in mind, the advisory committee then set down aims or objectives specifically for the highway and allied construction engineering aides course. Those objectives are:

1. The training program is designed to prepare young men to advantageously enter employment in engineering construction projects such as roads, streets, railroads, sewers, building construction, in jobs that involve surveying; mapping; field drafting, testing of construction materials, and inspection.
2. The training to include both manipulative field, laboratory and drafting training as well as related technical instruction in mathematics, science, human relations and communication skills.

The training program developed includes besides the general or related subjects a certain period of class or laboratory time on surveying, highway design, basic drafting, plan and map reading, materials and testing, computations, problem solving in surveying, slide rule and highway construction problems.

The training is scheduled from elementary to advanced work in four eighteen-week units. Each school will offer the various units of work as proposed by the committee, but need not necessarily follow the sequence as laid down by the committee.

The actual time a student remains in training might depend on a number of factors: the background of education and experience he brings; the course he may wish to follow after his first full year of required day school work; and finally, what he wants to obtain from the instruction.

Most students enroll for the first full year day course which is 36 weeks in length.

<sup>1</sup> See Appendix A for outline of program.

For men without previous experience this period should give sufficient training for the employment objectives of Wisconsin State Highway Commission's Engineering Aide II classification. Students who cannot or do not desire to take the entire 72 week course in two consecutive school years may complete the second year offerings in the vocational school over an extended approximated period of three years of evening school courses. Higher employment level is likely to be reached if the student completes the full two-year program.

Men with previous experience and employment in the occupation will have their experiences evaluated and courses will be adjusted accordingly.

### CONCLUSIONS

It is not supposed that the program outlined for the training of highway technicians is the panacea for all the problems of engineering aid employment in the future. There are and will be, however, many problems that this cooperative venture between the Wisconsin State Highway Commission, the related agencies and groups, and the Wisconsin State Board of Vocational and Adult Education must solve.

The great pace of technological changes and advancements in highway construction, revisions in legislation, the need for expansion of facilities, the preparation of qualified instructors and other similar problems require that great care and periodic review be exercised in the continued development of this program.

It is believed, however, that sound planning has been developed in Wisconsin. Continued adherence to the basic standards which have been established will enable development of a post-high school highway and allied construction engineering aid program of the non-collegiate type which will meet the real and basic needs of the state.

## Appendix A

### HIGHWAY ENGINEERING AIDES PROGRAM

1st Semester

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 9:20	Tech. Math I Slide Rule	Tech. Math I	Tech. Math I	Communication Skills IA (Effective Speaking)	Tech. Math I
9:24 10:14		Communication Skills IB (Report Writing)		Communication Skills IB (Report Writing)	
10:18 11:08	Basic Drafting (Includes basic mechanical, plan reading, topographical, symbols and profiles)	Basic Drafting	Basic Drafting	Basic Drafting lettering devices,	Plan Reading
11:12 12:06	Basic Drafting	Basic Drafting	Basic Drafting	Basic Drafting	Plan Reading

Noon Hour

12:52 1:42	Tech. Science IA		Tech. Science IA		Tech. Science IA
1:46 2:36	Surveying I (Theory)	Materials and Field Testing	Surveying I	Materials and Field Testing	Surveying I (Theory)
2:40 3:30	Surveying I (Theory)	Materials and Field Testing	Surveying I	Materials and Field Testing	Surveying I (Theory)
3:34 4:30		Materials and Field Testing	Supervised Field Work	Materials and Field Testing	

Note: Laboratory courses require a minimum of two clock hours for each credit hour.

## Appendix B

### HIGHWAY ENGINEERING AIDES PROGRAM

2nd Semester

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 9:20	Tech. Math II	Tech. Math II	Tech. Math II		Tech. Math II
9:24 10:14	Construction Laboratory I	American Institutions		Human Relations	
10:18 11:08	Highway Design I (Horizontal and vertical curves as applied to highway construction road intersections; computations of earthwork quantities; map diagrams and drafting and layout as related to the above)	Highway Design I	Highway Design I	Highway Design I	Highway Design I
11:12 12:06	Highway Design I	Highway Design I	Highway Design I	Highway Design I	Highway Design I

Noon Hour

12:52 1:42	Tech. Science IB		Tech. Science IB		Tech. Science IB
1:46 2:36	Surveying II (Theory)	Field Trips and Problems in Surveying	Surveying II	Field Trips and Problems in Surveying	Surveying II (Theory)
2:40 3:30	Surveying II (Theory)	" (Student on his own time)	Surveying II	" (Student on his own time)	Surveying II (Theory)
3:34 4:30		"	Supervised	"	

Note: Laboratory courses require a minimum of two clock hours for each credit hour.

The second year of school work, whether completed on a full time school year basis or through an extended period of evening school courses, will include such courses as engineering law, contracts, and specifications, hydraulics of drainage and soil mechanics, concrete design, estimating, advanced construction laboratory, structural drawing, and advanced highway design.