

RESEARCH LABORATORY OPERATIONS

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

RESEARCH LABORATORY OPERATIONS

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RESEARCH LABORATORY OPERATIONS

The Research Laboratory was established in 1939 to carry on the research work formerly done by the various Divisions within the Department. The Laboratory was charged with the responsibility of creating and executing a program of highway research commensurate with the needs of the Department.

FUNCTIONS

The functions of the Research Laboratory may be broadly defined as follows:

1. To visualize the problems of highway technology, to determine which of the many phases involve further research, to formulate and execute a definite program of research.
2. To perform experimental and developmental research directed toward the solution of technical problems arising in the various Divisions of the Department, or to the development of new procedures and methods and the improvement of existing ones.
3. To participate in theoretical research directed toward the solution of certain major problems of interest in the general field of highway engineering.
4. To engage in cooperative research programs with educational institutions, agencies of the Federal Government, and certain manufacturers on problems of mutual interest.
5. To provide specifications and standards for materials, make specialized analyses and research tests on new materials, and render assistance in regard to construction difficulties.
6. To accumulate, analyze, and distribute to the Department technical and research information from outside sources pertaining to highway problems.
7. To prepare technical reports for distribution within the Department and, where applicable, for publication in national research publications.

8. Through membership in the various national technical organizations, represent the Department in their activities by taking part in committee work.

9. To act in an advisory capacity to the Department on technical problems or matters of policy in regard to design, construction, and maintenance practices.

FACILITIES

A. Personnel

Research Laboratory capability is primarily a matter of developing a knowledgeable and specialized staff in the various aspects of highway design, construction, and maintenance. The staff of 78 people includes a professional staff of 33, consisting of 10 Civil Engineers, 4 Chemical Engineers, 8 Chemists, 3 Electrical Engineers, 1 Mechanical Engineer, 2 Physicists, 3 Geologists, and 2 Statisticians. We have been stressing graduate studies and 8 out of 12 of the staff, at the 13 level or above, have one or more advanced degrees. At the 11-13 level, 4 out of 12 have one or more advanced degrees. Four out of 6 of our engineers at the 11-12 level are registered and, of course, all at the 13 level and above are registered professional engineers. A staff of 45 supporting personnel consists of 32 laboratory technicians and aides, 2 machinists, 1 technical editor, 4 clerical persons, 4 graphic presentation designers, and 2 photographers.

B. Laboratories

The Research Section has been developed with special laboratories in the following areas: concrete, cement, and aggregate, soils, structures, electronics, lighting and photometry, coatings, sealers and plastics, spectrochemistry, and statistics and data processing. Each of the Laboratory areas is equipped with standard and specialized equipment to carry out their functions. The total equipment inventory, as of January 1, 1968, consists of 1620 items with a value of \$572,362.

ORGANIZATION

The operations of the Research Laboratory are organized into four sections: Materials Research; Spectroscopy and Photometry; Physical Research; and Soils and Aggregates, with supporting administrative units for Statistics and Data Processing, Publications-Library, and Graphics, as shown in Figure 1.

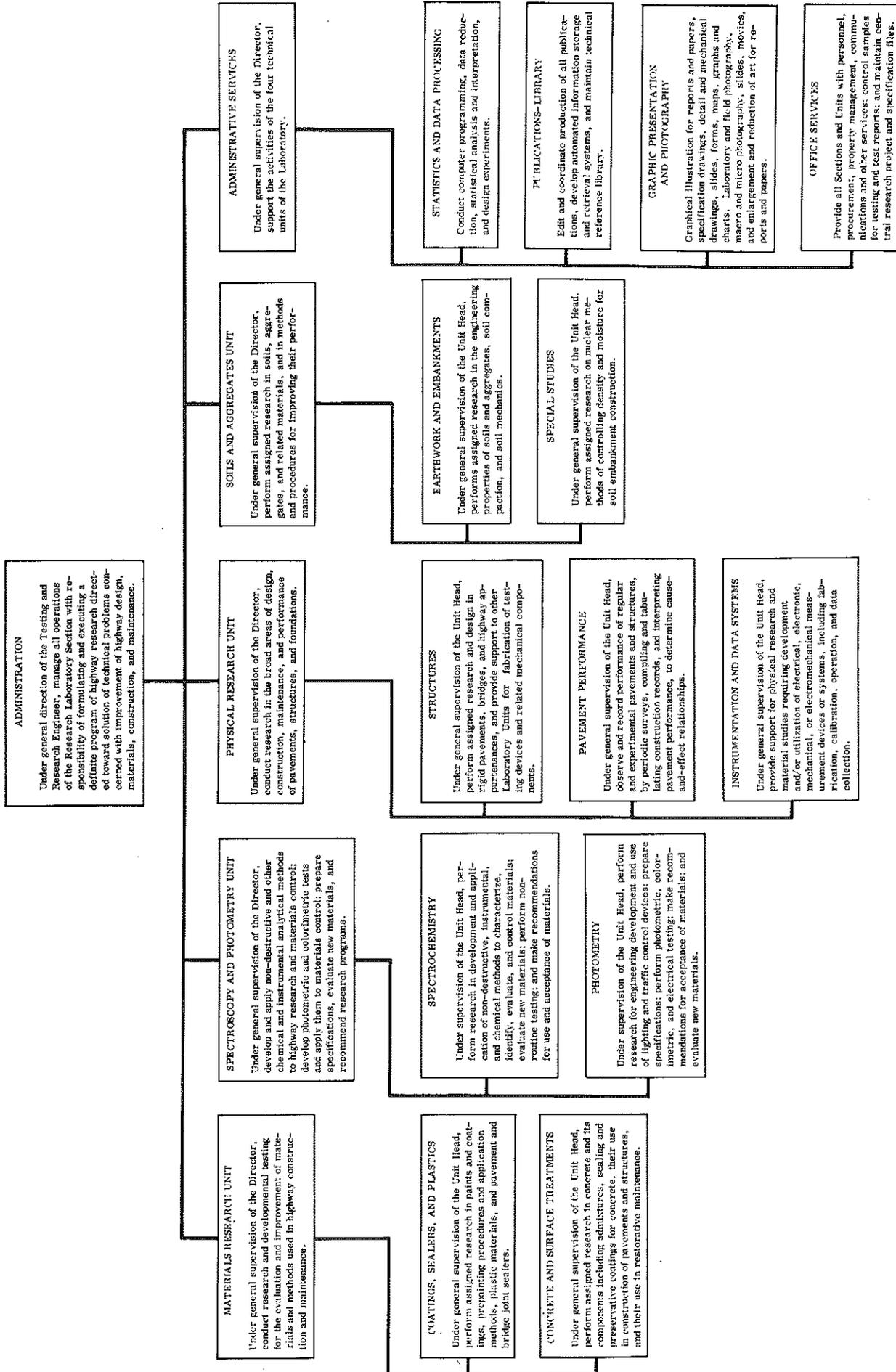


Figure 1. Research Laboratory organization chart.

OPERATIONS

The Research Laboratory's operations span a rather broad spectrum of Departmental interests, including research assignments in planning, traffic, design, construction, and maintenance. This Section conducts its activities primarily on the basis of requests and expressed needs of other operating Divisions of the Department. The Laboratory's current work program may be divided into the following four general areas of research:

1. Highway Planning and Research Projects: This research is conducted in cooperation with the Bureau of Public Roads, and largely Federally financed.

2. Departmental Research Projects: These are generated by requests of other Divisions and are generally of the following types:

A. Specific Assignments--where the study may be terminated upon completion of testing or analysis.

B. Continuing Performance Studies--where a study may continue for up to 15 years until definite results are obtained in the evaluation of the performance of materials or methods.

C. New Materials Projects--these are evaluations of methods or materials referred to the Laboratory by the Department's New Materials Committee which first screens them in a preliminary review to determine if they are of interest to the Department. Since the Committee's formation in 1959, 218 projects have been assigned.

3. Technical Assistance: This service is rendered to other Divisions by specialists within the Laboratory on concrete, soils, structures, etc. Some of this work is handled through continuing Departmental Committees, such as Traffic Control Devices, or Bridge Inspection Committee; or Ad Hoc Committees for special areas such as continuously reinforced pavement design, or bridge deck finishing. This area also includes consultation work on special problems, as well as the more routine matter of developing new specifications or revising existing specifications.

4. Acceptance Testing: The Research Laboratory tests certain new or specialized materials such as highway lighting, luminaires, cable, standards, traffic control devices, reflectorized signs, signals, traffic controllers, illuminated case signs, delineators, traffic paint and glass beads, and other materials such as neoprene joint seals and epoxy materials.

The distribution of work in these four areas is shown in Figure 2 for January - December 1968. The major distribution changes are reflected in Acceptance Testing, an increase from 4 to 10 percent, Departmental Projects, an increase from 31 to 44 percent, and a decrease in Highway Planning and Research projects from 31 to 16 percent since 1964.

Highway Planning and Research Projects

These projects are initiated by the Research Laboratory preparation of a Project Proposal. This proposal covers the research problem, the scope of the study, the objectives, benefits of the study, the research plan or procedure, and an estimate of the cost. The proposal is then reviewed by the Department's Research Policy Committee and, if approved, is submitted to the Bureau of Public Roads for their review, approval, and incorporation in the HP&R, largely Federally financed, research program. To receive Federal financing, these projects must be of national rather than merely local interest, and research benefits should be applicable to other States.

Since July 1963, when this program became effective, 19 projects have been handled under the program. Four of these have been completed--the "Pile Driving Study," "Sign Brightness in Relation to Legibility," "Effect of Loadings on Bridge Life," and "Determination of Air Content of Hardened Concrete by Gamma Ray Transmission." Four are nearly complete, with final reports being written or already submitted for review and approval, these are:

1. Control and Prevention of Deterioration of Concrete Bridge Decks: This study involves evaluation of structural design, construction, materials and maintenance, and their effect on the durability of the bridge deck surface. Currently, the deterioration of bridge decks after 10 years or less, as illustrated by the New York Thruway bridges, the Dan Ryan Expressway bridges in Chicago, and some of our own bridges, makes this an urgent issue.

2. Concrete Pavement Design: All Michigan's postwar pavements have been studied in terms of performance observations at the end of 5-, 10-, and 15-year periods of service. Condition surveys and roughness measurements are made and the performance of these pavements in terms of the absence of cracking, spalling, joint blow-ups, etc., are related to construction, materials, traffic, and environmental variables, in a cause and effect analysis.

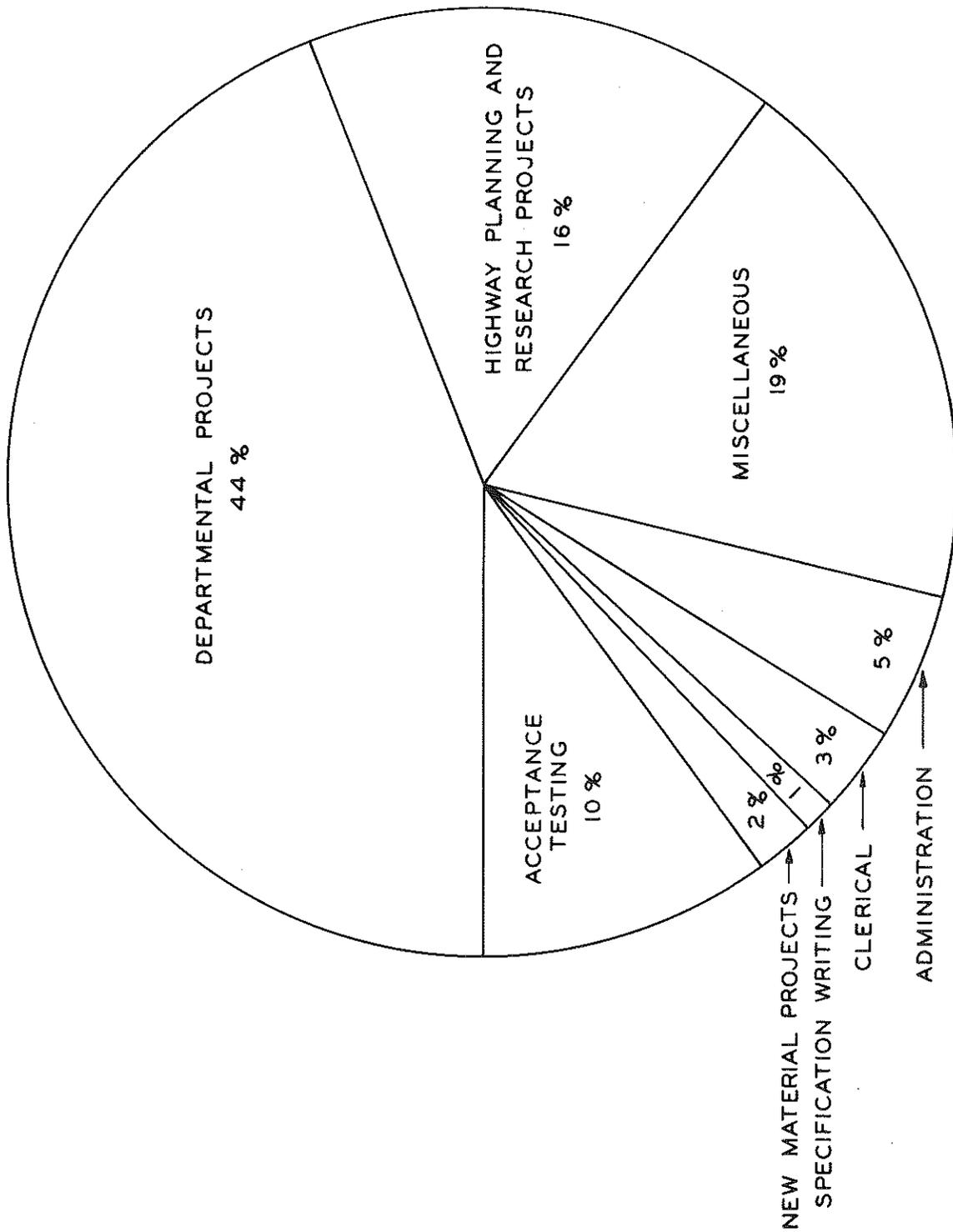


Figure 2. Division of labor.

3. Lights and Lighting for Hazard Warning: A study to improve safety under construction conditions, by developing and improving battery-operated flasher warning lights or other hazard warning devices which will eventually lead to improved specifications and possible standardization among the States.

4. Dynamic Load Aspects of Truck Size and Weight: This project studied the effect of pavement roughness along with truck suspension characteristics, on the impact effect, or increasing dynamic axle load over the static axle weight.

During the fiscal year starting July 1, 1968, nine HP&R projects are programmed. Seven of these are continuations of previous studies and two are new projects. Approximately one-quarter of the research effort is scheduled on HP&R projects for the coming year. A few of the HP&R studies are as follows:

1. Automatic Weighing of Vehicles in Motion and Collection of Traffic Data by Electronic Methods. This project is in the final phase of testing the accuracy, and evaluating the serviceability, of the system.

2. Highway Quality Control Program. This is a continuation of a study to develop quality assurance for highway materials and methods based on statistical procedures adopted from industrial quality control methods.

3. Protective Coatings for Highway Metals. This is a continuing research program for improving the durability of paint and galvanized coatings for bridge steel, guard rails, etc.

4. Development of Nuclear Methods for Quality Control of Highway Embankment Construction. This is a continuing program to evaluate and improve the speed and accuracy of measuring density and moisture content of soil and aggregates by means of radioactive isotopes.

Departmental Studies

Currently, the Research Laboratory is engaged in 107 Departmental research projects. The largest part of these are of the continuing variety, requiring long-term observations of performance.

Eighteen projects are performance evaluations of construction and maintenance methods.

Forty-seven projects are performance evaluations of highway materials and methods.

Twenty projects are structural design studies.

Ten projects are for the purpose of developing certain individual specifications.

Nine projects deal with gathering research information not directly applicable to specific project objectives, but necessary for departmental information or for application to other studies.

Three projects cover investigations of cause and effect in situations on construction projects where performance was materially below normal.

In addition to these 107 projects, there are currently 55 investigations or evaluations of new materials and methods. These are projects which have been assigned by the Committee for Investigation of New Materials and test results will be reported back to the Committee for possible approval and implementation into existing specifications.

The results of these studies are covered in reports. Figure 3 shows the new research projects in 5-year increments (pro-rated) and the number of reports in 2-year increments.

Technical Assistance

An example of this area of research work is the Research Laboratory Section representation on the Bridge Deck Inspection Committee. The committee has inspected over 250 bridge decks where maintenance problems have developed. They assess the need for repairs, recommend materials and methods to restore them, provide an estimate of repair costs, follow construction operations, and evaluate service performance.

Acceptance Testing

The final major area of the Research Laboratory's work deals with acceptance testing of new or specialized materials. One area of such testing in which we have been involved for over 10 years is traffic control devices (traffic signals, traffic controllers, illuminated signs, reflective sign materials, traffic paint, and traffic beads). Recently, two new major areas of acceptance testing have developed: 1) the use of preformed neoprene joint seals in place of hot-poured rubber-asphalt joint seals, and 2) the

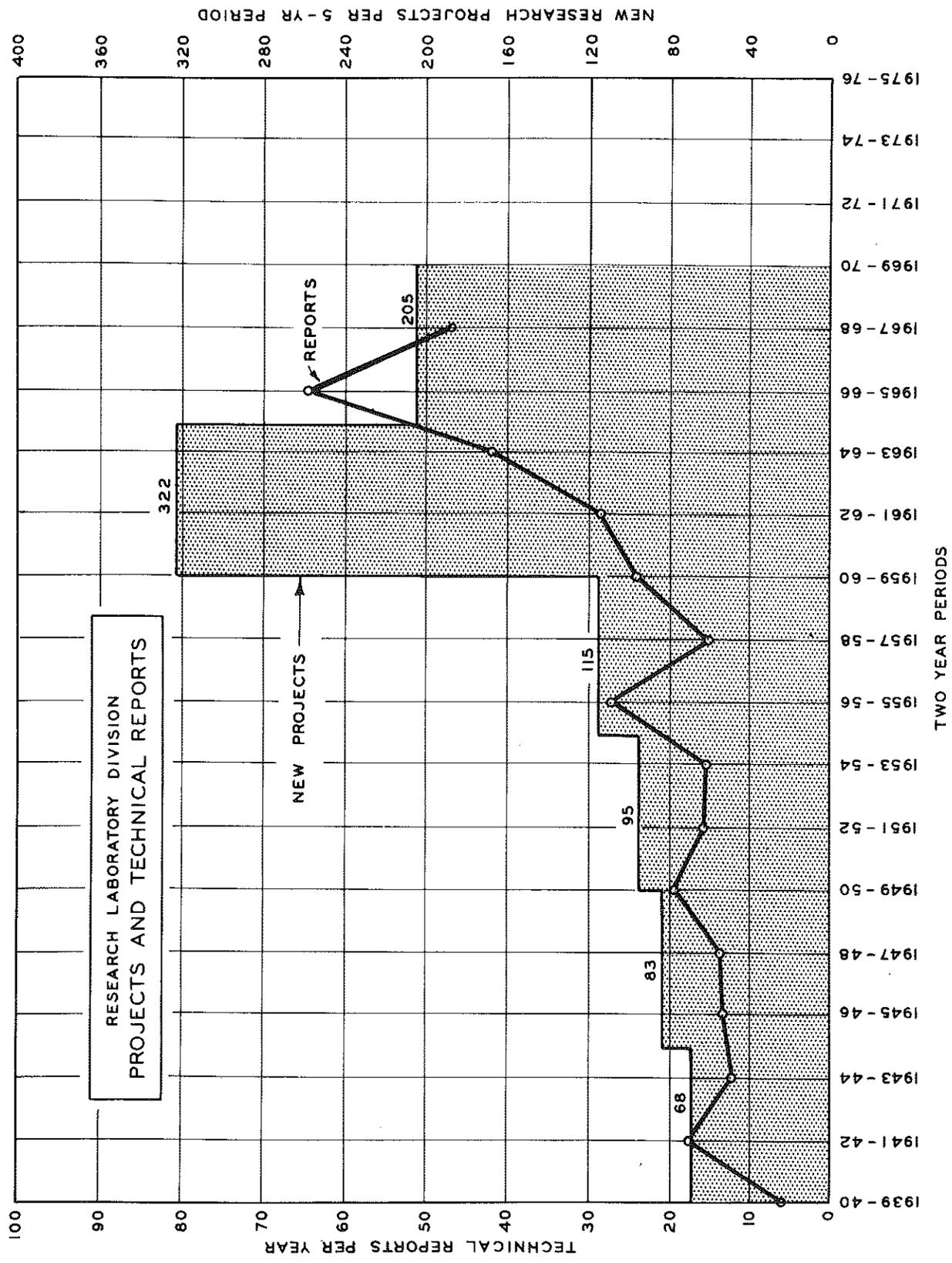


Figure 3. New research projects and number of reports.

initiation of lighting on highway projects in urban areas. Acceptance testing in connection with highway lighting, requiring the building of special photometric equipment for measuring the light distribution at various angles from luminaires, and the testing of a variety of electrical wires and cables, and the testing of the light standards.

The growth of acceptance testing since 1964, in terms of materials tested, is illustrated in Figure 4. It should be noted that the total number of samples tested for acceptance has increased nearly 100 percent, going from 557 samples in 1964 to 1,057 in 1968.

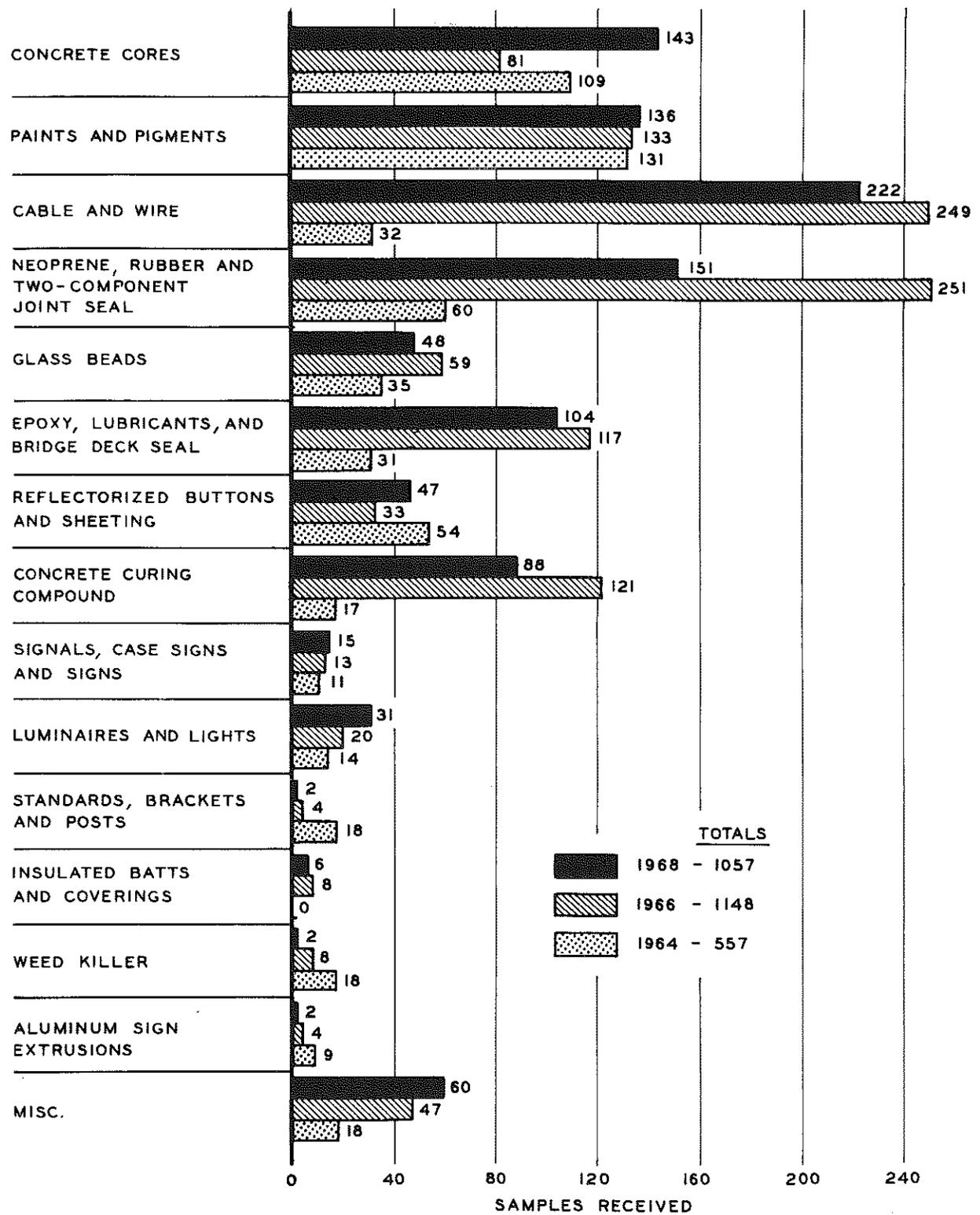


Figure 4. Growth of acceptance testing.