

MICHIGAN  
STATE HIGHWAY DEPARTMENT  
G. Donald Kennedy  
State Highway Commissioner

SUMMARY  
OF  
RESEARCH PROJECTS

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Research Laboratory  
Testing and Research Division  
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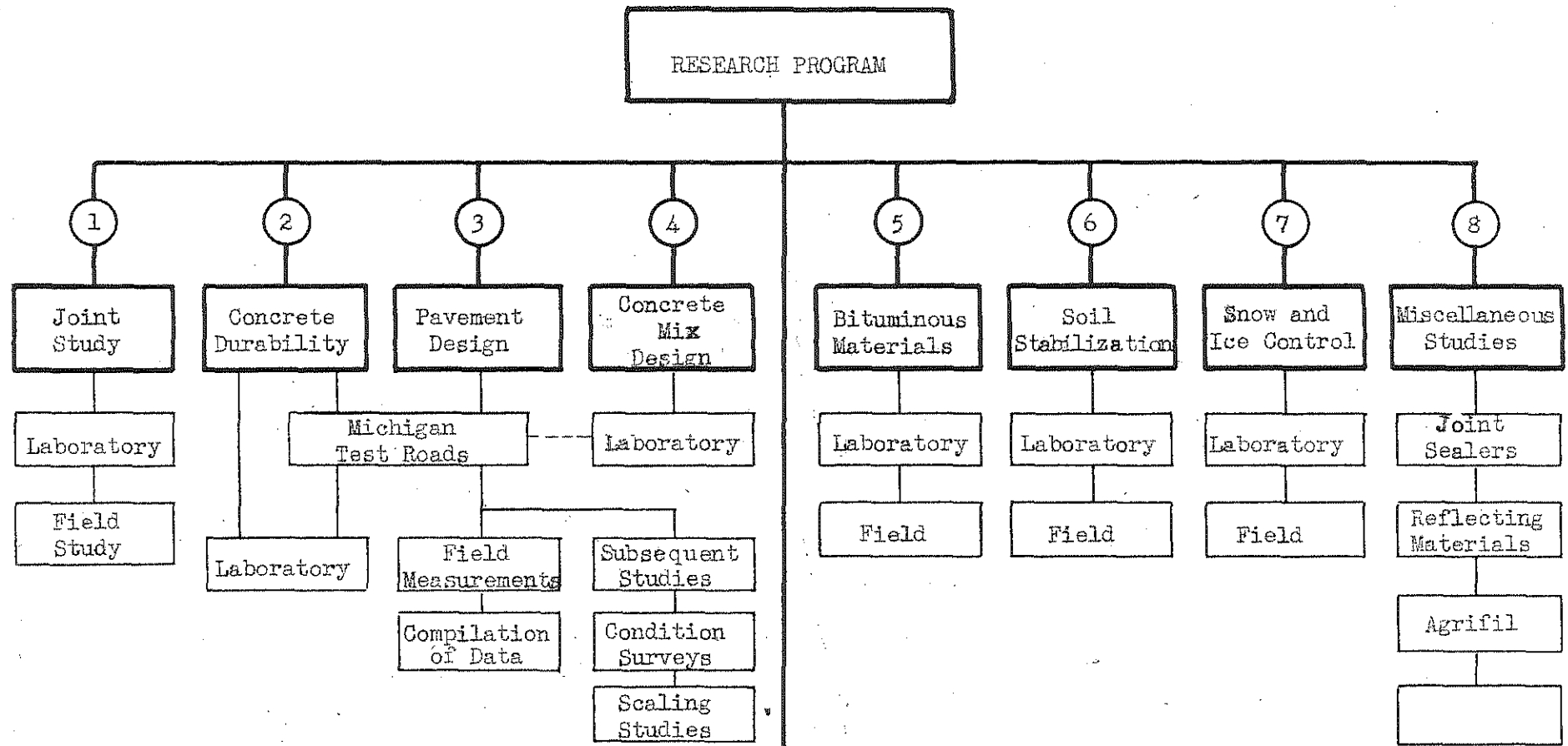
SUMMARY OF RESEARCH PROJECTS

This report contains the purpose, scope and present status of each of the nine major projects included in the research program of the Highway Department.

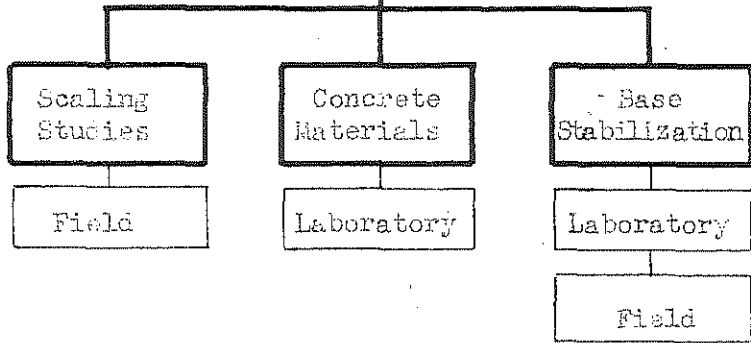
The report has been prepared expressly for the engineering committee of the Department in order that the committee may study the research program and make recommendations for future pursuance of the work.

The major research projects are -

1. Joint study
2. Concrete durability study
3. Concrete pavement design
4. Concrete mix design
5. Bituminous materials
6. Soil stabilization
7. Snow and ice control
8. Miscellaneous studies
9. Houghton project.



HOUGHTON PROJECT



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## PROJECT 1

EVALUATION OF LOAD TRANSFER DEVICES

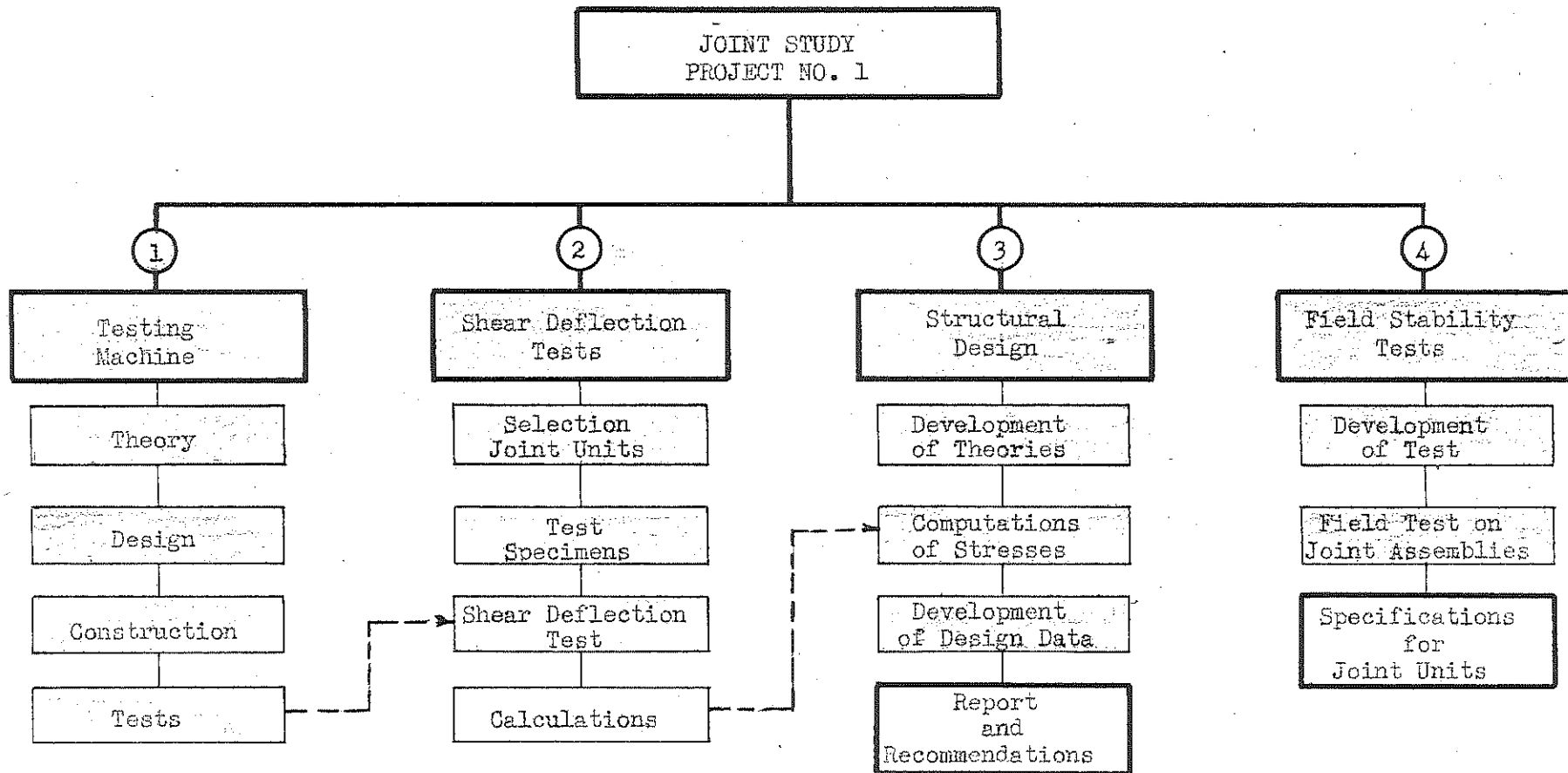
The evaluation of load transfer devices pertains to the study of the statics; elastic and plastic properties; strength characteristics and stress distribution in transverse joints composed of different types of load transfer devices.

The purpose of the study is to establish criteria for the evaluation of load transfer devices and joint assemblies, to determine proper spacing of same and to obtain data for writing specifications.

The importance of such a study is quite evident. There has been a feeling, for some time, among engineers that as long as expansion joints are required in concrete pavement slabs some type of load transfer device will be required to strengthen the free edges at such joints, especially to maintain the slabs at equal elevation. However, there has been a wide divergence of opinion as to how it should be accomplished and a decided lack of agreement on the fundamental structural requirements at such a joint when load transfer is used.

Load transfer devices have been used experimentally for a number of years but no definite criteria has been established for their use and design. Because there is such a diversity in the design and use of these devices, the situation seems to dictate the necessity for obtaining accurate information regarding other characteristics as individual units in concrete, as well as their characteristics in groups in a concrete slab.

JOINT STUDY  
PROJECT NO. 1



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The project has been planned to include the four following major studies -

1. Development and construction of a special hydraulic testing machine capable of not only testing joint units but equally adaptable to other tests requiring compressive forces.
2. Shear deflection tests on various types of load transfer devices to determine their mechanical characteristics. Also shear tests exemplifying load transfer at contraction joints.
3. Completion of data and necessary mathematical calculations incidental to the structural design of pavement slab edges at expansion joints.
4. The establishment of a proposed field installation test for joint unit assemblies and preparation of specifications for load transfer units, and joint unit assemblies.

#### Development of Hydraulic Testing Machine

Purpose: To design, and construct a compression machine capable of testing the various types of load transfer devices.

Scope: The testing machine was to be designed and constructed with the thought of using it for other laboratory tests involving the need for compressive forces.

Status: This part of the investigation has been completed.

#### Shear-Deflection Tests

Purpose: To study the characteristics of the various load transfer devices under laboratory shear-deflection tests in order to obtain data necessary for the successful design of expansion joints.

Scope: The study has included seventy individual shear-deflection tests on load transfer devices including the several proprietary makes on the market as well as special devices. Also, the study includes shear-deflection tests on different types of contraction joints.

Status: This work has been completed.

Structural Design of Pavement Slab Edges at Expansion Joints

Purpose: To develop a definite criteria for determining the proper spacing of load transfer units and to establish stress relationships in concrete slab edges at expansion joints.

Scope: The study will include a review of the work of Westergaard, Teller, Friberg, the previous work of the Michigan State Highway Department, as well as the laboratory studies included in the scope of the joint project.

Status: This work has been completed and written up in preliminary form.

Field Installation Test for Joint Unit Assemblies

Purpose: To establish a field test whereby a joint assembly could be subjected to conditions similar to those encountered in actual concrete construction for the purpose of judging its merits and to determine if it meets specifications.

Scope: The study includes two separate parts; first, the development of a suitable joint assembly test and second, to prepare specifications to include all types of load transfer assemblies.



Status: This work has been completed and is written up in preliminary form.

Summary

All laboratory and field work has been completed. Approximately two weeks work needed to finish preparation of graphs by Mr. Fremont. The rough draft of the entire project is about 50 percent complete at the present time. Final report should be finished by June 1st.

## PROJECT 2

DURABILITY OF CONCRETE PAVEMENTS

A survey study of all concrete pavements shows that a considerable percent of the surface is scaled in varying degrees. This condition has become more apparent as the use of chemical salts has increased for the removal of ice from pavements. Scaling has been common in most parts of the state, but, on a whole, the concrete is predominantly good. But, even so, the unsightliness of scaled areas and subsequent maintenance and the added possibility of further deterioration is of immediate concern to the highway engineer.

For this reason, a study of scaling, its causes and methods for prevention, has been incorporated into the research program under the title of "Durability of Concrete Pavements".

The durability project includes the following major parts:

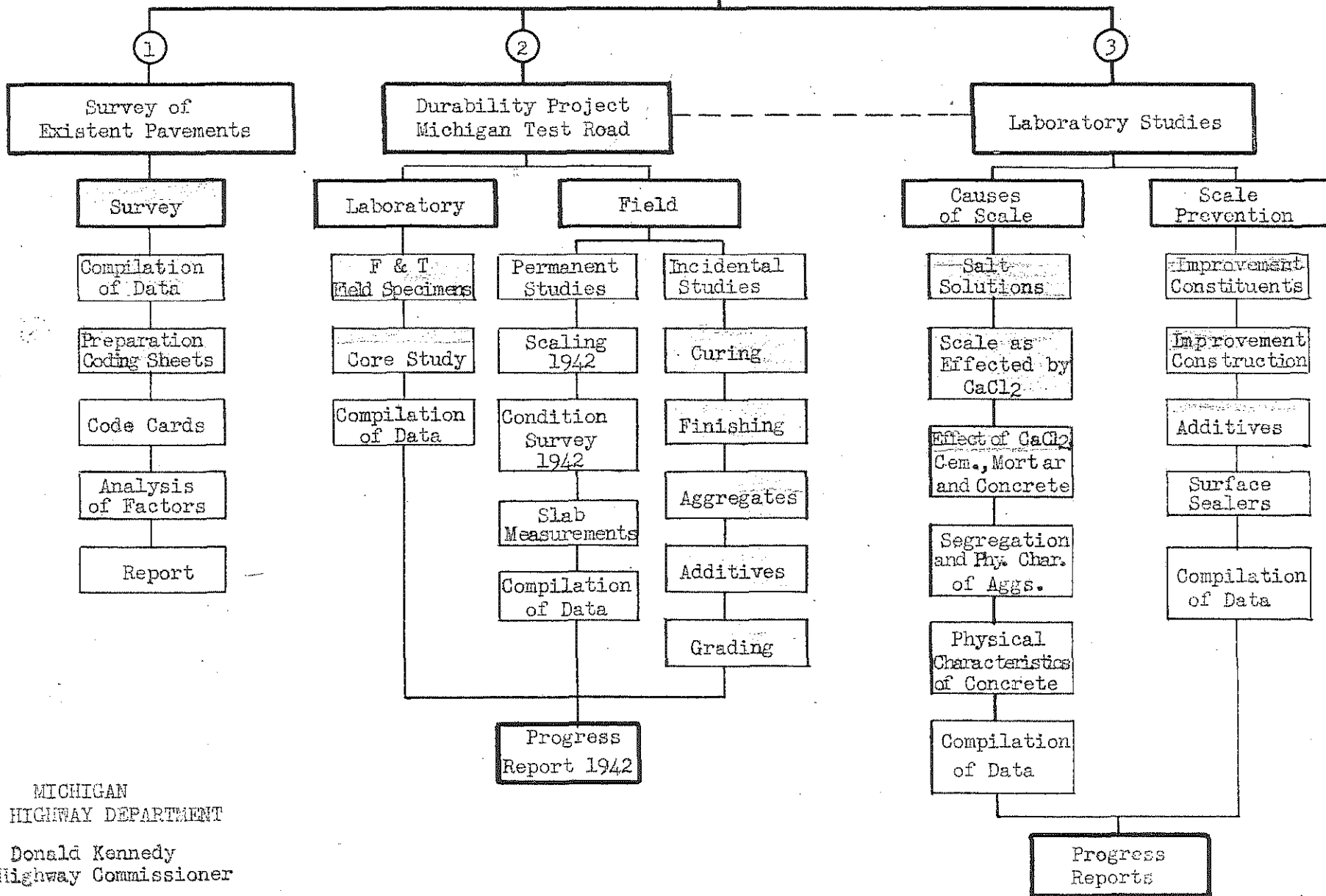
1. Condition survey of existent pavements.
2. Durability project of the Michigan Test Road.
3. Laboratory durability studies.

The major studies outlined above will be discussed separately including their purpose, scope and present status.

Condition Survey of Existent Concrete Pavements

Purpose: To determine by visual observation the amounts and degree of scaling prevalent in concrete roads in Michigan and to correlate this information with the various factors incidental to the construction of the pavement slab.

DURABILITY CONCRETE  
PROJECT NO. 2



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Scope: Survey included all of the concrete pavements on the state trunkline system.

Status: All of the factors and amounts of scaling have been recorded on coding sheets specially prepared for this particular study. It remains to have the data on the coding sheets transferred to cards for punching and the desired information obtained by the manipulation of the cards through the International Business machines. It is proposed to have this completed as soon as possible.

Durability Project of the Michigan Test Road

Purpose: The performance of concrete under the severity of service cannot be predicated upon laboratory studies. Therefore, the purpose in constructing the durability project was to obtain a field laboratory to obtain accelerated action of chloride salts or ice on concrete pavement and to study the resultant action. Also, to evaluate the effect of variation of factors relative to construction and materials used in highway construction upon the durability of concrete pavements.

Scope: Embodied in the durability project are the following considerations:

1. The grading of aggregates with definite recognition of the material passing 200 mesh.
2. The comparative effect of various types of additives including, physical and chemical varieties as well as cement blends and cements produced with grinding aids.
3. Crushed limestone aggregates with special attention to finer fractions.

4. A study of finishing methods in relation to scaling.
5. A study of various curing methods in relation to scaling.
6. Accelerated scaling studies.
7. Comparative laboratory freezing and thawing tests on field specimens.
8. Special laboratory study of pavement cores taken from durability project including freezing and thawing, unit weight, void content, distribution of aggregate.
9. Factors incidental to construction which might be contributory to scaling.

Status: The field and laboratory work has been practically completed on all problems except the accelerated scaling studies and the core study, numbers 6 and 8 respectively. It is planned to carry on the scaling studies for a period of years. The core study is now in progress. It is proposed to submit all of the data from the durability project in the form of a progress report. The compilation of data for this progress report has been started.

#### Laboratory Durability Study

As a part of the general investigation of the durability of concrete pavements in Michigan, laboratory studies have been undertaken to supplement the field study and the durability field project of the Michigan Test Road.

The laboratory program has been divided into two main divisions devoted to the following work -

1. The determination of causes of scaling.
2. A study of methods to prevent scale.

The above problems pertaining to the laboratory durability study will be discussed in the order given.

1. The Determination of Causes of Scaling

Purpose: To make a comprehensive study of the many factors considered to be contributory to scaling for the purpose of obtaining substantial data to enable us to approach the problem of prevention in a logical manner.

Scope: The study of causes of scaling has been divided into three phases, chemical, physical and mechanical. Under chemical causes have been included -

1. Compilation of data pertinent to salt solutions involving a bibliographical study and a field study to determine the probable concentrations of salt solutions on pavements due to ice removal methods.
2. Scale formation on concrete as effected by chloride salts, involving such studies as the chemical reaction of chloride salts on the constituents of concrete and the formation and distribution of chemical and products conducive to scaling.
3. The chemical action of chloride salts on neat cements, mortars and concrete under different test conditions,

The physical phase involves two main subjects -

1. The segregation and variation of constituents of concrete, such as bleeding when associated with mix design, physical characteristics of constituents, working of the concrete surface and interfacial relations between the constituents of concrete.

- 2. Variation in physical characteristics of concrete from top to bottom of slab, involving grading, amount of cement, density, absorption, porosity and coefficient of expansion.

Mechanical factors will be considered to include frost action, freezing and thawing and traffic conditions.

Status: Parts 1 and 2 of the chemical phase have been temporarily completed pending further results from other phases of the problem. The study of chemical action of chloride salts on neat cements is practically completed and preparation has been made to continue with the study on mortars and concrete.

Studies 1 and 2 of the physical phase have been correlated with construction factors relative to the test road and that part has been completed. However, further laboratory studies are necessary to completely terminate the project.

The mechanical factors remain to be studied.

2. Scale Prevention Studies

Purpose: It is a recognized fact that scaling can be materially reduced by additives, and by the proper control of construction practices. Therefore, it is the purpose of this investigation to study the relative merits of the many proposed methods of scale prevention as a part of the whole subject of durability of concrete.

Scope: The scale prevention studies include the following subjects:

- 1. Improvement of characteristics of constituents of concrete.

2. Improvement of construction practices involving mix design, construction operations and curing methods.
3. The use of admixtures or grinding aids.
4. The use of surface sealers.

Status: These four problems cannot be completely terminated until the durability project has been exhausted in all its phases. However, enough data has been accumulated, so far, to enable the Research Division to present certain recommendations relevant to the subject.

#### Summary

Coding sheets for pavement survey have been submitted to the Planning Division for punching cards. This will take several weeks. The various factors must then be analyzed and a report prepared.

Field work on the durability project of the test road has been completed until next winter when it may be desirable to carry on scaling studies for another winter season.

Laboratory tests on field specimens from the test road are practically completed.

Laboratory study of cores from the test road has been started. It will require several months to complete the proposed study of core sections.

Practically all of the data so far available on this part of the durability project is in the form of preliminary reports submitted by various members of the organization. It is planned to assemble this data into a formal progress report covering the test road up to the present time.



The laboratory durability study has been stopped due to lack of personnel. The program should be completed especially the study of the effect of calcium chloride on mortars and concrete since the part pertaining to cements has been practically completed.

Further studies on certain wetting agents such as Orvus and other additives should be continuous to keep the department up to date.

A laboratory technician or engineer, well versed in the design of concrete mixtures and allied subjects, is needed to carry on this particular work on the durability of concrete.

It is planned to start working on the final report on this subject just as soon as project No. 1 is out of the way.

## PROJECT 3

CONCRETE PAVEMENT DESIGN

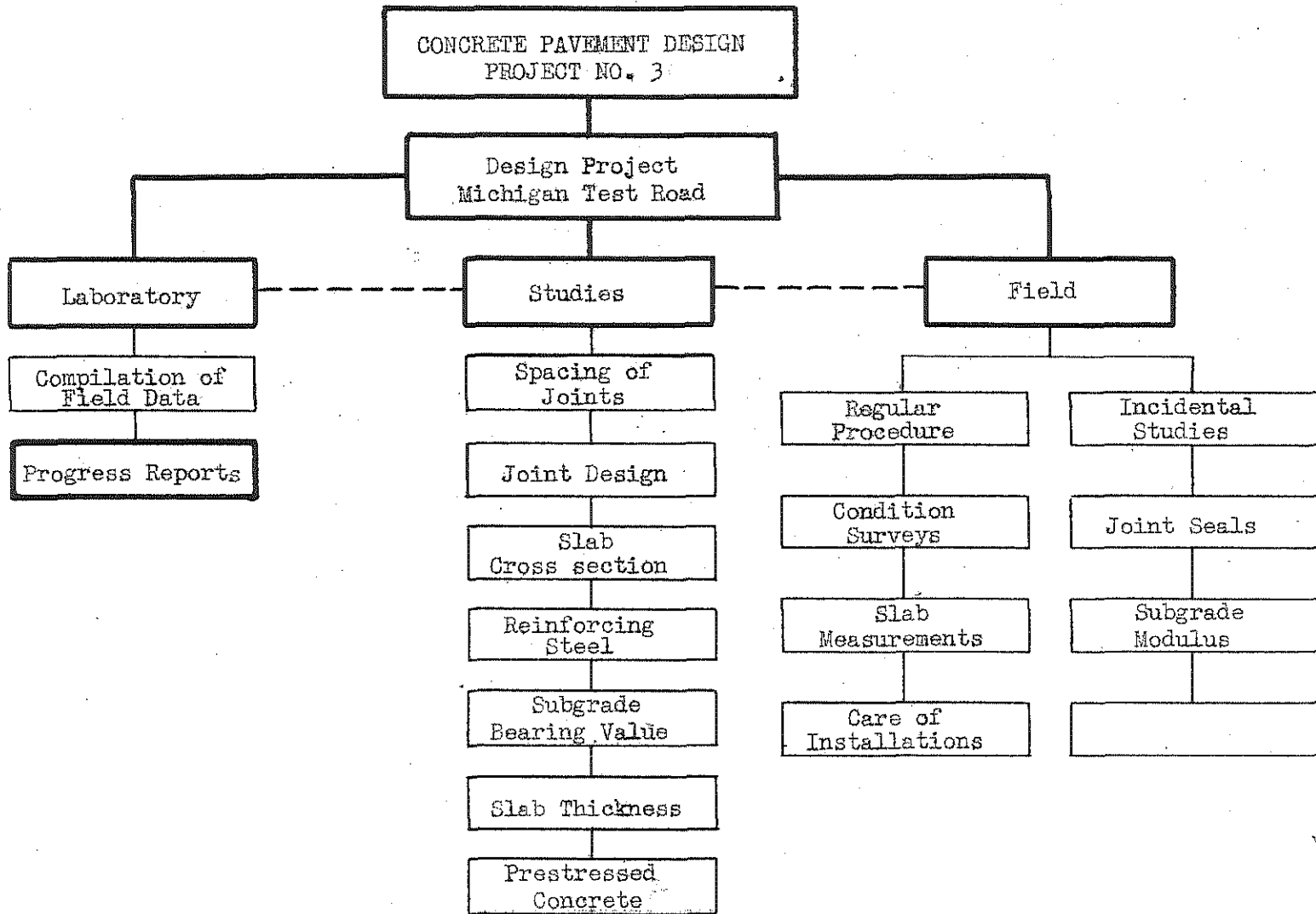
Purpose: To establish certain fundamental principles in concrete pavement design and to correlate certain laboratory studies with construction methods in order to develop more durable concrete pavements. The facts and relationships obtained shall be used for the improvement of the Michigan State Highway Department design and construction procedure.

In order to realize the purpose of the project, it was necessary to construct an experimental pavement incorporating the principles and factors incidental to design and construction. This experimental pavement is known as the design project of the Michigan Test Road.

The design project coincides in a general way with the Public Roads Administration's plans and procedure for construction of experimental roads which were submitted to the Department in 1940.

Scope: The important design studies considered with respect to modern practices are:

1. Spacing of expansion and contraction joints.
2. Expansion and contraction joint design.
3. Uniform slab thickness versus balanced cross sections.
4. Amount of reinforcing steel necessary.
5. Relation of pavement cross-section to subgrade supporting value.
6. Pavement cross-section thickness.
7. Prestressing of concrete slabs during curing.



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Included in the scope of the design project were certain incidental construction features, such as -

1. Mechanical versus manual handling of concrete on subgrade.
2. Mechanical versus hand tamping of forms.
3. The use of different types of joint seals.

Importance: There is need, at the present time, of a comprehensive evaluation of modern theories of design and construction. This statement is clearly demonstrated in recent reports of technical writers on the subject.

The value of this study is further enhanced by increased beauty, safety, roadability, economic life and reduction of cost of construction and maintenance.

Furthermore, no study of this type has been carried on since the Bates Road Test in Illinois in 1922-23.

Status: It will take several years time before sufficient data will be accumulated from the design project of the test road to warrant making any definite conclusions relative to the design studies. However, the data will be compiled as received from the field and, no doubt, some definite trends relative to the various factors studied will be noted within a short time. This project is in progress continuously.

Summary

We have started to compile and analyze the field data from the design project of the test road. This work has been assigned to Fremont with help as needed.

It is imperative that the field measurements be continued as scheduled. At the present time, we need a man to take over this work. A man qualified to handle the various measuring instruments and one who is absolutely dependable.

At the present time, it is doubtful if sufficient data has been accumulated to show definite results.

PROJECT 4

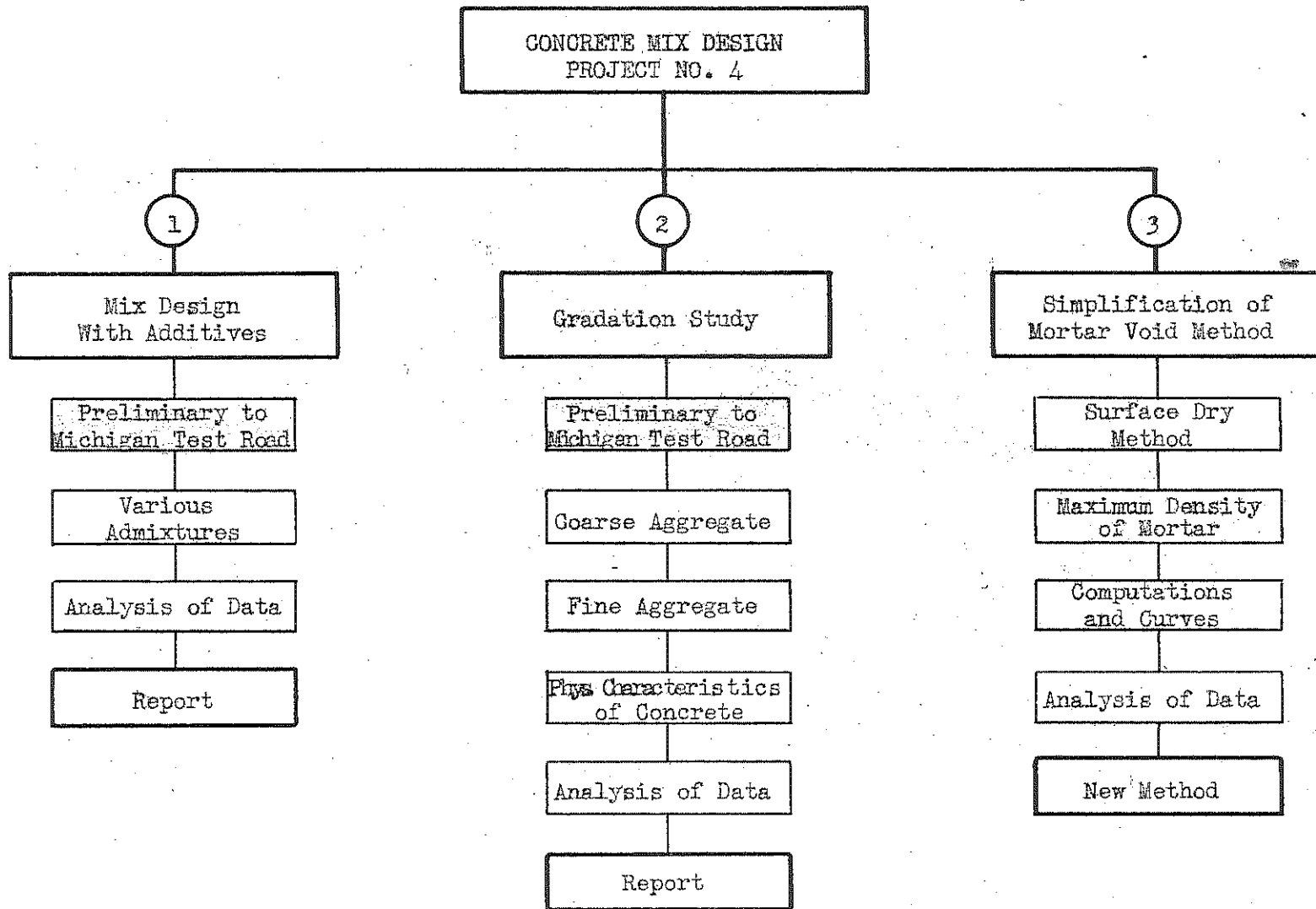
CONCRETE PROPORTIONING AND GRADING OF AGGREGATES

Purpose: The purpose of this study is two-fold. First, to design concrete mixtures according to the mortar void theory, using various additives as preliminary work to the durability project of the Michigan Test Road. Second, an attempt to design a practical and economical concrete mix that would show improvement in resistance to scaling as compared to some of our present day pavements.

Scope: The project is comprised of three main problems, namely:

1. The design of concrete mixtures by mortar void method when additives are to be used in the mixture. A preliminary study to durability project of test road.
2. A gradation study of concrete aggregates and cement as related to scaling and durability of concrete.
3. The simplification of mortar void method of concrete design.

Importance: In one respect, this subject is a part of the durability project, however, it is of such significant importance from another standpoint that it has been set up as a separate project. It is significant that our present specification requirements are not all that they should be with respect to gradation of fine and coarse aggregates, especially where workability and durability are concerned. Also, it is important that we consider several possible changes in gradations and thus open up local material sources for the manufacturing of more



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economical concrete. The mortar void method of concrete design as used by the Department should be thoroughly studied in all its phases and simplified so that it can be understood and applied by all engineers, who are interested in concrete design problems.

Status: Part one of this project program has been completed. The balance of the project program was dropped because men were not available for assignment to the work. Preliminary report No. 21 has been prepared.

#### Summary

The work completed, to date, on this project has been tied in with the durability project of the test road and will be treated as such under project 2.

Since the mortar-void method of concrete design has been simplified to a great degree during the last two years, there remains only one more factor in this project which might be worthy of consideration. That factor is the possibility of changing the maximum size aggregates in pavement slabs to obtain a more economical concrete.

No men are available at the present time to assign to this project.



## PROJECT 5

BITUMINOUS MATERIALS

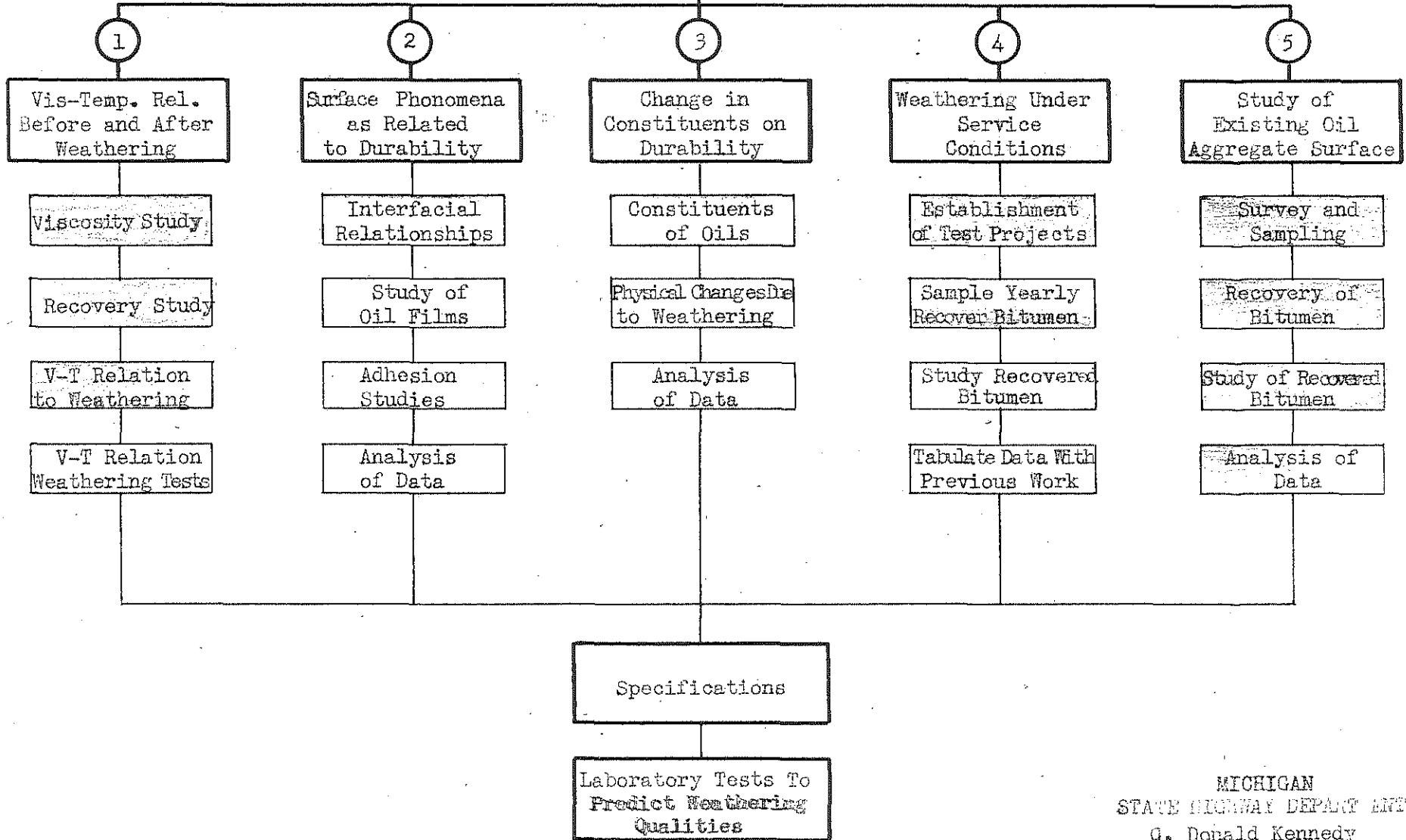
Purpose: This is a continuation of a bituminous research program initiated in 1933. The purpose being to determine the changes in characteristics of slow curing asphalts before and after weathering with the idea of perfecting a laboratory test whereby it would be possible to distinguish between bituminous materials possessing good or undesirable weathering qualities before they were incorporated in the bituminous mixture.

Scope: The scope of the investigation included five important phases of the subject of durability of bituminous materials, namely:

1. The viscosity-temperature relationship of bituminous materials before and after weathering.
2. Physical and chemical surface phenomena as related to durability.
3. Effect of change in constituents upon durability.
4. Changes in characteristics of slow-curing asphalts after weathering under service conditions. This study embraces sixteen test projects established over a period of years from which samples are taken each year for laboratory study.
5. Condition survey of existing bituminous surfaces using slow-curing oils as a binder. Samples were taken from the various surfaces for correlation with laboratory studies. The studies of changes in characteristics of asphaltic cements has not been undertaken.

Importance: The urgent need for continued research in bituminous materials is evident because of the rapid growth of bituminous surfaces

BITUMINOUS MATERIALS  
PROJECT NO. 5



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in Michigan, especially of the oil-aggregate type which produce definite maintenance problems involving stockpiling and repairs. The undesirable variation in characteristics of the bituminous materials from the various refineries, as well as the failure of current specifications to predict service behavior of the bituminous material makes it doubly important that better laboratory control must be devised to insure durable and lasting surfaces.

Status: Parts 1 and 5 of this project have been completed. Only certain phases of parts 2 and 3 have been touched upon. Part 4 is continuous in that each fall a survey is made of the test sections, samples taken, recovery of the bitumen made and subsequent studies conducted on the recovered bitumen.

#### Summary

It was necessary to establish this project as a long range problem in order to obtain reliable information on the weathering of asphalts. The man who has been carrying on this work for the last six years has left the department for other work.

The absolute viscosity and weathering studies will become more valuable to the bituminous problem as each year passes and, therefore, should be continued.

At the present time, there are several road samples to be recovered and analyzed. Also, accelerated weathering tests which were started should be completed to correlate with field data.

A bituminous man is needed for this work.

## PROJECT 6

SOIL STABILIZATION AND SUBGRADE

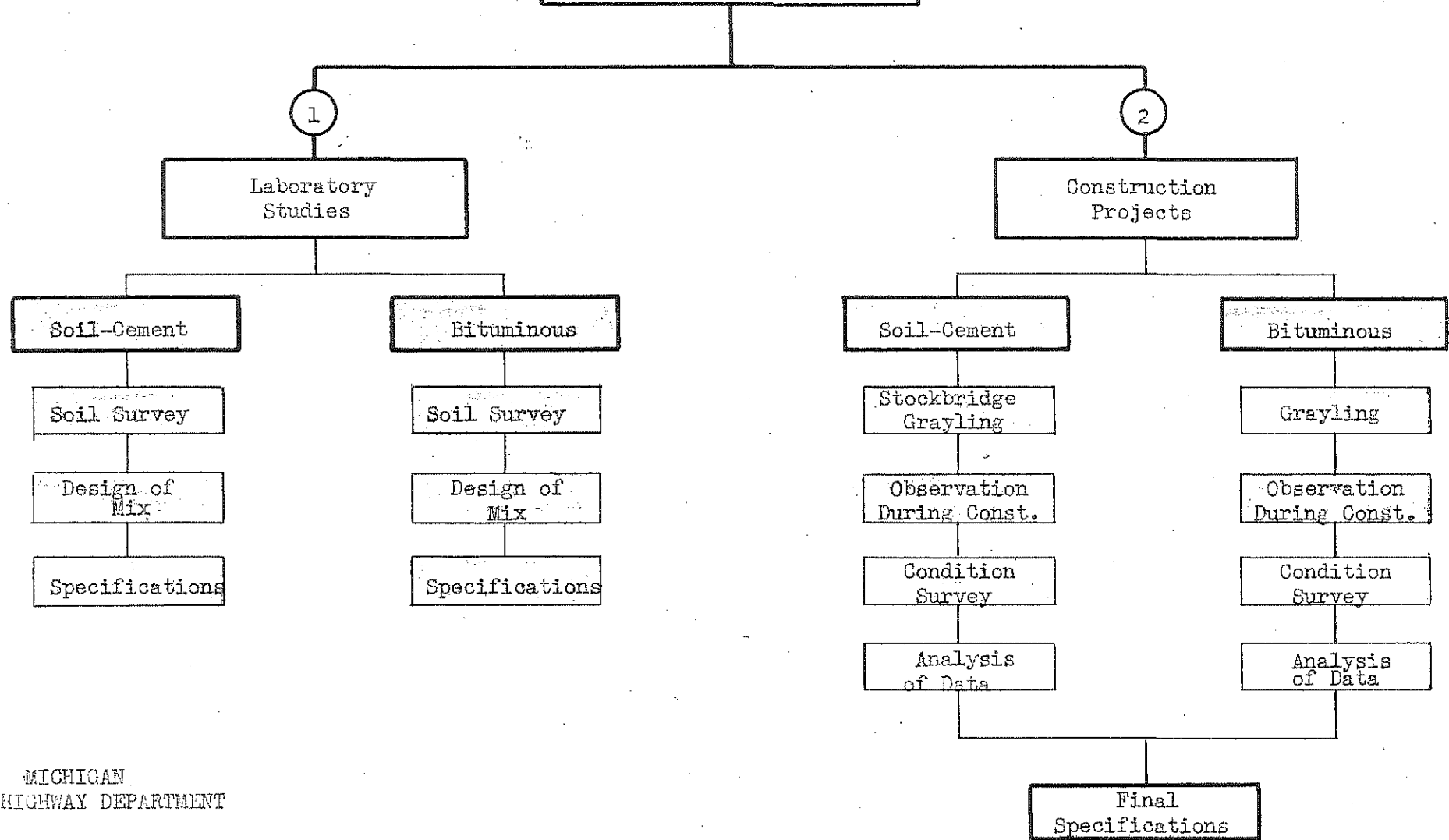
Purpose: To construct soil-cement and bituminous stabilized road surfaces using existing roadway material, new material and Portland cement to produce a low-cost light-traffic surface. The purpose being to determine the feasibility of constructing such roads with existing surfacing materials, or with suitable local materials, and to develop specifications for the use of the Michigan State Highway Department in construction of such types of roads.

Scope: This project included the construction, in 1941, of two soil stabilized roadway surfaces as follows:

1. Soil cement construction on M-92, Stockbridge north, length 3.02 miles, project M 33-50, C1.
2. Soil cement construction on M-72, Grayling east, length 1.57 miles, project M 20-20, C2.
3. Bituminous stabilization on M-72, Grayling east, length 4.5 miles, project M 20-20, C2.

Importance: Many types of stabilized roads are being developed and it is important to the Michigan State Highway Department to know which are best suited to Michigan conditions. From an economic standpoint, it is important to know the relative cost of this type of construction as compared to other types of light-traffic surfaces. Also, it is desirable to know if this type of construction is satisfactory for certain localities where prepared aggregates are not available.

SOIL STABILIZATION  
PROJECT NO. 6



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Status: The work outlined under the scope of the project has been completed and specifications based on this work have been prepared. Preliminary reports Nos. 34, 38 and 39 have been prepared.

Summary

A condition survey has been completed on the Stockbridge project. This data is now being prepared as a supplement to the final report. This should be completed within the next two weeks.

A condition survey will be made of the Grayling project soon and a final report submitted.

Mr. Thornburn, who has been assigned to soils studies is leaving the Department April 15th, which depletes the personnel in this particular work.

It was planned to run durability cycles by A.S.T.M. and P.C.A. procedure on the field soil cement specimens, molded on the Grayling and Stockbridge projects. The purpose being to compare laboratory and field specimens. This work has not been done because until the present time it conflicted with durability studies on concrete.

This work can be done with present personnel.

Subgrade modulus studies have been started on the test road which should be completed this summer. It is suggested that Mr. David Hall, now at the college, be hired during the summer to complete this work.

## PROJECT 7

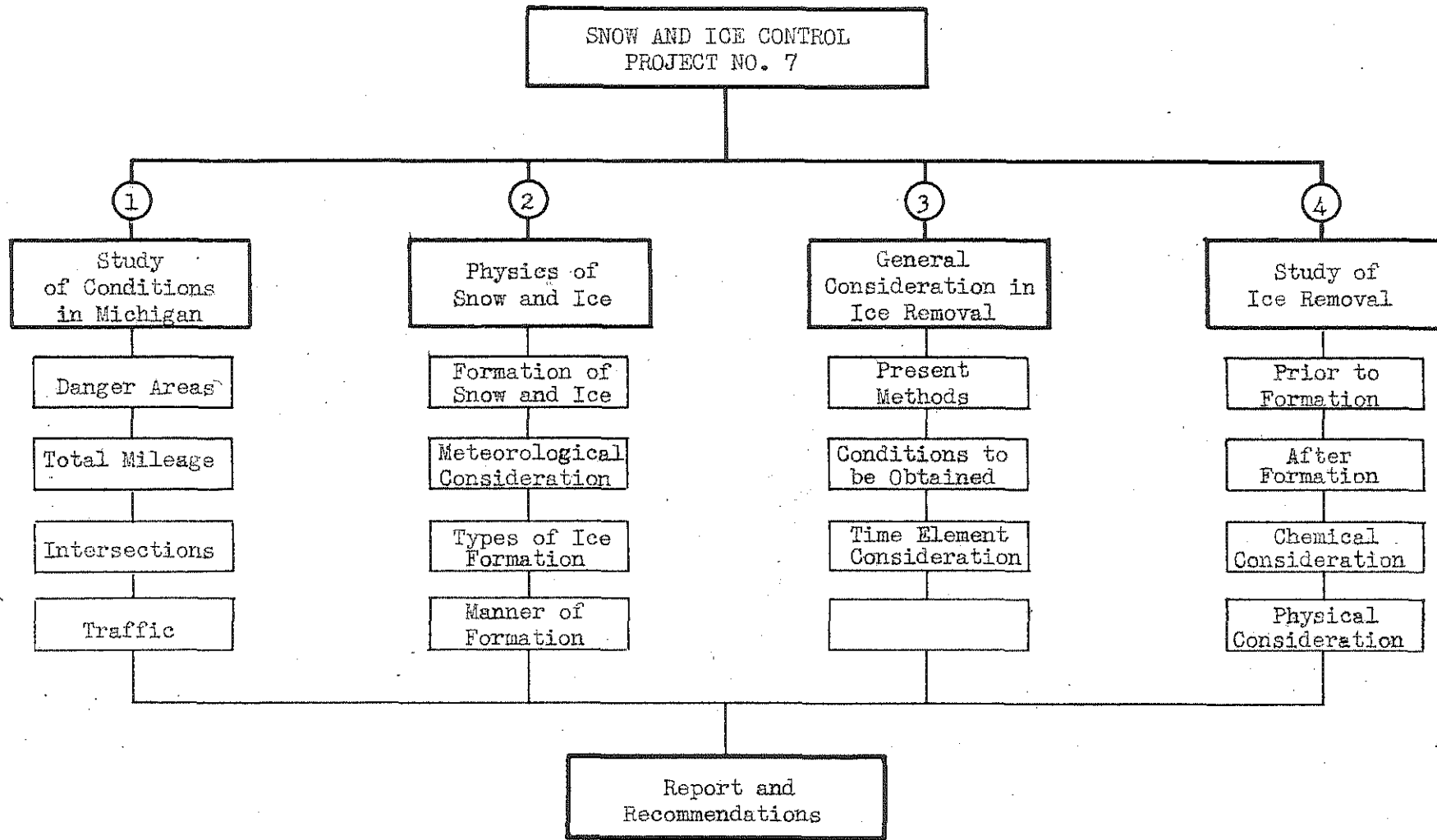
SNOW AND ICE CONTROL

Purpose: The snow and ice problem on highways has reached a state of real importance in highway transportation. Therefore, it is believed that serious consideration should be given to introducing modern methods into removing or preventing ice formation on pavements. It was proposed to attack this problem from a scientific standpoint in an attempt to find out better, modern and economical methods to overcome this serious traffic hazard.

Scope: This problem is only in the outline form, taking into consideration such phases as -

1. Survey of ice conditions in Michigan.
2. Physics of snow and ice.
3. General considerations in ice removal.
4. Comprehensive study of ice removal methods.

Importance: Michigan, because of its unusual topographic location, with respect to the Great Lakes, is subjected to frequent snow and sleet storms which interrupt the normal functions of the Michigan highway system. They also cause many traffic accidents, excessive maintenance costs and reduction in traffic movement. Therefore, any studies which will reveal methods which will improve these conditions should be worthy of consideration by the Department.



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Status: This work has not progressed beyond the outline and discussion stage because men have not been available to assign to the work.

Summary

This project may be set up as a cooperative investigation with the Maintenance Division in so far as they can furnish data relevant to certain parts of this problem. The chemical, physical and theoretical parts can be handled by our present personnel in the research laboratory.

This project should be started as soon as possible in order to be prepared for tests to be conducted next winter.

## PROJECT 8

MISCELLANEOUS STUDIES

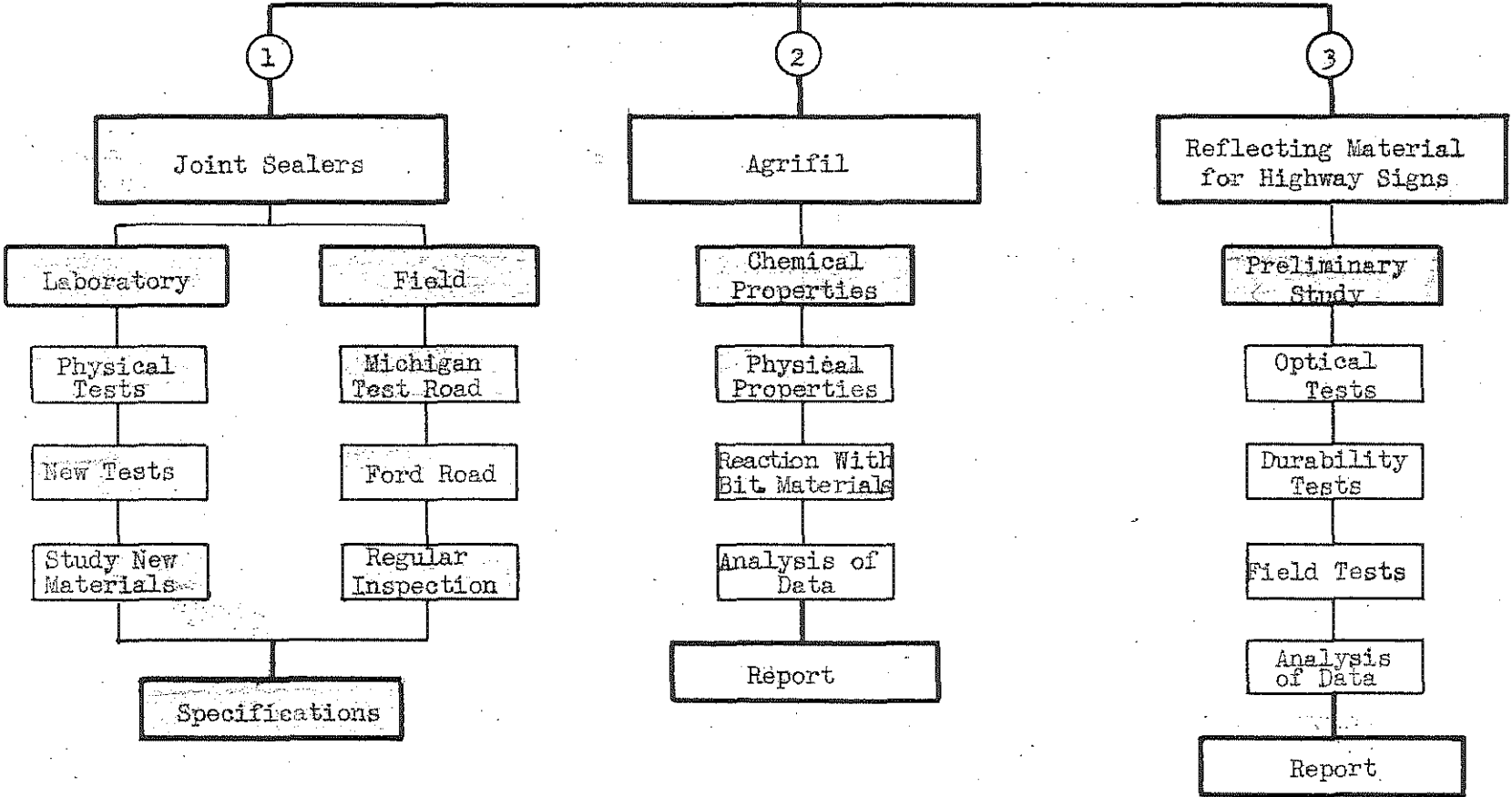
This project was established to take care of miscellaneous research studies of a special nature requested by administrative officials and division heads of the Highway Department. The investigations being carried on at the present time are -

1. A comparative study of reflecting materials for highway signs.
2. Agri-fil and its use as an admixture in bituminous mixtures.

Preliminary work has been completed on study 1, but in order to complete the work weatherometer tests must be made in Ann Arbor, which will require at least 30 days time. The optical work can be done in East Lansing. This study can be completed with present personnel in approximately 8 weeks.

The study on agri-fil is completed as far as physical and chemical characteristics are concerned. If it is believed desirable to continue the study involving bituminous mixtures in the laboratory, I believe that it should be done at Ann Arbor because we lack the personnel at East Lansing.

MISCELLANEOUS  
PROJECT NO. 8



1204

ESTABLISHMENT OF BRANCH RESEARCH DIVISION LABORATORY  
AT MICHIGAN COLLEGE OF MINING AND TECHNOLOGY,  
HOUGHTON, MICHIGAN

In March 1941, at the request of Grover C. Dillman, President of the Michigan College of Mining and Technology, State Highway Commissioner, G. Donald Kennedy, instructed the Research Division to proceed with the establishment of a cooperate research project between the Michigan College of Mining and Technology and the State Highway Department. The Research Division to assume the responsibility for the general direction of the work.

It was understood that the branch research laboratory would be established at Houghton for the purpose of using the laboratory facilities of the College for convenience in investigating the problems of immediate concern to the construction of highways in the Upper Peninsula.

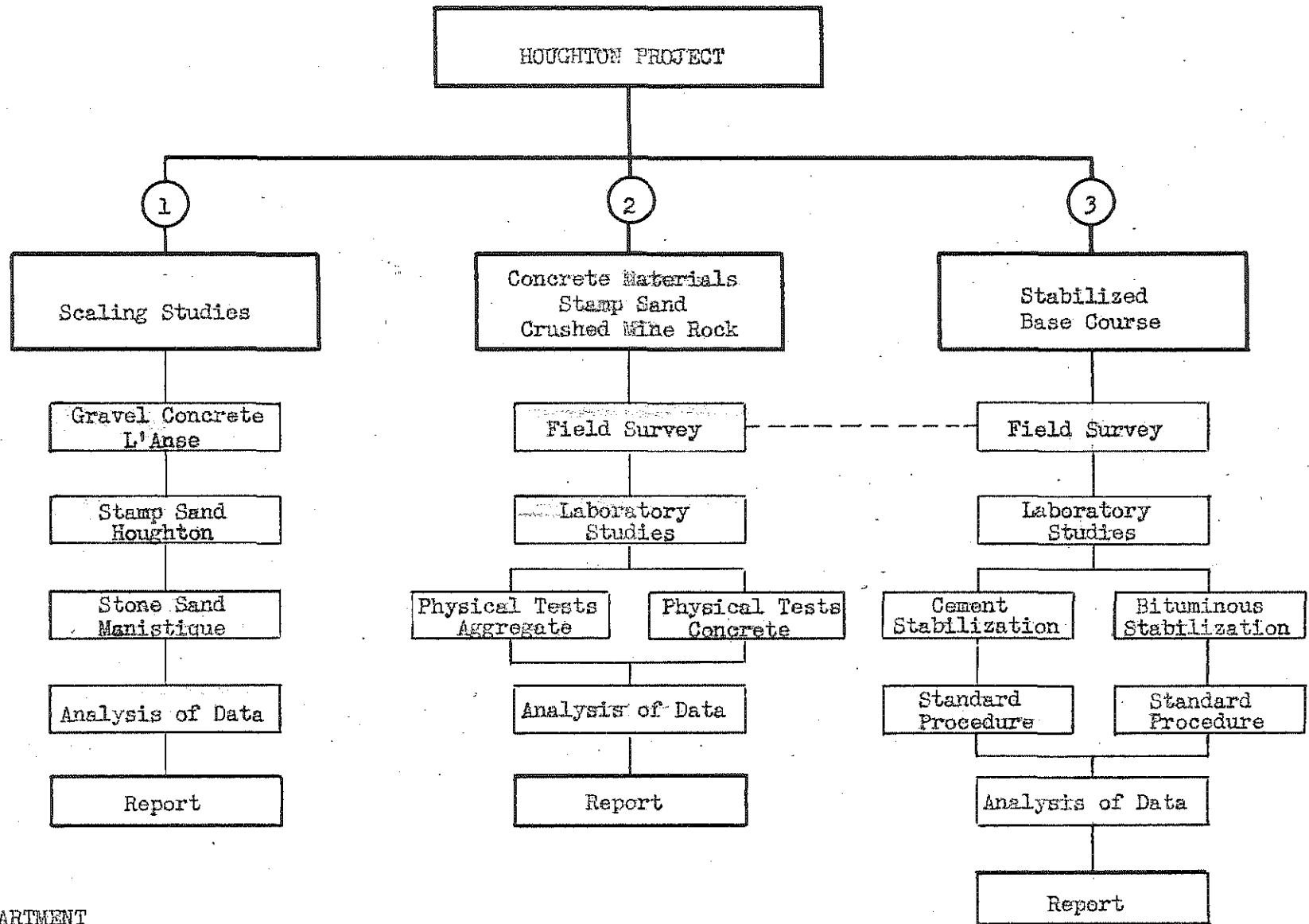
After considerable delay in obtaining and training a man to assume the responsibility for this particular project, the project was started in December 1941 under the following program.

The program was prepared on the basis of suggested projects recommended by the Testing Division and the current activities of the Research Division in the Upper Peninsula.

The research program consists of three major projects as follows:

1. Field scaling studies on concrete pavements.
2. Concrete materials investigation.
3. Stabilized base course investigation.

The major studies listed above will be discussed in the order presented.



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FIELD SCALING STUDIES ON CONCRETE PAVEMENTS

Accelerated scaling studies were made on certain concrete pavements to supplement similar scaling studies on the Michigan Test Road as well as laboratory studies being conducted at East Lansing.

The field scaling projects include a comparative study of calcium chloride salt versus natural freezing and thawing, the effect of calcium chloride on concrete containing stamp sand and the effect of calcium chloride on stone sand with and without silica dust and containing Orvus,

Investigation of Calcium Chloride Salt versus Natural Freezing and Thawing of Water on Concrete Pavement

Purpose: To conduct comparative scaling studies on a concrete slab not previously treated with calcium chloride to determine in what degree calcium chloride or natural freezing and thawing are inductive to scaling of concrete surfaces.

Scope: Scaling panels similar to those used on the Test Road were installed on US-41, Baraga County near L'Anse. The pavement was constructed in 1941 using Champion Sand and Gravel.

Status: This work has been completed.

Investigation of Calcium Chloride on Stamp Sand Fine Aggregate Concrete Pavement

Purpose: To determine the resistance to scale of concrete pavement containing stamp sand as a fine aggregate.

Scope: Scaling panel was established on pavement surface containing stamp sand. The scaling panel is on US-41 about 8 miles north of Hancock toward Calumet, station 440+00.

Status: Work has been completed.

Investigation of Calcium Chloride on Stone Sand Fine Aggregate Concrete With and Without Silica Dust and Containing Orvus

Purpose: To determine the relative resistance to scaling of stone sand concrete pavement with and without silica dust as a mineral filler and containing Orvus.

Scope: Scaling panels were installed on stone sand project in the City of Manistique. Project M 75-28, C2. Panels at station 53+00 right (Orvus and silica dust). Station 54+15 left (Orvus only).

Status: This work has been completed.

CONCRETE MATERIALS INVESTIGATION

It was proposed to make a comprehensive study of local mine wastes to determine their suitability for use in highway construction. The study includes both stamp sand and crushed mine rock.

Study of Stamp Sand as Fine Aggregate for Concrete

Purpose: To determine the suitability of stamp sand, ground and reground for use in concrete mixtures. This will entail field and laboratory studies on the aggregate separately and in concrete specimens.

Status: This study is in progress. To date, the work has consisted of collection of samples and running routine laboratory tests on materials from different sources.

Study of Crushed Mine Rock as Coarse Aggregate for Concrete

Purpose: To determine the suitability of crushed mine rock for use as coarse aggregate in concrete mixtures. This will entail field and laboratory studies on the aggregate separately and in concrete specimens.

Status: This study is in progress in conjunction with the stamp sand investigation.

STABILIZED BASE COURSE INVESTIGATION

Purpose: A study to determine the suitability of stamp sand for bituminous or portland cement stabilized base courses. The study will consist of two parts -

1. Bituminous stabilization studies.
2. Cement stabilization studies.

It was proposed to conduct laboratory studies on these materials for the purpose of developing proper mix design and prepare specifications for base or surface construction.

Status: This phase of the program has not been started.

Summary

At the present time, the work at Houghton is being concentrated on the study of local materials for use in concrete mixtures. The scaling studies have been completed. The stabilized base course investigation has not been started.



The conditions under which this project was originally established makes it a continuous proposition employing at least one man full time under occasional supervision from the Lansing office. Maybe some better method can be devised to carry on this work and still maintain the present relationship between the College and the Highway Department.

GENERAL SUMMARY

<u>Project</u>	<u>Status</u>	<u>Men Required</u>	<u>Men Available</u>	<u>Men Needed</u>
Joint Study	Laboratory work complete. Being written up.	1	1	0
Concrete Durability Study.	In progress-would require at least a year to finish.	3	3	0
Concrete Pavement Design	In progress-time required, indefinite.	4	3	1
Concrete Mix Design	Dormant	1	1	0
Bituminous Mixture	In progress-time required, indefinite.	1	0	1
Soil Stabilization Subgrade Studies	Soil stabilization studies completed. Subgrade studies should be continued.	0	1	1
Snow and Ice Control	Ready to start.	2	1	1
Miscellaneous Studies	Projects under way can be completed within a few weeks.	1	1	0
Houghton Project	In progress, time indefi- nite.	1	1	0