

## GRADUATES COURSE IN HIGHWAY ENGINEERING AT COLUMBIA UNIVERSITY.\*

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The status of highway engineering in the United States was ably presented before this Society at the New York meeting in 1909 by the Hon. Logan Waller Page, Director of the United States Office of Public Roads. As stated by Mr. Page, many years will elapse before the supply of thoroughly trained highway engineers will exceed the demand. The conditions existing in 1909 have not been materially improved during the past two years.

The technical graduate who is attracted to highway engineering has several more or less well defined fields open to him: namely, the highway departments of municipalities and towns; those of state, counties and parks; the engineering organizations of contractors; and the engineering and sales departments of companies dealing in materials and machinery used in highway work. In city and town work, matters relative to the construction and maintenance of streets and pavements compose the bulk of the work assigned to the highway departments together with more or less road engineering problems. With state, county and park departments, the construction and maintenance of all types of road surfaces and bituminous pavements constitutes 90 per cent. of the work of such organizations, while certain problems in street pavements and highway bridges have to be dealt with occasionally. The prevailing idea, however, that the two fields just mentioned are easily separable and that the preparation for one should not be the preparation for the other is essentially wrong. Since the lines of demarcation between the above fields are rapidly becoming obliterated the successful highway engineer of to-day, whether engaged by the city or state, must have a comprehensive knowledge of all branches of highway engineering and allied subjects. Otherwise it is obvious that it will be impossible to follow that important principle of economics of highway engineering, the adaptation of methods and materials to local conditions.

In contemplation of these opportunities, the essential pre-requisites of a successful career as a highway engineer must be given due consideration in order that the future prospects offered by this field of engineering may be thoroughly understood.

The ideal foundation consist, first, of four years training in a course to civil engineering; second, practical experience in both field and office in connection with the construction and maintenance of roads and pavements on a system of highways; and, third, the acquisition of knowledge along certain lines of particular value to the highway engineer.

In explanation of the last pre-requisite it might be stated that to be well informed, the highway engineer must acquire considerable knowledge relative to the economics of highway engineering, materials of highway engineering, management engineering, highway laws, and systems of administration, mechanical appliances used in highway engineering, highway bridges and culverts, road and street surveying, drafting and designing, methods used in a road material laboratory, advanced dynamic and structural geology,

lithology, petrology and petrography, processes of industrial chemistry, methods of testing bituminous materials and the interpretation of results, and finally advanced highway engineering covering the most recent practice throughout the world in the construction and maintenance of all kinds of roads and pavements.

The fulfilment of pre-requisites numbers one and two is easily accomplished except that the graduate of one or two years standing may with difficulty retain his position during the months from December to March inclusive, especially if he is connected with a state or county department or the organization of a contractor. In these fields of highway engineering the immense amount of work to be completed during the construction season in the north requires the maximum engineering force obtainable both in the field and in the office, while during the four months mentioned above, the natural confinement of a large percentage of the work to the office necessitates reducing the engineering staff. The prospect of being without work for four months of the year has prevented many high grade technical graduates from entering the field of highway engineering. In certain cases it has been possible by co-operation between state highway departments and colleges giving courses in civil engineering to mitigate the evils of this situation. As a concrete example may be cited the writer's experience while he was Deputy Engineer of the State Board of Public Roads of Rhode Island. Many of the best civil engineering students at Brown University were employed throughout the college year part time and during vacations all the time, year in and year out, with the natural result that upon graduation some became members of the permanent force. At all times, however, the office force consisted of trained men of a number commensurate with the work of a given season. It should be said that in many cases this plan will not work out satisfactorily for the field or inspection force, due primarily to the fact that while the construction season extends from April to November inclusive in certain sections of the country, the long vacations cover only June to September inclusive, hence the impracticability of utilizing undergraduates, resident at the University, in the months of April, May, October and November in the above field positions.

The third pre-requisite mentioned might, of course, be covered by collateral reading, but it is self-evident that only a very limited idea of certain of the subjects mentioned can be acquired in this way. Especially is this statement applicable to over 50 per cent. of the subjects which, it is apparent, must be illustrated and exemplified by laboratory equipment and well stocked museums or developed through the medium of research library work. The United States Office of Public Roads, through the medium of its corps of civil engineering students, offers a method by which a limited number of men may receive training in the construction of roads and instruction in various subjects related to highway engineering. However, as Mr. Page stated in 1909, "this plan will provide but a small percentage of the engineers that will be required."

The problem before the educational institutions of this country is that of determining by what method the subjects outlined above can be offered upon a practical basis. The writer does not favour a four years undergraduate course in highway engineering, not only because of the varied and potent reasons which have been presented to this Society on various occasions with reference to specialized undergraduate courses, but also because undergraduate students are not sufficiently mature to acquire the benefits which should be derived from a combination of practical experience and specialized knowledge.

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