1949 PROGRESS REPORT
COMMITTEE ON SURFACE DRAINAGE

Carl F. Izzard[1], Chairman

The Committee on Surface Drainage held its annual meeting at the University of Iowa, Iowa City, on June 16-17, 1949, immediately following the Fourth Hydraulics Conference sponsored by the Iowa Institute of Hydraulic Research. Nine members of the Committee were present, including two from the Pacific coast, which has not been represented previously.

The following report gives the present status of research projects sponsored by the Committee, discusses the needs for additional research, and cites developments in hydraulic research of interest to highway engineers.

Good progress is being made on the project on scour around bridge piers and abutments which is being conducted by the Iowa Institute of Hydraulic Research as a cooperative project of the Iowa State Highway Commission and the Bureau of Public Roads. The pattern and depth of scour with certain basic pier shapes, with and without a web wall, have been observed with the pier at an angle of 0, 10, 20, and 30 degrees to the axis of the testing channel. Contours of the scour are recorded by photographing the exposed edges of thin horizontal layers of colored sand spaced 0.1 ft. apart. Tests so far have been made with no appreciable bed load movement in the channel.

An additional channel is now being constructed which will be equipped with a sand-feeding mechanism which will make it possible to observe the effect of moving bed load upon the scour around piers. No reports have been published. The Bureau of Public Roads has assigned an engineer to work part-time on this project while undertaking graduate studies in hydraulic engineering. After completing training, it is planned that this man will take charge of field investigations of scour around bridges. The laboratory project is expected to continue for several years.

Tests aimed at reducing potential scour around existing piers were made by the Rocky Mountain Hydraulic Laboratory in Colorado during the summer of 1949.

Qualitative studies of scour patterns around groups of piling and quantitative comparison of scour for single piles under various conditions of uniform sediment sizes are partially completed at Massachusetts Institute of Technology.

The investigation on hydraulics of storm drains for express highways is continuing at the University of Illinois with expanded laboratory facilities. Tests have been completed on a 1: 3 scale model of the toe-of-slope gutter and inlet grating, and of the barrier curb gutter with both grating and curb opening inlets. An analysis of the results of tests on the curb opening inlets, which had no depression of the gutter flow line, correlating these data with the results of other recent tests on curb opening inlets with a depression of the gutter flow line, is being presented at the annual meeting of the Highway Research Board. A half-scale model of an inlet catch basin proposed for the Congress Street Expressway in Chicago has been tested. A full-scale model of the toe-of-slope gutter is being constructed with a concrete surface to determine actual roughness factors for typical finishes. Full-scale tests are being made of flow through typical inlet boxes without a catch basin. Tests will be made later on a structure designed to trap sediment which may be carried into a storm drain. A very thorough analysis has been made of various statistical methods of determining the frequency and intensity of rainfall for various durations. A new method having a sound statistical basis has been developed and is being tested.

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The Johns Hopkins University is conducting a research project on storm water drainage for the City of Baltimore, Baltimore County, and the Maryland State Roads Commission. The project as now planned will encompass two rather distinct lines of investigation: (1) a study of curb and gutter inlet capacities, and (2) a hydrologic study of storm runoff. The first has the objectives of learning the deficiencies of inlets as now designed and the subsequent improvement of present designs. The second study will attempt to adapt and test under Baltimore conditions the most advanced techniques insofar as possible. Field measurements on sample urban areas are planned.

The investigation on hydraulics of culverts at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, is still in an inactive status. The committee was unanimous in its belief that this project should be reactivated. The laboratory has recently published Bulletin No. 2, "Grate Inlets for Surface Drainage of Streets and Highways," which is a complete report of the studies by Larson.

Tapley advises that a final report on a model investigation of divided flow on street intersections is in preparation. These tests were made at Los Angeles for the City and the California Division of Highways in connection with surface drainage intercepted by the Hollywood Parkway.

The Bureau of Standards has completed tests for the Bureau of Public Roads on a 1:16 model of a vertical drop in a storm sewer tunnel designed to operate under pressure with velocities up to 25 ft. per sec. The tests indicate a loss of head of 4-1/2 ft. at the design discharge. Losses would have been much greater if the connections to the drop shaft had not been well rounded, and could have been reduced to about 1 ft. by careful streamlining of the approach bend.

Highway engineers may be interested in knowing that the Bureau of Standards publishes annually a bulletin, "Hydraulic Research in the United States," summarizing information on nature, description, status, results, and publications of hydraulic research projects.

A paper in the April 1949 *Proceedings* of the American Society of Civil Engineers entitled "Control of the Hydraulic Jump by Sills" gives basic information useful to the highway engineer in studying the problem of dissipating energy at the outlet of a culvert. A symposium in the November 1949 *Proceedings* brings together for the first time data on "High-Velocity Flow in Open Channels." Important differences between high-velocity and low-velocity flow which should be considered in the design of curves and transitions for high-velocity flow are indicated.

The Subcommittee on Hydrology of the Federal Inter-Agency River Basin Committee has published a new edition of "River Basin Maps Showing Hydrologic Stations." Copies of these maps are available on request to the U. S. Weather Bureau, Washington, D. C. The subcommittee has also recently published its Bulletin No. 3, "Summary of Current Requirements for Additional Hydrologic Stations to Meet Federal Needs," which is a report resulting from the regional conferences held in 1948.

Sixteen state highway departments and one county highway department this year are contributing approximately $100,000, matched by the U. S. Geological Survey, for various investigations of stream flow similar to those described in last year's report.[2] Statewide flood frequency studies are about ready for publication in Connecticut, Minnesota, Missouri, and Washington. A tabulation of flood frequency data for the Columbia River Basin of the State of Washington has been published in Water Supply Paper 1080. Dalrymple is presenting a paper at this meeting describing how frequency data from a number of gaging stations in a region may be correlated.

The importance of having reliable information on flood frequencies is emphasized by the fact that approximately $400,000,000 is being spent annually on the construction of drainage structures by federal, state, and local

[2]Highway Research Abstracts, Vol. 19, No. 3, pp. 20-23 (March 1949)

agencies in the United States. This estimate is based on statistics compiled by the Bureau of Public Roads which indicate that the cost of stream-crossing bridges over 20-ft. span averages 15 percent of the total cost of constructing highways and that approximately 10 percent of the total cost, or about $160,000,000 a year, goes into culverts and other small drainage structures. It is interesting to note that the small drainage structures aggregate in cost more than the total cost of all bridges over 20-ft. length up to a length of 280 ft.

The hydrologic data available for the design of small drainage structures is pitifully small when one considers the investment that is being made in such structures. For example, if we consider that culverts take in drainage areas up to 1-1/2 sq. mi., we find that only 0.2 percent of the gaging stations currently operated by the U. S. Geological Survey are on drainage areas in this size category. Only 21 percent are on drainage areas less than 100 sq. mi. The committee feels strongly that more gaging stations ought to be installed on drainage areas under 100 sq. mi., and particularly on drainage areas under 2 sq. mi.

The Soil Conservation Service is continuing its good work in collecting and analyzing runoff data on small drainage areas with particular emphasis on the effect of changes in land use. The regions to which their studies are applicable, however, constitute only parts of a few states in the East, Middle West, and Southwest. The committee hopes that the Soil Conservation Service will be able to expand its program for hydrologic research, recognizing that peak runoff rates on small agricultural areas are subject to great variations requiring intensive research to evaluate the variables. The present status of this research is described in a paper by Potter which will be presented at this meeting.

The Bureau of Public Roads has recently established a Hydraulics Branch in the Research Division which will be responsible for all research activities in hydraulics and hydrology as applied to highway engineering. The staff will also work on the development of simplified methods of hydraulic analysis and will conduct in-service training courses to familiarize field engineers with these techniques. The services of this staff will be available for consultation on difficult hydraulic problems encountered on current projects. A number of charts to facilitate hydraulic computations for flow of water through culverts, open channels, gutters, and storm drain inlets have been prepared. Copies of these charts can be obtained for trial use by highway departments on request.