A Review of Scheduling Procedures for State Highway Construction Programs

A paper on "Advance Programing Methods for State Highway Systems," contained in Highway Research Board Bulletin 249, outlined eight major factors essential to the programing process required for state highway improvement. HRB Special Report 62, "Formulating Highway Construction Programs," stresses philosophy, concepts and theory as discussed in a two-day workshop, which followed generally the eight-factor outline. Objectives, principles and benefits of a good highway programing process are reviewed at length in those and other references, and will not be repeated in this report.

The programing process may be condensed into two broad aspects—decision-making and execution. These are closely related in many ways, but have been segregated by the Committee on Highway Programing for separate study and analysis.

This report emphasizes the "execution" or administration phase by reporting available essential details of scheduling and control methods and procedures, with only incidental attention to the bases for making decisions on the priority of projects in an extended program.

Data were accumulated by reference to published material and by personal interviews with officials of 35 states, 2 Canadian provinces, 7 metropolitan counties, and 17 cities. Interviews were conducted by staff of the Highway Needs Branch, U.S. Bureau of Public Roads, and of the Highways Division, Automotive Safety Foundation, in 1961 and 1962. Therefore, some of the procedures outlined herein may have been superseded or otherwise improved.

Allinson Consultants of Fall River, Mass., under terms of an engineering contract with the U.S. Bureau of Public Roads, prepared the initial analysis of the basic data. Their work was supplemented, particularly in preparation of the appendixes, by staff of the Automotive Safety Foundation. The Highway Research Board Committee on Highway Programing has reviewed the text and appendixes and the report is, therefore, a composite product.

This report is limited to analysis of highway department procedures for the following states:

Alabama	Illinois	Michigan	New York	Texas
Arkansas	Iowa	Minnesota	North Carolina	Utah
California	Kansas	Mississippi	Ohio	Virginia
Colorado	Louisiana	Missouri	Oklahoma	Washington
Delaware	Maine	Nebraska	Pennsylvania	West Virginia
Florida	Maryland	New Jersey	South Carolina	Wisconsin
Georgia	Massachusetts	New Mexico	Tennessee	Wyoming

A supplemental report on county and city program execution will be issued later.

Presented at January 1963 meeting of Committee on Highway Programing.

•HIGHWAY PROGRAMING has been defined in various ways, as follows:

Highway construction programing is the translation of construction warrants into capital budgets, thence matching work flow to the flow of revenue (1, p. vi).

Programing—A systematic process of setting forth a collection of things to do with due consideration given to priority and all other factors which determine the desirability of carrying out the act. Highway programing is the scheduling of the construction of highway improvement projects, and of the essential design, right-of-way acquisition and other activities which must precede such construction (1, p. 202).

Priority programing for highway development is the rational selection of projects according to factual need, systematically scheduled to carry out defined objectives within limits of money and manpower, and fixed in advance with reasonable flexibility to meet changing conditions (2).

Each of these definitions involves scheduling, which is further defined as "The mechanics of setting up highway construction programs for a period of years, the system for which must provide for control and for early adjustment of programs to changing conditions, scheduling of precontract engineering and other operations, as well as construction expenditure rates" (1, p. 202).

Objectives, principles, methods and procedures of program formulation and scheduling vary widely among the states and cannot be summarized or classified in a manner which fully reveals basic fundamentals. There are, of course, certain similarities among some states, but these are found to be more superficial than fundamental. Variations seem to be the result of differing state laws, basic objectives, administrative policies and procedures, size and scope of programs, centralized vs decentralized operations, personal relations, and other factors, the combination of which defy simplification or standardization of exposition.

Nevertheless, it is clear that all highway building agencies desire the most effective, yet easily managed, methods for highway programing (as previously defined). The agencies have experimented with different approaches to this problem, and are continuing to do so. They express an interest in how other agencies do it, in the hope that some others' ideas can be adapted for their own use.

This report, therefore, includes in two appendixes carefully condensed factual reports of highway programing processes in 35 states, to the extent that information is available. Data are classified on a functional basis, rather than a state-by-state basis, in order to make possible an orderly comparison of the essential features.

The appendix classifications serve also as a general outline for this summary report, as follows:

A. Highway Program Formulation

1. Apportionment of funds
2. Bases for project selection
3. Financial schedules of available funds
4. Program formulation

B. Highway Program Administration

1. Time schedules for precontract engineering
2. Control and adjustment of time schedules for precontract engineering
3. Control and adjustment of expenditure schedules

A. HIGHWAY PROGRAM FORMULATION

As stated previously, decisions and execution are closely related in the programing process. Scheduling of work to be done by certain times is simply a concrete way of stating what projects are to be started and completed within a time framework. This is program formulation, and each program is limited by funds available for it.

Each program may also be limited by available manpower to carry it out—thus affecting the timing—and by legal or other requirements for such matters as procurement of right-of-way, advertising periods, etc. These matters clearly affect the scheduling but are not as limiting as funds.

1. Apportionment of Funds

The scope and nature of every statewide program depends first on how available funds are apportioned. Initial responsibility rests with state legislatures which apportion state taxes among governmental agencies. Amounts allocated to state highways may be further restricted in a variety of ways, either by law or by administrative policy, or both. Restrictions may be by object, such as debt service, maintenance, equipment purchase, construction; by area, such as highway or congressional districts; by systems, such as primary, secondary; by matching requirements for Federal aid (an increasingly significant factor); or by combinations of all these and other items, such as allocations for individual projects or different types of work.

This study shows that, for funds available for construction (including right-of-way) of state highways in 21 states:

(a) 20 states allocate shares to each highway district, but 4 of these allocate only secondary funds or a resurfacing program.

(b) Of 16 states allocating most funds by districts, 8 use proportionate needs as the principal or sole basis, and 2 more use needs as a major part of a formula. One of the 8 takes road class into account.

(c) Of the 16 states in (b), 4 allocate by arbitrary percentages, 1 by a formula which includes sufficiency ratings, and 1 through annual discussions.

(d) The remaining state (of the 21 reviewed) does not appear to have any district allocation plan. This is substantially true also for the 4 states mentioned in item (a).

In general, therefore, it may be concluded that area distribution of construction funds is of primary concern to the states reviewed here. The "needs" in each district seem to be the predominant influence in allocations, although the definition of "need" seems to vary; this ranges from existing needs on critical sections to 20-year needs.

There is little reference to system classification, although it is recognized that some state laws initially allocate specified shares to state primary, secondary, etc., systems in states having such distinctions. Additionally, all states recognize the importance of matching Federal-aid funds which are limited, by Federal-aid system, to specified amounts. However, because the Federal allocations are made to the state as a whole, state policies for area distribution, etc., can generally be applied, except for the Interstate System, which usually receives special and different considerations.

From this review, it appears that most program formulation currently must be developed by districts within a state, inasmuch as each district generally is allocated some specified amount of money in each time period.

2. Bases for Project Selection

Some information on the bases for selection of individual projects to be included in a specified construction program is available in 31 states—10 more than were involved in the discussion of fund apportionment. It is not intended to provide an adequate review of this problem, which is highly complex and planned for later study. Discussions in the already-cited references outline the many factors that are involved.

However, in order to establish a working schedule, it is obvious that decisions must be made concerning what work goes into it. This section, therefore, reviews broadly the responsibilities for decision-making and some of the bases for those decisions.

Omitted in this review is the question of how firmly decisions, once made, are adhered to. Frequent revisions of project selections and planned improvements are stumbling blocks that upset the schedule and the organization established to carry it out. Therefore, it should be clearly understood that the information provided here should be considered as only the first steps in the initial project selection. Many revisions can and do occur, for reasons not necessarily revealed in this report.

The following summary tends to oversimplify the problem, which usually involves much review through each level of responsibility, study of available data (often furnished by the head office), public hearings, and numerous conferences. Of the 31 states reviewed:

(a) Basic responsibility for selection of projects for annual work programs rests with district engineers in 25 states; of these, 16 use sufficiency ratings or other types of priority rating formulas in their consideration, including 4 states in which it is added that personal judgment of district engineers and commissioners plays a large part.
(b) Of the 25 states, 9 frankly indicate that personal opinion of the district engineers (based on their knowledge and judgment) is the principal basis for project selection.
(c) In 4 of the 31 states, projects are selected by state headquarters, 2 of which use sufficiency ratings, 1 uses general data, and 1 uses largely personal judgment.
(d) The remaining 2 states have no specified procedure.

It is indicated that, consistent with the emphasis on district allocation of funds, the district engineers in a majority of states have the prime responsiblity for initiating work programs. Of the 31 states, 18 show some use of sufficiency or priority ratings. It is not to be inferred, however, that the remainder are doing a less effective job.

For example, one of the better over-all programs is planned and scheduled in a highly decentralized department through district offices which are staffed with competent personnel in all categories of planning and design, as well as other activities. Within budget limits and general policies established by headquarters, each district has autonomy of action. In such cases, the principal problems of headquarters are to establish guideline policies, coordinate actions between districts, and review to assure general agreement.

It should also be observed that few, if any, states have developed adequate techniques to "rate" urban projects, or to compare urban vs rural conditions. Thus, in this problem area, as well as in others, much informed judgment is essential and many factors other than those reported must be considered in program formulation.

3. Financial Schedule of Available Funds

To arrive at the amount of construction to be scheduled for a predetermined time, the availability of funds and a schedule of expenditures must be forecast.

There are two reasons for needing to know the rate of funds available for construction, by month. The first is obvious—it controls the expenditure for improvements. The second, not so obvious, is that the schedule of construction contract and right-of-way expenditures controls the residual funds available for other projects. The type of work to be done and the time of year the contract is let greatly influences the available cash at future times. Should the schedule for lettings have to be adjusted, the cash position changes, which in turn may require further adjustment in the letting schedule. The scheduling of lettings must be firm to keep a favorable cash relationship and the rate of income and expenditures has to be established to keep the letting dates as scheduled.

The income and expenditures by month are required for the length of the scheduled program. This, in many states, is longer than the official budget period or period of actual approved income and expenditures.

Although the information from the interviews precludes accumulating comparable statistics, some over-all facts were observed, as follows:

(a) Availability of funds
  (1) The availability of construction and right-of-way funds to many highway departments appears to be set by the schedule of Federal-aid reimbursement. This is of prime importance to the sparsely populated states, where state matching funds are only 30 to 40 percent of the total available for construction.
  (2) Legislated bonding authority permitted 13 of the surveyed states to issue long-term bonds in 1961. The financial flexibility thus provided allows these states more freedom in the selection and scheduling of construction projects.

(3) Four of the 35 states do not dedicate highway taxes for highway uses. Thus, the availability of funds is dependent on legislated and often unpredictable (for long terms) appropriations from general state funds.

(b) Expenditure schedule

(1) In the determination of forecasted expenditure schedules, allowances are made for seasonal variations in construction activity. Some states have formed an "experience record" of contract expenditure by categorizing past contracts by size, type, and letting dates. An average monthly expenditure was thus determined for each month of an $X size contract, let in a Y month and of Z months construction duration. As a result, advance construction expenditure schedules can be established from the cost estimates of programed projects.

(2) State budgetary procedures are a factor in determining expenditure schedules. In some states the full amount of contract must be on hand and encumbered upon award. Conversely, in other states contracts may be awarded in anticipation of revenues.

4. Program Formulation

"Programs" range from a simple list of jobs to be done as soon as possible, to complex schedules for years in advance. Legislative, budget and administrative requirements (or desires) affect the nature and form of program documents. Efficient execution of the programs may also depend heavily on how they are formulated and recorded.

The following summary cannot provide a complete analysis of how programs are developed in the 35 states reviewed. For one thing, interviews and other available data do not always provide complete information in each general category. But within limitations, the review of program formulation indicates the following:

(a) At least 6 states require approval of proposed programs by the governor, or the legislature, or both.

(b) Responsibility for statewide assembly of program or lists rests as follows: in 6 states, the chief engineer or his office; in 1 state, the assistant chief engineer; in 1 state, the assistant chief engineer and the highway planning division; in 4 states, the highway planning division or division of planning and research; in 4 states, the programing engineer; in 1 state, the highway planning and programing engineers, jointly; in 7 states, the office of planning and programing, or similar title; in 4 states, an official or office other than those previously indicated; in 7 states, not indicated.

(c) Time period for long-range programs: 1 state has a general 15-yr needs plan; 2 states have some general indication of projects planned as far as 10 yr ahead; 1 state develops a 6-yr plan; 12 states cover a 5-yr period. Of these 16 states that have long-range plans, 5 are reasonably firm as to year of construction and the remaining states use the "programed projects" as a pool for shorter-range schedules.

(d) Time period for shorter-range programs: 2 states have 4-yr programs; 3 have 3-yr programs; 4 have 2-yr programs; 8 have only an annual program; 1 has no definite time period (projects are selected continuously); 1 did not indicate the program period.

(e) Programs are published in at least 11 states. Of these, 1 state releases its 5-yr program, 1 releases its 3-yr program, 5 release 2-yr programs (although 3 of them have longer-range programs of some kind), and 4 release 1-yr programs (although 2 of them have longer-range programs).

(f) Of the 25 states having more than a 1-yr advance program, it is indicated that at least 10 follow the practice of a "rolling" program; i.e., renew the full-term schedule regularly. This is accomplished by dropping completed projects from the preceding schedule and adding new ones sufficient to utilize money and manpower estimated to be available in an additional period (say 1 yr) at the end of the term.

(g) At least 10 states follow the practice of "overprograming"; i.e., deliberately including in schedules more work than funds will permit, in order to have a reservoir of projects which can be substituted for delayed work. The amount of overprograming ranges from 20 percent to 100 percent and more.

From the foregoing review, it can only be concluded that there is an extremely wide variation in the practices of, and responsibilities for, the formulation of construction programs. General indications are that:

(a) Few states require official action on specific programs by state authorities outside the highway departments.
(b) Responsibility for statewide assembly of programs varies widely.
(c) About one-half the states have programs looking ahead four years or more.
(d) Only about 20 percent of the states publish advance programs of two or more years duration.
(e) Overprograming in one-third of the states indicates lack of firm controls.

B. HIGHWAY PROGRAM ADMINISTRATION

Study of the execution phase, or administration of the programing process, involves examination of existing procedures for (1) scheduling precontract engineering in accordance with decided-upon program goals, and (2) monitoring both engineering and financial schedules to insure the continuous accomplishment of goals. In these operations, both the availability of engineering manpower and the availability of finance, must be considered jointly in order to make the most logical and efficient use of these basic resources. This study shows that systematic, formal methods are not yet developed—especially for manpower allocation.

Although the administrator's task is sometimes facilitated by consulting engineering forces and authorization to sell bonds, frequently he is impeded by statutory regulations, political whims, and impossible-to-foresee delays. Therefore, systematic reporting and controls are needed to permit adequate adjustment of the initially planned schedule.

1. Time Schedules for Precontract Engineering

Under optimum conditions, all precontract engineering forces of the highway department would be engaged in activities that would lead ultimately to programed right-of-way or construction contracts. Moreover, contracts should be ready for award within the time limitations (exact date, month, year, etc.) as stipulated in the highway construction program documents, and they should be within the framework of available funds. A realistic schedule of precontract engineering activities involves the interrelation of the following general factors:

Financial Schedule of Available Funds.—Inasmuch as many states appear to have a fixed schedule of construction money available, the financial schedule controls the letting schedule and thus dictates to a large degree the schedule of precontract engineering activity. In other states where construction money is less rigidly controlled, the schedule of expenditures may be adjusted to create the most efficient use of both manpower and money.

Engineering Manpower Requirements.—Each project of the program should be examined in order to identify the various engineering activities that are to be performed, the sequence of these activities, and an estimate of the specialized (right-of-way, design, planning, survey) engineering manpower required to accomplish each activity in specified time periods.

Engineering Manpower Available.—The manpower available to accomplish the required precontract engineering should be classified consistently with the activities previously identified. Where feasible and desirable, the personnel may be aggregated in working units, such as survey parties or design squads.

Thus, given the breakdown of engineering activities required to bring the desired highway program to the award stage and the men available to accomplish the work, it

is possible, by trial and error, to outline a work schedule that coincides with the financial schedule of available funds. The task is further complicated by the need to keep idle time and overtime to a minimum.

The complexity of the problem for a whole series of projects appears to have precluded development of basic scheduling theory, which should be the topic of further study. For the most part, this review attempts to reveal the extent to which scheduling has approached ideal conditions.

Upon examination of procedures in 35 states, it was found that 14 maintain schedules of letting dates for at least the oncoming program year. Only 5 of these 14 attempt to schedule letting dates for a second year in advance, and only 2 of these schedule three years or more. The maximum period over which any state has scheduled letting dates is five years. In the two cases where letting schedules go beyond two years, monthly or quarterly target periods are established rather than specific dates.

In some states a formal schedule of some generalized precontract engineering activities has been established. Eleven states have proposed completion dates of various engineering activities throughout at least a one-year period; seven of these schedule engineering activities through a second year, and five continue their schedule beyond three years. Again, five years is a maximum period for scheduling.

The activities scheduled vary from a basic list (location survey, plan preparation, and right-of-way acquisition) to multiple lists of considerable complexity. Some states use the bar chart to portray both the inception and completion of each engineering activity; others use Kardex files to record only estimated and actual completion dates.

There is an overlap of states that formally schedule letting dates and states that schedule engineering activities. Thus in a combined total of 17 states future work is scheduled by the use of one or both of these tools. Of the 18 states that do not maintain advance schedules of activities or letting dates, six use their priority list of projects (their program) as an indefinite guide. Engineering activities are advanced as rapidly as possible on projects near the top of the list, and scheduling is performed on a month-to-month basis.

Some of these six states operate on a highly decentralized basis. In these cases, target letting dates and expenditures are given to the district engineers, and responsibility for advancing priority projects to the letting date is thus delegated to the district engineer.

Only two states of the 35 appear to have neither a priority list of projects, a schedule of advance engineering activity, nor a schedule of advance letting dates to guide the flow of work.

In general, scheduling procedures have advanced in some of the states to the point where future target letting dates are established and, thus, by working backwards from these targets, some other intermediate completion dates are established. These milestones are not necessarily instituted with the view of making maximum use of engineering manpower, but rather are created both to be gages from which over-all project progress may be observed and to be used as intermediate target points to which various responsible engineers must gear the work of their respective sections.

The committee found that few if any states used effective methods of scheduling manpower. Time required to carry out preletting activities is based on personal judgments without the benefit of work measurement analyses (3). Complete examination of each programed project to determine the sequential arrangement of activities and the manpower required is a necessary prerequisite to proper scheduling. The network diagraming devices, successfully utilized in the determination of critical paths (CPM) and project evaluation (PERT) of individual projects, might prove to be a valuable tool in the over-all scheduling procedures of the highway departments.

2. Control and Adjustment of Time Schedules

Once the schedule of precontract engineering activities or, at least, the target letting dates have been established for the priority projects, a systematic method should logically be incorporated to insure targets are hit or, if a miss is likely, to take action such that the previously planned-for balances of expenditures and manpower will be maintained.

The highway program of most states involves such an enormous amount of precontract engineering that communications have a great bearing on control of the program and inherent schedules. At the time data were collected for this survey, the periodic staff conference, the status board, the telephone, or the form letter were the means by which program progress was reviewed. It appears, for the most part, that status reports were required periodically at the headquarters office and that these reports arrived in time to coincide with staff review conferences. The following tabulation reveals that the monthly schedule review is the most prevalent:

Period of Schedule Review Conference	Number of States
Semiannually	1
Quarterly	1
Bimonthly	2
Monthly	14
Triweekly	1
Biweekly	1
Weekly	4
Periodically	1
Inform. not avail.	10

Of the 25 states, only one held review conferences at intervals greater than three months. Generally, these meetings are attended by division heads or personnel who are both capable of answering for a possible delay in a project or an activity, and capable of projecting a future schedule.

Thus, with the aid of status reports and through the medium of scheduling review conferences, both control and adjustment of the highway program are exercised.

But most states are aware of the limitations in this system and are at the stage where more reliable and more rapid processes are being investigated. In fact, one state has fully mechanized the status reporting portion of this problem. This state has established proposed completion dates for each precontract engineering activity of programed projects; and, through the use of punch cards, computers and data on actual completion dates, periodic status tabulations are available. This is but part of the control problem; for although status information is available, the mechanics for subsequent schedule adjustments are not incorporated.

The complexity of the process involved in the original establishment of a schedule (described briefly in the preceding section) suggests that adjustments in the schedule on a periodic or continuing basis would be similarly complicated. The systematic procedures established for program scheduling might also be used to monitor and thus reschedule the program. The repetitive utilization of such procedures and the complicated nature of both scheduling and monitoring the highway program indicate a possible area for computer application.

3. Control and Adjustment of Financial Schedules

As adjustments in the highway program arise, the rate of construction expenditure is necessarily changed. To control the flow of expenditures and to facilitate required adjustments, systematic procedures are desirable.

Monthly reports to the highway commission or other designated responsible authorities appear to be both the manner and frequency in which expenditures are reviewed and revisions to the expenditure schedule are made. These reports are simply status sheets that compare the proposed schedule of receipts and disbursements during the program period with the actual amounts spent and received to date. The forecasted effects of deviations from the original proposals are seldom systematically estimated. Only four states of the 26 reviewed appear to make such forecasts.

The manner in which funds are obligated appears to be of significant importance to the highway program. At least four states have a very simplified accounting procedure in which the full amount of a contract is obligated upon award of contract. In these states, large cash balances in the highway fund (sometimes general fund) are maintained to cover the full amount of construction under way. In at least four other states, the full amount of a contract is obligated within the current budget.

In at least five states, contracts are awarded on the basis that anticipated revenues

will cover some of the contract expenditures. Forecasts of cash on hand are therefore critical. Several methods are used to overcome the inevitable deficits that occur from time to time. In some cases, the deficits are avoided through the temporary use of other state funds; in others, short-term bonds are sold to maintain a positive balance in the highway fund. For large contracts or for continuing activities that extend beyond a year, supplemental allocations for outstanding projects may be made in the following budget period.

In general, the monetary controls appear to be far more exact and more widely applied than the controls exercised over preconstruction engineering activity. This is due to the nature of each area for, although the dollar affords an excellent gage for the measurement of financial status, both the number of engineers and their activities must be examined closely to measure the status of plan production.

C. OVER-ALL EVALUATION

As mentioned at the outset of this review, a fissure was artifically created between the decision-making (program formulation) and execution (program administration) aspects of the highway programing process. Although the primary mission has been to report on the execution phase alone, the interdependency of the two areas justified elaboration in both. However, discussion of the decision-making aspect has been confined to areas that affect highway program administration.

In summarizing this review, an over-all evaluation has been developed. Using three fundamental elements of programing, each state's procedure was examined to determine the degree of formal utilization of each element and the future time period over which these elements were employed:

Advance Construction Program.—In order to execute the highway program, decisions must be made as to the time period in which to accomplish construction goals, the amount and schedule of available finances, the basis for project selection, and the actual selection of projects.

Schedule of Letting Dates.—With the knowledge of what projects to advance toward construction and the time period in which the program must be completed, there is need to schedule project letting dates that make full use of money and manpower. The establishment of a project letting date creates at least an informal or implied schedule of various other completion dates for each engineering activity.

Schedule of Precontract Engineering Activity.—Ideally, formal schedules of precontract engineering activity should be installed for the earlier years of an advance construction program. Although some states are investigating and adopting systematic scheduling techniques, this review has revealed that no state has progressed to the ideal situation whereby:

1. Each programed project is analyzed to accurately detail and arrange sequentially the various engineering activities.
2. An estimate is made of total time and manpower required to accomplish each activity.
3. Projects are compared and shifted in time to maximize the use of manpower resources.

To facilitate the evaluation, a range of seven classifications is presented for the 35 states in this review. The first category indicates the most comprehensive use of programing procedures; the last is representative of the informal approach. (How well the inevitable changes are fed back to revise programs and schedules has not been evaluated.)

Category 1:

Six states have highway construction programs that represent planning for two or more years with letting dates and precontract engineering activities scheduled for at least the first two years.

Category 2:

Five states have highway construction programs that represent planning for one or more years and include precontract engineering activities scheduled for the first year.

Category 3:

Two states have highway construction programs that represent planning for two or more years with project letting dates scheduled for at least two years and no formal schedule of precontract engineering activity.

Category 4:

Four states have highway construction programs that represent planning for one or more years with project letting dates scheduled for one year in advance and no formal schedule of precontract engineering activity.

Category 5:

Ten states have highway construction programs that represent planning for one or more years with no advanced schedule of letting dates or precontract engineering activities.

Category 6:

Six states have priority lists of projects that might be considered their highway construction program. No formal time period for program completion is prescribed.

Category 7:

Two states have no formal advance program or schedule.

REFERENCES

1. "Formulating Highway Construction Programs." HRB Special Report 62 (1961).
2. Automotive Safety Foundation, "Priority Programing for Washington," p. 47.
3. "Highway Employment Trends and Requirements." HRB Bull. 296 (1961).

Appendix A

HIGHWAY PROGRAM FORMULATION

1. Apportionment of Funds

(Information available for 21 of 35 states)

State 1: Prorated on basis of needs.

State 2: Allocated to districts on percentage basis by highway commission resolution.

State 6: Planning division develops current need by estimating cost to bring to adequacy all critical sections shown in last condition rating. Need is computed on project basis, and percentage of total need existing in each district is figured. Available funds are allocated for construction in the several districts on basis of these percentages.

State 7: No fund distribution formula for primary and Interstate work. Secondary funds allocated to counties on formula weighted $\frac{1}{3}$ area, $\frac{1}{4}$ population, $\frac{1}{4}$ productive area, $\frac{1}{6}$ assessed valuation. Formula not followed precisely from year to year; rather, a running balance is kept to determine whether a county is over- or under-allotted.

State 9: Distribution of state funds to districts is based on needs as set forth in a 1954 highway needs study.

State 10: Construction funds forecast to become available in a program period are spread among the ten districts by a formula weighted 20% population, 20% area, 10% highway revenue production, 50% needs costs on critical sections.

State 11: The 100 percent state funds are distributed by districts on basis of equal weight given to population and mileage. Other funds are divided by districts through head office budget discussion, by request of districts, and by availability of plans.

State 12: Formula for distribution of construction funds to districts weighted 10% population, 5% area, 25% urban state truck mileage (including connecting streets), 60% adjusted rural state trunk mileage.

$$\text{Adj. rural state trunk mileage} = \frac{\text{Actual rural miles} \times \text{veh-mi of travel per mile}}{\text{Avg. sufficiency rating} \times 1,000,000}$$

State 13: No formal allocation of funds.

State 17: For primary system only, construction funds allocated to districts by formula based on sufficiency ratings.

State 18: Funds estimated to be available for construction are forecast for five years ahead. The legislature has dictated some of the major policy affecting distribution of construction funds among the counties. Formula allots each county a share of available funds by ratio of its 20-year needs on state highways to total state needs.

State 19: Allocated to counties for secondary road system by formula which includes area, population, road mileage, vehicle-miles of travel. State primary system allocation to districts handled more informally, each district receiving an agreed percentage. Other than required matching FAP funds, state primary system receives residue of available funds after all other allocations are made.

State 20: Funds for farm-to-market system apportioned to counties by formula.

State 21: Deputy director of planning and programing allocates available Federal and state funds to divisions according to need. Consideration is given to needs of each classification of highways on both Federal and state systems.

State 23: For the 1960-5 5-year program, Federal-aid primary funds were allocated to each district on basis of a highway needs study.

State 26: State's 1950 highway law dictated that $^{9}/_{14}$ of gasoline tax revenues is to accrue to state highway department and that $^{1}/_{3}$ of this $^{9}/_{14}$ be used exclusively for construction. Department has to split all construction monies equally between the three commissioners' districts. This apportionment is again split by formula between the several construction districts within each commissioner's district.

State 27: Federal-aid secondary funds divided approximately equally between each of the three districts.

State 31: No apportionment formula. Bureau of research and planning makes estimates of future revenues, determines project needs by districts, and distributes anticipated revenues among 10 districts on basis of needs.

State 33: Eight percent of state construction and right-of-way funds must be expended in each of the eight highway commissioners's districts.

State 34: Fund appropriations for capital construction are mainly for matching Federal aid. A relatively small amount is appropriated for non-Federal-aid construction. Once appropriations are made, head of department has full authority to make subsequent decisions concerning individual projects. For 100 percent state funds available for capital construction, no division is made to rural, primary or secondary. All urban construction is Federal aid. On the resurfacing program, there are approximate district allotments within which each district engineer is expected to operate.

State 35: A proportionate allotment of construction funds is made for each of the nine construction districts. Although district allotments are subject to some flexibility, a predetermined percentage is used for basic allotment. District allotments based on estimated needs as determined in needs study.

2. Bases for Project Selection

(Information available for 33 of 35 states)

State 1: Law requires that all highways on state system be rated at least every two years. Sufficiency rating of 70 considered cutoff for critical need. Machine tabulations of sufficiency ratings, costs and needs are prepared for each division. Division engineer, state highway engineer, and their assistants, select two-year project list and agree on type of improvement.

State 2: Central office maintains list of projects with sufficiency ratings below 70. Districts utilize list in selecting five-year program.

State 3: Projects are selected based on a 1956 highway needs study and subsequent program study. Construction priority ratings were applied to all deficient sections of state highway system. District engineer makes initial project selections.

State 4: Projects selected for annual program are based initially on judgment of district engineers. Selections also guided by highway needs study which is assembled and displayed on straight-line diagrams containing limits of projects, estimated cost and type of work.

State 5: Project selection based on a 1960 highway needs study and sufficiency ratings. Special significance given to structural deficiencies. Sections rated are kept small and are never longer than a single construction project.

State 6: Priorities for improvements on FAP and FAS systems are made from a condition rating classification system. Because numerous administrative and jurisdictional matters affect actual program of urban work, ratings serve only incidentally in assignment of construction priorities to urban extensions. Using condition ratings, and with consideration to closing gaps and to continuity of improvement, planning and programing division selects projects for annual program.

State 7: No sufficiency rating or other project selection device. District engineers submit priority list of projects, from which planning and programing office assembles proposed program.

State 8: Several sources of recommendation considered in selection of projects for construction: 15-year needs report, recommendations from public at commission meetings and hearings, division engineer.

State 9: Using a 1960 needs study as a guide, district engineers select projects for inclusion in three advance biennium budgets. Other guides used in the decision-making process include: maintenance costs, accident reports, traffic congestion, area distribution.

State 10: Commission relies on three sources of information for selection of projects for construction: periodic public hearings, district engineers' priority ratings based on sufficiency ratings, bureau of planning and research priority rating system based on empirical formulas (does not include urban projects).

For FAP system:

$$\text{Priority} = \frac{\text{dPpsm} + \text{dApsm} + \left[\frac{\text{DVM}}{\text{Rf}\ (1 + \text{Tf} - .08)}\right]}{\text{SR} + \text{dMEpm}} + \text{Lf}$$

in which dPpsm is the district population per FAP mile, dApsm is the district area per FAP mile, DVM is the daily traffic over critical section, Rf is the highway revenue production factor (example, in 1958, 184.7 miles of FAP travel produced $1 of state highway revenue), Tf is the percentage of trucks, Sr is the sufficiency rating, dMEpm is the district maintenance expenditure per mile, Lf is a linkage factor, 1-3 (varies with sufficiency rating of adjoining sections and percent truck traffic).

For FAS and state-financed systems:

$$\text{Priority} = \frac{\text{cPpsm} + \text{cApsm} + \frac{\text{DVM}}{\text{Rf}}}{\text{SR} + \text{cMEpm}} + \text{Lf}$$

in which cPpsm is the county population per FAS-S mile, cApsm is the county area per FAS-S mile, cMEpm is the county maintenance expenditure per mile, Lf is a linkage factor, 1-5 (varies with sufficiency ratings of adjoining sections), and all other symbols are as defined for the FAP system formula.

State 11: Projects selected mainly through advice of district engineers.

State 12: Project selection largely responsibility of district engineers, the selections being based on a highway needs study and head-office-established quota of construction funds.

State 13: No formal priority procedure. Projects informally selected with due consideration to recommendations of division engineers.

State 14: District engineers annually recommend locations, needs and estimated costs for following year's program. Primary base for development of long-range construction programs is a 1953-4 statewide needs study. A "backbone system" is being studied in detail as part of advance engineering program.

State 15: Initial project selection based on district engineers' personal knowledge of conditions and sufficiency ratings for primary and secondary systems.

State 17: Sufficiency ratings utilized to select FAP projects. Other projects selected by district engineer and district commissioner.

State 18: Based on fund apportionment, each district is given target amounts of construction funds for five-year period. Districts make initial project selections, guided by long-range highway needs studies. Route priorities and continuity of development are guiding principles, with emphasis on main freeway routes, traffic and accident rates. No formal rating procedures; usual policy is district staff discussion on round-table basis. Highly decentralized organization, with each district fully equipped with traffic engineers, planning staffs, route location engineers, etc. Round-table discussions utilize facts and needs reports to some extent, but generally intimate knowledge of district planning engineer and others dictates ultimate recommendations and decisions.

State 19: State primary roads classification (Class I, interstate and interurban truck routes; Class II, interstate and interurban passenger car routes; Class III, heavily traveled local roads; Class IV, lightly traveled local roads) for 1958-75 provides guide for selection of projects. Standard for classification and an applicable standard for design has been established for each grouping. Headquarters programing office may initiate action toward scheduling work on certain locations, but more often district engineers propose projects. In FAU work, since cities are required to participate in 25 percent of all project costs, they are also basic originators of projects.

Secondary road system projects selected by resident engineers on annual basis, largely on availability of plans. County Board approval requested annually. Since no local funds are used, such approval is generally pro forma.

State 20: For primary and secondary state systems, projects are recommended by district engineers on basis of a 1954 needs study, sufficiency ratings, maintenance cost, and traffic. For farm-to-market system, projects are selected on basis of traffic and recommendations of legislators.

State 21: Each state highway surveyed at least every two years and a sufficiency rating established by sections. Department's purpose in selection is to bring lower rated sections up to adequate standards as rapidly as possible. Interstate highways are being programed as rapidly as funds permit, with priority given to large cities having heavy congestion and to heavily traveled rural highways between larger cities. Other selections made from important primary, urban and secondary routes to establish traffic relief routes around municipalities and to replace deficient bridge structures, correct poor line and grade, eliminate hazardous intersections and railroad-highway grade crossings.

In the 5-year rolling program, initial project selection is made by each of twelve divisions on a program form including such information as project identification, existing physical characteristics, capacity rating, service rating, structural rating, sufficiency rating, traffic, indication of excessive accidents and maintenance costs, purpose of improvement, proposed work, and cost details. A location map is also submitted. Recommended projects are forwarded to division of planning and programing for review and screening by the deputy director of planning and programing with the field division engineer, who assign a priority rating. The five-year highway construction program is a list of these rated projects.

State 22: Project selection based on deficiency ratings supplemented by recommendations of district engineers.

State 23: "Service rating" is used as a priority rating device. At present, a rural rating device that uses indexes of surface condition, accidents, operating speed.

State 24: Project selection based on sufficiency ratings and estimated needs costs; initial list drafted by district engineers.

State 26: Since construction funds are distributed, by statute, equally among highway commissioners' districts, then further distributed to construction districts by formula, recommendations for project selection for construction program are made by district engineers approximately six months to one year in advance of anticipated Federal-aid allotment for coming year.

State 27: No formal priority procedure for selection of projects. Federal-aid secondary projects selected by highway commissioners.

State 28: Projects tentatively selected four years in advance of anticipated construction. Initial selection made by district engineers with considerable guidance from a biennial sufficiency rating report.

State 29: By law, commission is required to prepare 5-year primary road construction program based, at least in part, on sufficiency ratings. Later revisions of program procedures are expected to utilize newer rating techniques and values.

State 30: No rating procedure or other guides used in selection of projects on basis of relative need. Personal knowledge of existing conditions and a 1956 master plan of highway development form basis for project selection.

State 31: A highway needs study is considered the long-range plan. Most urgent projects, together with sufficiency ratings, form basis for initating projects into annual program. Bureau of research and planning does "control section" planning, which is

an approach to route planning. Needed improvements within a control section are considered candidates for annual program. Needed improvement may cover all or only part of a control section. Programing and planning section then would consider other work to be done on control section to ultimately bring entire length to uniform design standards.

Bureau of research and planning maintains "control section program charts" that contain small-scale drawing of control section with designated work units, priority rating (for structures and total section), traffic, character (description of area), description of work units (type of construction involved in each unit), phasing table (time sequence of preconstruction with costs involved).

State 32: Development of advance annual programs begins in office of programing with 20-year needs study. This, by law, is updated regularly, and the needs established by 5-year periods. Estimates are based on general average cost per mile. Included as separate items are preliminary engineering, right-of-way, construction, and construction engineering. Needs are arrayed in priority sequence and compared to limit of construction funds available over 5-year period.

State 33: Plans branch of planning division is charged with making sufficiency studies. Rating indexes are grouped as adequate, tolerable, inadequate, and critically inadequate. A 1960 "Needs Cost Report" deals with needs of existing rural state highways based on a 1960 sufficiency study. Only those roads considered to be inadequate (rating 69 or below) for 1960 traffic are shown. A master plan prepared in 1960 to serve as an objective upon which to base future planning, was approved by the highway commission, but was not accepted by the legislature. Although the factual information appears to be available, project selection is not systematized. Projects are selected by district engineers without direct regard for sufficiency ratings or plans.

State 34: A rather generalized needs study, based on 1958-9 data, coupled with a sufficiency rating evaluation accomplished on 50 percent of the mileage each year, tends to guide selection of projects. However, basic decisions are made by district engineer. Resurfacing projects recommended in construction program are reviewed in regard to volume/capacity ratios, structural ratings, and sufficiency ratings. All proposed projects are set up for higher authority and final decision rests largely with assistant head of highway department.

State 35: Construction projects selected initially by planning and programing division to conform with district allotment of funds. All construction projects selected on basis of project needs priorities. Road life unit of planning research section has developed current "road status cards" together with "construction project log" records. The log shows in diagram form the year-by-year improvement for each section of the trunk highway system. Record cards are reproduced on punch cards, from which machine printed listings classify all road sections by individual characteristics, such as traffic volume, shoulder type and width, surface type and width, etc.

3. Financial Schedules of Available Funds

(Information available for 19 of 35 states)

State 1: An IBM program has been established to project financial obligations. Factors are applied to a project cost based on the quarter construction began and the length of construction time in quarters to tabulate out obligated balances remaining on a project.

State 2: No detailed projections to indicate at what times specific unearned obligations will be anticipated to fall due.

State 7: Upon letting of a contract, contractor gives state his proposed schedule of work and state keeps track of amounts payable. Based on this information, state each month prepares tabulations of predicted contract payments for one year in advance.

State 9: Operates on an anticipated revenue basis, which makes it necessary that projections be made of monthly cash demands. Comptroller feels sure he has a satisfactory working plan for estimating cash demands for construction and preliminary engineering, but has not yet devised a scheme for anticipating rate of expenditures on

right-of-way. For preliminary engineering, this is an annual lump sum estimate by districts, with only different rates for monthly expenditures between summer and winter. For construction, two bases seem to give best results—the number of calendar working days as stated in the contract, and the month in which the contract was awarded. Cash demand projections for construction projects have been worked out on a percentage basis, using these two criteria for each quarter. Over-all projections of anticipated funds for an oncoming biennium are made by the motor vehicle department and the highway planning survey.

State 10: Office engineer projects state highway department's income by month for fiscal year. This is based on registration, population and fuel consumption over a seven-year period.

State 11: Highway department's bureau of fiscal management prepares "spread sheet" by month for the budget period. Estimated revenues and expenditures are replaced with actual monthly figures as budget period progresses. In preparation of spread sheet, contingent commitments or carry-overs of obligations from preceding periods are first recorded among expenditure items. State may encumber future budgets in this way, so current budget is not charged for full amount of contract obligations unless work is entirely completed within budget year. Primary concern is, thus, with cash balances. Charts of balances over a 4-year period indicate drawdown during summer months and uptrend in winter. Anticipated monthly expenditures for contract items based primarily on rate of permitted Federal-aid obligations reimbursement. It is assumed that plans and right-of-way will become available to earn Federal funds and consequent state matching as rapidly as permitted. Remaining state funds not tied to Federal aid are spread for expenditure according to best judgment of chief engineer and other engineering design staff as to how rapidly work can be placed under contract.

In spreading proposed contract expenditures for future budgets, carry-over status reports are prepared periodically, and remaining cash payments to be made monthly are spread according to average percentages which depend on type of contract and experience with rates of payment. As new projects are advertised, engineers' estimates, working days to complete, etc., pass through bureau of fiscal management, which anticipates total future monthly cash requirements in accordance with a standard set of factors developed from past experience of contract payment. The data then replace the past estimates of projected monthly expenditures on spread sheet.

Similarly, ROW settlement (separate budget item) is estimated over future time, and actual obligations are substituted for estimated amounts as they come in. Due to state's 6-year limit within which ROW settlement can be deferred, study shows that half of any particular obligation will be paid out within 12 months, and balance is spread over remaining 5 years in decreasing annual percentages.

State 14: Anticipated actual expenditures within annual construction program depend on date of contract award within current year and nature of work. This is estimated by construction division on forms containing all programed projects grouped by system, along with estimated or actual award date, estimated or authorized present annual cost, carry-over obligations from preceding years, and estimated total expenditure. Amounts for current year are divided among each of the twelve months. Similar sheets are prepared for carry-over work from each of two or three preceding years, as well as for new starts for current year. Remaining obligations for ensuing year are indicated. All sheets are revised monthly, with actual expenditures substituted for estimates as they become known.

State 18: Program and budget engineer in headquarters office prepares budget estimates and advises districts of annual target amounts to be spent over 5-year program.

State 19: Highway commission allocates funds annually and has no legal authority to commit funds beyond ensuing year.

State 21: A tentative program report outlines the forecast of funds available in forthcoming fiscal year. Each project is listed and an estimate is included of expenditures by quarters for preliminary engineering, construction engineering, right-of-way, construction. Another project listing breaks the estimation of expenditures into categories of participation, such as FAI, FAU, FAP, FAS, state, local.

State 24: Budget prepared by planning and research engineer on basis of anticipated revenues. Tabulations of quarterly revenues are related to quarterly schedule of plan completion.

State 25: Comptroller forecasts future cash requirements by quarters for two years ahead and relates these to current and anticipated income. After estimating basic cash needs for debt service, administration, maintenance, etc., remainder of income is available for construction, engineering, and right-of-way purposes. Comptroller advises planning and programing division of available funds by systems, years, and quarters. These estimates control advertising dates. Forecasts are revised each six months; this affects scheduled advertising dates. Master program lists all construction, engineering and right-of-way projects scheduled for current program. Costs for engineering, right-of-way and construction are detailed, with breakdown between Federal and state participation.

State 26: Program manual, "Schedules for Lettings, Surveys, Public Hearings, Plans and Right-of-Way Acquisition," lists Federal funds that will accrue for two fiscal years. This document outlines both total Federal participation and breakdown between preliminary engineering, right-of-way, and construction, for each programed project. Department has authority to issue bonds up to $85,000,000 to be used exclusively to meet deficits in matching Federal monies.

State 29: State highway commission operates on basis of anticipated receipts and disbursements. Contract engineer makes an anticipated receipts schedule by months for entire year. Anticipated costs are estimated by 24 project engineers throughout state for submission to central office, where they are compiled with scheduled program items.

State 31: Bureau of construction, since 1949, has recorded monthly payments made on total contracts outstanding. Composite average expenditures by months have been computed and reduced to a percentage distribution by months throughout the year. This distribution, with schedules of available finances and contract awards, is used in a computer program to estimate monthly expenditures on contract awards and thus the residual funds available for new contracts.

State 32: Finance division provides estimates of income monthly for five years ahead. Projection includes share of motor vehicle highway fund, municipal participation, Federal aid, miscellaneous receipts. Forecasts are revised quarterly and furnished to deputy commissioner and chief engineer for use in developing program limits. Projections are based on an experience table developed from a study of payments made on completed projects.

State 33: Comptroller's division of highway department prepares and justifies all budget estimates and financial plans. Biennium budget contains estimated road-user revenues, based on average of three preceding years.

State 34: This is a general fund state. Highway department indicates its proposed needs to state budget director, who with governor makes decisions on totals to be recommended. A sizeable bond issue has been authorized, but it is held in reserve and has not been utilized except in small parts.

State 35: Program development section of planning and programing division maintains several tabulations that portray estimates of program expenditure for each month of current construction program. Breakdown of expenditures is by district and by type of work.

4. Program Formulation

(Information available for 35 of 35 states)

State 1: Planning and programing division is responsible for biennial program assembly and publication. Engineering and right-of-way are included in program. Highway commission is advisory, therefore does not give formal approval. Governor's review and comments are given before publication.

State 2: District highway improvement proposals are submitted to chief engineer's office and to highway planning for additions. District submissions are overprogramed

about 50 percent by underestimating costs. Final 5-year program is trimmed to about 15 percent overage.

State 3: Based on a programing study, a 5-year construction program, updated each year, is basis for project scheduling; operation of program is a function of highway planning survey division.

State 4: A 5-year advance program is maintained. Listing shows Federal system, location, route number, total Federal funds required, apportionment of Federal funds between construction and right-of-way, and matching state funds.

State 5: Responsibility for advance programs delegated to planning and research division. Program manager, under direct supervision of planning and research engineer, is responsible for actual development of 5-year program through cooperation of the five highway district engineers and top management.

After selection of the tentative 5-year program, two conferences are held before the program is submitted to the state highway commission for formal approval. The first includes planning and research engineer, program manager, and each of the five district engineers. The second is held with top administrators of highway department. These conferences are important steps in forming a firmer program, as special circumstances can arise and sometimes alter the tentative program. Some special circumstances are traffic control problems, state construction resulting in pertinent feedback information, commitments made with other authorities, coordination of work, etc.

The conference with field personnel, and information gained from top administrators, permits adjustment of programs to accomplish even distribution of work throughout the state. Necessary changes are made by programing section, then tentative program is submitted to state highway commission for review and formal approval.

Advance programing has been for one 5-year period only. Anticipated revenue for the 5-year advance program has been based on Federal funds and the necessary state matching funds.

State 6: A 3-year program is in effect at all times. The first year (annual) is generally a firm program; remaining two years are tentative. Program is tentatively set up by planning and programing division for approval by chief engineer and highway commission.

State 7: From priority recommendations of district engineers, planning and programing office assembles projects into (a) "A" priority program, of construction and right-of-way purchase for upcoming fiscal year; and (b) "B" program that includes both a tentative second-year construction program and a list of surveys authorized (preliminary engineering authorization). The "B" list includes costs for something more than a year's work, the accompanying "surveys authorized" work lists only engineering costs.

State 8: Advance planning department is charged with continual re-analysis and updating of priorities and projects in 15-year plan. Each year projects are taken from 15-year plan and offered to highway commission for preliminary approval. This is go-ahead sign for beginning of planning that will ultimately lead to a construction contract in three to four years.

State 9: Each district engineer prepares three biennium budgets, with each project detailed by type of work and estimated costs. Work control engineer assembles districts' data and selects projects for Federal aid. These working budgets are then subject to review by director of highways before working copies are prepared for highway commission review and approval. Commission reviews all three biennium budgets, but approves one and gives tentative approval to the other four years. This, in effect, constitutes a 6-year rolling list of projects. Current annual programs are selected from first two years.

From this budget are extracted projects pertaining to each legislative district, and these lists are made available to each legislator. During the legislative session, a meeting is scheduled for each legislative district. The budget is made public and various items are discussed. Although the budget is prepared and submitted to the legislature in detail, legislative approval is by appropriation only for the total amount.

From the approved budget, district engineers prepare an annual construction program of items that appear in the current budget, projects carried over from previous

budgets, and projects not previously programed. This district submission is the first attempt at a priority rating and is tempered with district manpower requirements and the amount of money available. Usually these annual programs are optimistic and contain 60 to 70 percent of the total work load in the biennium.

State 10: Programing is coordinated by director and chief engineer, with assistance of office engineer, who prepares and submits program proposals, and district engineers, who constantly review adequacy of roads and patterns of road use in their areas.

Once arrayed in a critical inventory, the allotment of funds made to each district indicates number of possible project selections for each county in the district. These selections were first adopted into a 3-year highway improvement program in January 1960. As highway sections drop into the critical category in biennial reviews of sufficiency, the socio-economic evaluation formula is applied and they are inserted in the "critical inventory" in proper order of urgency.

Publication of the program, well in advance of construction, assures citizens that future highway construction is not a piecemeal list of projects but instead is a well-developed progressive and coordinated plan for continued improvement of the entire system.

The state does not prepare an annual program as such. All monies must be appropriated by the legislature biennially, and the appropriation must cover all Federal funds. Budget is prepared by state highway department and is submitted to legislative council, which draws up all appropriation bills. Council can question any budget item, but cannot change or revise budget. Director appears before legislative council on state highway budget. Hearings begin about Labor Day and last until Christmas. Department representatives usually appear before the council at least three times during this period. Any revamping of budget is done within the department.

Projects are selected by commission from 3-year program. When projects are taken out of program, new ones are added. Money is distributed by districts, and projects, moneywise, all are accumulated up to a certain amount, usually 80 percent of allotted 2-year amount.

The working program is then turned over to the chief engineer, who releases projects for scheduling. Some two years may elapse between commission approval and scheduling of projects.

State 11: State budget, as submitted by governor to legislature, is generalized and based on dedicated revenues and Federal aid. Highway department expenditure items include administration, engineering, construction financed with state funds, construction financed with state and Federal-aid primary road funds, construction financed with state and Federal-aid secondary road funds, construction financed with state and Federal-aid urban road funds, construction financed with state and Federal-aid Interstate road funds, state highway and bridge authority rentals, acquisition of right-of-way, maintenance and construction of other roads and bridges, road maintenance, flood and storm damage, service operations. Additional internal construction budgets are maintained by highway department.

Proposed budget is determined by a top level budget committee within the department. Federal aid has major influence on budget and programs; however, bonding authority permits acceleration of Interstate program. Other funds not required for Federal matching are available for expenditure on any road system, but emphasis is given to secondary state system.

Department maintains both a 2-year and a 4-year program. The 2-year list outlines actual proposed construction and bidding program; the 4-year list includes the 2-year program and most of the other projects that are in some stage of preliminary engineering. Although both lists are maintained in the head office, they are based on decisions of the district engineers and availability of plans. Because the districts are largely autonomous, in some cases districts have embarked on engineering work in locations not yet listed in the 4-year program.

The 2-year list is machine tabulated and contains description, district priority, ADT, present width, type of improvement, cost, highway system, and method of financing. The list includes a 50 percent excess of project cost estimates over the target goals of available funds. All major construction projects are included; resurfacing,

hazard eliminations, betterments are excluded. The 2-year program is published for the FAP, FAU and FAI systems only. When published, it is states that projects for the next two years are to be selected from among this excessive list.

The legislature does not act on individual programs or lists of projects.

State 12: Based on quotas, districts submit proposed projects for each year's construction. Each project is described and estimated in some detail, together with the district's proposal for financing methods. Districts are requested to submit estimates totaling 25 percent more than annual quota would permit and are encourage to submit more than one year in advance. Costs and fund sources are shown separately for preliminary engineering, right-of-way, structures, grading, base, surface, other.

Estimates are summarized by planning and research division on an internal form by state system and by county. They are listed in district rank of priority and are reviewed by head office for adequacy of estimates and policy decisions. Following this review, with particular attention paid to determining sources of funds, essential data are recorded on IBM cards by year of proposed construction and by system. At this point, highway commission approval is sought for 1-year tentative program, about one year in advance. Then IBM summaries are run for a check on funding of projects over a 2-year period, when some projects may have to be shuffled between various sources of financing, deferred, or pulled forward. By law, commission must issue a public program no later than November for succeeding year beginning July 1.

Planning and research division has no control over concept, location or design and is not responsible for advance planning as such. Generalized surveys, such as O & D, are not scheduled as part of programing operations. A needs study completed as of January 1960 covers a 10-year period. Priority by years is included to some degree in the needs study, but current advance program discussed in the preceding has not yet been compared to needs survey.

State 13: No long- or short-range program of highway construction. No formally established backlog of projects, thus project selection is a continuous process.

State 14: Advance Engineering Programs. —In 1958, a public document entitled "An Enlarged Program of Highway Planning and Construction" was assembled from basic data contained in a 1954 needs study. This report has remained as a primary base for advance engineering (5-year) programs.

Separate advance engineering programs are developed for the ABC system and the Interstate system. These programs list all projects on which studies or detailed engineering will be carried out over a 5-year period. Most recent estimates of costs of construction, right-of-way and engineering, along with the present status of studies, surveys and plans, are incorporated. Also shown is responsibility of work (state or consultant) and whether a public hearing is required. Projects include major route studies for proper design and development of certain routes from border to border. The list is revised several times a year by correcting data contained in previous versions. Annually the program is revised completely (a) to eliminate completed work, (b) to move second-year priorities to the current year, and (c) to add a fifth year group.

No attempt is made to balance probable construction expenditures or engineering budgets with annual income. It is estimated that 50 percent more work is in study or engineering stages of the advance engineering program than could be accomplished in any single year or for the five years as a whole. Engineers, both state and consultants, are instructed to proceed as rapidly as possible with the A priority group, then move on to the B group, etc. Theoretically, no studies or surveys are authorized to be done on locations not covered somewhere in the 5-year program.

Work carried on with 100 percent state funds has no similar advance engineering program. Much of such work is simply maintenance betterments, but may include major resurfacing projects, bridge construction, climbing lanes, and curve correction, which may or may not be let to contract. In certain cases, however, projects are taken from the advance engineering program to be financed with 100 percent state rather than Federal-aid funds.

Programing engineer is responsible for development of both the advance engineering program and the annual construction program discussed later. He recommends especially the long-range route studies and establishes approximate contract limits

upon which detailed engineering proceeds. Detailed control is centered in engineering department, which recommends final contract limits, design standards, and details, as well as preparing estimates at several stages. Final recommendations of engineering department are then returned to programing engineer and chief engineer for approval. Other documents for control purposes flow through program engineer's office as discussed later.

Annual Construction Program.—As in the procedure for advance programs, the annual program is divided into ABC construction program and Interstate construction program, but these are prepared by programing engineer for only one ensuing year. The list is divided into quarters, with projects contained in each quarter limited by Federal "contract control" amounts. Therefore the lists show not only identification but also total project cost, the fiscal control and probable fiscal year cash expenditures, as well as the project status or estimated letting date. The only difference between project costs and control costs is that occasionally a project will be listed as being paid from state funds not subject to Federal contract control provisions.

Estimated costs include 10 percent for engineering and contingencies. Specific projects are included basically from the "A" group of the advance engineering program. Estimated letting dates are established based in part on status of plans and right-of-way and in part on funds available. Probable letting dates are established by reference to status reports of advance engineering program and through weekly meetings of all major department heads with program engineer, during which annual program might be revised in accordance with current facts, or delays are reviewed and action taken to reduce them. The annual construction program is, therefore, revised monthly and issued to all concerned. The program is made public in the beginning of the year.

Attached to the program is a list of supplemental projects totaling 80 percent as much money as the regular proposed construction program. These supplemental jobs have been selected from the advance engineering program because plans are completed, or nearly so, and, therefore, the projects could be substituted for any in the regular construction program which might be delayed or dropped.

State 15: Projects for capital improvement program are initially selected by district engineers, then reviewed by chief engineer. Highway commission adopts program and recommends approval to governor and general assembly. As a "general fund" state, total amount of program is based on what the department thinks it will receive as related to previous approvals.

State 16: Construction programs are prepared beinnially. After Federal ABC and Interstate funds are made available to the state, field offices are advised to proceed in preparation of their programs. Districts are given two months to prepare programs for submission to central office, which takes about two additional months to consolidate district programs before submission to highway commission. Central office screening of field programs is based on knowledge of existing conditions by area engineers in design division, balance between districts, maintenance costs, traffic, accident records, etc. Commission has authority to accept or reject any part of program.

State 17: Proposed annual construction program is a part of formally adopted state road department annual budget. Each district prepares its own district budget. Budgetary document contains estimated annual expenditure for each project then under way or proposed.

State 18: Advance program is a 10-year list of projects tentatively scheduled for first five years. State's "Planning Program" itemizes project identification and limits, total project cost, costs of project elements (regrading, viaduct, etc.), element costs spread by scheduled time period for construction or right-of-way acquisition, and remarks concerning reasons for project inclusion, stage of plan completion and other general information.

Headquarters budget and program engineer compiles next fiscal year's budget (program). He receives up-to-date information on plan completion, availability of right-of-way, etc., by direct contact with district planning engineers and by reference to status reports of 5- and 10-year advance plans. Once budget has been assembled, tentative letting dates are established by budget and program engineer. To avoid advance knowledge by contractors, this information is kept confidential.

Annual construction program, which is reflected in annual budget, is set up for one fiscal year ending June 30 and is submitted by division of highways to commission in previous October.

State 19: Interstate System. —In development of construction programs, Interstate work is analyzed and reviewed on a statewide needs basis. Interstate projects are set up in a form that divides the projects into final design, preliminary design and public hearing state, all other locations. The form identifies the project section and separates each section into right-of-way, grading, bridge, paving, signing and landscape contracts. The total cost, desired advertising date, status of hearings, status of right-of-way, and status of survey are indicated. State operates on a rather decentralized basis through eight district offices, so the program engineer receives detailed reports on planned programs for the 50 percent of the Interstate work under design by the districts. (Remainder is by consultants reporting to headquarters.)

State Primary System. —Districts and head office discuss and agree on urgency and limits of tentative contracts. Amount of work to be included in any one year is based on what money can be spared.

State Secondary System. —Programing is generally under control of engineer of secondary roads. Secondary program is integrated with total budget allocations and coordinated with advertising schedules by programing office. Allocation of secondary funds is given to district engineers in mid-April for fiscal year beginning July 1. Tentative budgets are returned by June 1. Proposed projects are listed and map locations are required. Because allocations have remained similar from year to year, the process has remained relatively uniform and district and resident engineers have been able to plan secondary system more effectively than primary.

State 20: Three-year program for construction—first year lists projects and letting dates; projects for the second year are not scheduled (considered to be the planning program); third year considered to be a guide only. The programs are assembled by assistant director, chief engineer, and deputy chief engineer. They overprogram approximately 20 percent to compensate for delays in some projects. General fund appropriations may supplement motor vehicle tax revenues.

State 21: The 5-year rolling highway construction program as compiled by division of planning and programing contains a listing of priority projects broken down by divisions. A further breakdown of division projects is made according to type of construction, as follows: resurfacing and widening projects, municipal and rural; Interstate projects; municipal projects; rural projects. Cost summary breakdowns are by division, priorities, Federal aid, and construction type.

From 5-year construction program, director of highways prepares biennial budget. Although individual projects are not listed in budget, director must adjust work load according to funds estimated to be available for each fund account and by systems. Biennial budget contains actual expenditures for past two fiscal years, director's budget request for following two fiscal years, and governor's recommendations. Expenditures are summed for director's office and undistributed costs, administration, planning and programing, right-of-way, design and construction, operations, capital outlay for highway improvements. Governor submits budget for legislative review and approval.

State 22: Program formulation is a continuous process. At monthly meetings of highway commission, projects are brought forth and adopted. This formal commission approval constitutes go-ahead for preliminary engineering. A tentative 5-year program is prepared under supervision of chief engineer.

State 23: Prior to establishing 5-year program, highway planning staff, in concert with district engineers, develops a project priority list based on service ratings. This list, with a forecast of available funds, estimates of project costs and fund allocation formulas, was used to establish first 5-year program. Although program receives commission approval, it is for internal use only.

State 24: District engineers, in cooperation with highway commissioner for district, draw up a list of urgent projects for submission to chief engineer. A final compilation, 10 to 15 percent over-programed, is then presented to highway commission, which uses sufficiency ratings as a guide to cut projects in final preparation of annual program.

State 25: 12-year Program. —In 1952 12-year advance highway construction program for primary and secondary highways was set up for the 1954-65 period. Each project was listed in detail and placed in one of three 4-year proposed construction periods. The legislature adopted the program and a bond issue to help finance it at the specified annual rate. At least 90 percent of scheduled mileage in each 4-year period was required to be completed prior to proceeding with subsequent projects. Improved design of Interstate System, as well as for other routes, plus higher unit costs than estimated, caused the program to fall behind.

Short-Range Program. —In 1959 the planning and programing division was formed to prepare advance highway construction programs on a more specific basis. With estimates of funds furnished by comptroller, this division prepares, for commission approval, a 2-year program, the first year of which indicates award dates, engineering costs, right-of-way costs, and construction costs. Each March, highway commission reviews a revised 2-year program and approves a new program for oncoming fiscal year. To date, primary emphasis is on scheduling work to meet target limits of forecasted available funds two years in advance. In developing current 2-year program, a separate listing of status of surveys, plans, right-of-way, etc., was first made in order to develop and compile advance program on a realistic basis.

Planning and programing division also develops 5-year advance program for internal working purposes. This program, as well as 2-year program, is designed to meet estimated construction funds available, as determined by comptroller, and is set up separately for the several Federal-aid systems.

State 26: Practically all construction is done with matching Federal-aid funds; less than 5 percent of total construction is with state funds alone. Therefore, Federal-aid reimbursable schedule controls rate at which projects can be let. Each June 30, administrative assistant to director develops and releases 2-year program. Tools available for his work are fund apportionment formulas, district engineers' project selections, and Federal reimbursable schedule.

State 27: Three-man highway board elected by legislature selects projects and requests highway department to schedule preliminary engineering. Annual program consists of projects whose status will allow letting to contract in coming year.

State 28: Plans in terms of a 4-year program (period covering two bienniums). Highway department submits to legislature, via chief engineer and highway commission, a specific list of projects and estimated costs. This list comprises the first biennium program. Legislature has been providing financing for not only next biennium but also for biennium following, so gross financial estimates are also submitted for second biennium. Availability of bonding authority permits considerable flexibility.

State 29: The 5-year primary road construction program is developed by planning engineer and updated for publication annually to provide for a continuous 5-year advance program.

State 30: Bureau of planning and traffic formalizes annual construction program. Project selection is by chief engineer and a few department heads and is based on a 1956 master plan. This preliminary construction program, developed late in the year, is submitted to budget bureau, governor, and legislature. Appropriation usually takes place in June. After approval and appropriation (usually about August), projects are given "go ahead."

State 31: Division of highways has a biennium legislative appropriation. This is division's authority to spend money, and total amount cannot be exceeded. Motor vehicle user tax funds on hand determine actual amount of capital improvements that may be undertaken. Another limitation is Federal-aid reimbursement schedule. Annually, bureau of research and planning compiles lists of projects for each of the ten districts. One list is for Interstate work and contains end target dates for some of the projects to be completed and opened to traffic. A similar list is prepared for non-Interstate projects. Projects are broken into six groupings which carry some priority significance and are anticipated to be accomplished in the year's program. Project groupings are carry-over from previous year, commitments made by chief engineer or higher authority, projects on which some work (stage construction) has been done and which should be completed, projects made necessary by Interstate construction, miscellaneous projects, and new projects on a priority basis.

Districts review project lists and cost estimates and indicate their priority of work. Annual meetings are held with each district, to screen projects. Attending these meetings are district engineer and staff and several central office personnel, including research and planning engineer, programing and planning engineer, design and right-of-way—about 10-12 persons. Meetings last 1 to 1½ days and take about one month to review all the districts' project lists.

Charts, maps and fund estimates are used to acquaint district with state's over-all and individual district limitations. An amount of $3.5 million is retained and undistributed for emergencies.

Three state map overlays are prepared to show location and total cost for carry-over projects from previous program, commitments, and work started which should be completed (stage construction). Total equals funds (not including Interstate) estimated to be available. Estimated funds and project lists for each district are then brought together by a screening process. Individual projects are discussed by groupings and priority. Agreement is reached and projects accumulated until estimated funds are depleted. Excess projects are deferred. Bureau of research and planning compiles agree-on projects by districts into a total state program, which is published after review by chief engineer, director, and governor. Total estimated cost of all projects listed exceeds anticipated income to provide flexibility in execution of program. Revisions to annual program are accomplished in same manner.

Published program lists projects by districts. Interstate and non-Interstate contracts are broken apart for each district with subheadings by construction, right-of-way required for current program, and right-of-way required for future construction. Each project is shown by map reference number, route, basic construction section, phasing index, length, county, termini, estimated cost, and type of work. Costs are rounded for estimating purposes only and are firmed only at time of contractual obligations.

State 32: Office of programing publishes a 5-year program of primary and secondary state highway system improvement. This report summarizes proposed projects by highway district and shows mileage, individual cost items, and totals for entire 5-year period. Also included are individual project sheets that give more detailed description of each job, with estimated cost and probable Federal, state and city participation. This book is revised monthly to conform with latest cost estimates; however, no projects are added to original list in case savings are realized, at least until late in 5-year period. Likewise, no projects are deleted because costs are running higher than expected, until late in program.

State 33: Programs branch of planning division formulates annual and long-range highway construction programs based on systems, locations, and priority. These are subject to anticipated state and Federal revenues. Highway commission approves annual programs, but long-range programs are merely used as guides.

State 34: A "general fund" state, in which legislature annually appropriates a lump sum for highway purposes. This appropriation is divided into maintenance and operation, design, inspection and right-of-way, and capital construction. Annual appropriations for construction are mainly for matching Federal aid plus sums for right-of-way, personal services, and a relatively small amount for non-Federal-aid construction. Three separate programs are submitted to head office bureau of planning by district engineers—highway planning study program, design program, and construction program.

The highway planning study program is presumably a 10-year advance projection, with perhaps $500 million of estimated final construction cost. These are generalized studies which may involve O & D analysis, aerial survey, photogrammetry, feasibility studies, etc. Program is not keyed to any particular amount of anticipated funds, but is simply set up broad enough so that data are available for any reasonable future construction.

The design program includes identification, sufficiency ratings, costs, suggested hearing dates, status of right-of-way, and submission dates for P. S. & E's to go to main office. This program is established for 3 to 5 years ahead and includes $1.5 billion worth of construction. Although many projects contain schedule dates, many do not. No dollar control is required and almost anything can go into the design pro-

gram. At governor's request, design program should contain a "construction stockpile." The idea was to get a great deal of preliminary work under way so that, as funds became available or emergency conditions arose, plans could be completed quickly and an expanded construction program initiated. Design program is not compiled at any particular time, as requests by district engineers are received throughout the year. On approval of deputy chief engineer (highway planning), district engineer can proceed.

The construction program is prepared annually, by November 1, for fiscal year beginning April 1. This is a one-year program. For the most part these projects are advanced from the design program. Construction program is not released publicly, but is made available to all persons in department. It is deliberately planned for at least 50 to 60 percent more construction funds than anticipated will be available, to allow for project delays.

State 35: Program development section of planning and programing division formulates a continuous series of annual programs. A construction program is prepared for oncoming fiscal year, while planning programs are maintained for 4 or 5 years in advance. Planning program outlines a target for advance planning in anticipation of final construction program. Purposely about 20 percent oversize to allow for contingencies. Construction programs are tailored to exact monetary total to fit allotments or budgeted amounts. They show scheduled dates for letting of construction contracts and represent final coordination of related features such as rights-of-way, building removals, relocation of utilities, etc. Both planning and construction programs are drawn up in consultation with district engineers and submitted to them individually for final review and approval. Upon approval by program engineer and each of the district engineers, program is submitted to highway commissioner for review and approval.

Appendix B

PROGRAM ADMINISTRATION

1. Time Schedules for Pre-Contract Engineering

(Information available for 31 of 35 states)

State 1: Proposed letting schedules are drawn up by deputy state engineer for as far as 9 months in advance. Plans are in progress at time they are put on schedule. These letting dates are worked up in conference with construction, maintenance, right-of-way and design personnel.

State 2: Surveys and design are handled in central office by design department, which makes own schedules and does not require formal notice to proceed.

State 3: For first year of 5-year construction program, letting dates are firmly established. Projects listed for first year are those that will complete all phases of preliminary engineering. Right-of-way acquisition dates for contracts that will be let in future years are also firmly established for first year.

Second year is less rigidly scheduled. In succeeding years the program contains projects that require greater lead time, such as right-of-way procurement, complex utility adjustment or timing with other developments, as well as those projects of lesser urgency. No effort is made to schedule letting dates beyond second year. Late each year 5-year program is revised. File of highway project progress record cards, together with a schedule of available funds, is utilized to develop program and letting dates.

State 4: Schedule of proposed completion dates for various pre-contract engineering stages is maintained as a chart. Proposed and actual dates of completion are scheduled for survey, layout, contract plans—highway, contract plans—bridges, specifications, advertisement. Progress is established by maintaining columns for percent complete and actual dates of completion. Projects listed are those of current year's program only. A separate chart shows status of right-of-way. No schedule of proposed completion dates is incorporated.

State 5: The 5-year program adopted by highway commission specifies target years for construction. Based on target years, construction engineer initiates scheduling of preliminary engineering and right-of-way acquisition. Some phases of pre-contract engineering are given target dates for completion. As plan preparation progresses, design engineer establishes monthly letting schedules approximately four months prior to letting. Target dates of plan completion are set one to two months in advance.

State 6: A programing unit coordinates and schedules various activities of accepted program.

State 7: Planning and programing engineer assigns surveys. When they are complete, the Federal-aid secondary projects go to districts for design. After survey of Federal-aid primary or Interstate projects, planning and programing engineer prepares a planning report or location report for BPR approval. When approved the project goes into design.

Project scheduling is set up in conference after location report is returned. A control schedule is established with dates for location report complete, traffic studies complete, material report complete, plans to BPR for review, major structure complete, railroad agreements, papers to right-of-way, acquisition complete, plans to BPR for approval, ready to advertise, fundings, signing and signaling, remarks.

Scheduled completion dates of these activities are for a period of approximately two years.

State 8: Upon approval of a project by highway commission, preliminary engineering is initiated and scheduled by chief engineer. A schedule board, maintained for planning, preliminary engineering, right-of-way acquistion, design, and letting, is a bar chart that indicates schedule of all projects over a 5-year period and indicates origin and probable completion dates for each of these items.

State 9: Complex projects anticipated to extend beyond one biennium are scheduled to include location, right-of-way, and construction. Advancement of projects within annual programs rests with district engineers. Priorities for advancement are based on considerations in approximately the order: procurement of right-of-way, time of year and type of work, area distribution, other considerations such as new traffic generators that have been developed.

Target dates for execution of program are established by staff conference approximately every three months. Twice each year district reports development status of each project to main office on program review report form. Each staff member responsible for development of a phase of the work gives his best estimate as to time required for completion. Considerations in fixing target dates are generally dependent on completion of right-of-way, location surveys, plan preparation, bridges (handled by main office).

State 10: Office engineer schedules tentative letting dates for one fiscal year.

State 11: Two-year construction and bidding program does not contain proposed letting dates.

State 12: District engineers schedule all projects in current programs beginning with very first stages of work included in a project and carrying such scheduling through to proposed letting dates. Districts, for most part, recognized value of scheduling, which is composite of planning of several section heads in district; namely, people in charge of location, surveys and plans, right-of-way, plans, specifications and estimates, and construction. Individuals in charge of these operations find it necessary to make certain that work load is properly distributed to permit satisfactory completion of operation in specified time with available personnel. District engineers have put one man in charge of scheduling to make a final review of all proposals and to make certain that various activities were properly timed and correlated.

For most projects schedule involves (a) preconstruction activities, including route location, preliminary studies, hearings, commission determination; surveys and plans, including field surveys, road plans, structure plans, right-of-way plats, relocation order; right-of-way acquisition, including appraisals, negotiation, completion of acquisition, utility negotiations (public utilities on or off right-of-way and including railroad pipelines, etc.); and (b) construction activities, including structures, grade, base, surface.

State 13: When plans are initiated, no specific target date for completion is established. Bimonthly meetings are held to review progress of projects and to schedule lettings.

State 14: Priority assignments made to projects of advance engineering programs establish a generalized schedule that all engineers and consultants must observe. The priority/schedule relationship is: first priority, current year; second priority, second year; third priority, third year; fourth priority, fourth year; fifth priority, long range.

A detailed schedule of completion dates is maintained for annual construction programs. Items included in these schedules are: (a) program, including type of work (engineering, R/W, construction), project number, project description, program status (submitted, approved); (b) traffic and planning, including traffic studies, approval of standards, municipal agreements; (c) engineering, including engineer (name), surveys, plans (situation, field check by state and BPR, to right-of-way, to planning for review), signals and markings, public hearing, BPR review, modify; (d) plans, specifications and estimates, including BPR approval; (e) right-of-way, including appraisal (start), acquisition (start), right of entry, utilities; (f) railroad agreement, proposal and execution; (g) wages rates, requested, received, expiration; (h) advertisement; (i) letting date; and (j) remarks.

State 15: Completion dates for each project are anticipated by central office. Each division is then responsible for meeting these dates. No schedules for phase of work completion are kept.

State 17: Upon adoption of budget, commissioner (for district) and his district engineer informally handle scheduling.

State 18: Advance program is developed for 10 years ahead. All projects for first 5 years are listed and scheduled approximately by years within each district. No attempt is made to schedule last 5 years.

Within the district, round table discussions are used to arrive at project scheduling. Group meetings result in wide consideration of individual problems so that difficulties in timing of right-of-way purchase, engineering design, etc., are considered in schedule. Local cooperation by other governmental agencies has a large bearing on timing decisions. Other factors include maintenance, structural conditions, possibilities of stage construction, costs, emergencies, etc. General layouts are accomplished two or three years ahead of construction, with planning operations, especially in large metropolitan areas, prior to that. Plans are completed in districts three or four months ahead of advertising date in order to clear headquarter's review.

Annual budget or program and schedule of tentative letting dates is prepared by headquarter's budget and program engineer. This is based on information concerning plan completion, availability of right-of-way, etc., received by direct contact with district planning engineers and by reference to status reports of 5-year and 10-year advance plans.

State 19: No formalized program reports flow through programing office. Scheduled dates are largely set by agreement and cooperation among various department heads and district engineers. Each department head and district engineer assumes his own responsibility for adherence to agreed-on schedule.

District engineers must receive head office approval for surveys. These are generally authorized at least six months ahead of planned advertising dates. Actually, surveys and plans may be under way considerably farther in advance (and in some cases must be), but there is little integration of these advanced engineering stages with an anticipated construction program.

On Federal-aid secondary projects, secondary roads engineer anticipates Federal aid for a period of about four years. By formula he allocates these to districts and advises district engineer to schedule for these anticipated funds.

State 20: Letting dates are scheduled a year in advance.

State 21: Once a project has been approved for inclusion in 5-year construction program, division engineer may request assignment of a job number by submitting a standard form to central office. This form ties project back to program; division engineer states his schedule for plan preparation and completion. A central office form establishes work schedule for various pre-contract activities.

An annual report outlining schedule of all awards to be made in forthcoming fiscal year is revised quarterly.

State 23: The 5-year program schedules year for which preliminary engineering, right-of-way acquisition and contract letting is to be accomplished. Surveys and plans division establishes letting dates for each forthcoming fiscal year target letting dates for subsequent two years, and schedules for completion of surveys, roadway design, bridge design, and right-of-way acquisition. Bar charts portray the schedule.

State 24: Chief engineer's office schedules plan completion by quarters for ensuing program year.

State 25: A master sheet lists all construction, engineering and right-of-way projects programed for fiscal year. Construction projects contain scheduled advertising date, bid opening date, and allowable award date. Projects in engineering or right-of-way stages are listed and scheduled by quarterly work periods. Cost information is also outlined.

Programing division has taken lead (by direction of commission chairman) in establishing required deadlines for operations in order to meet an established deadline for completion of certain projects. Although there were some initial objections, deadlines were met. This suggests that this might be an effective procedure, provided fully cooperative relations can be established between all divisions and bureaus. It is indicated that engineering and right-of-way schedules will be developed by planning and program division for all projects. It is conceived that the division will obtain fixed time requirements for each engineering and right-of-way operation, without respect to any particular dates. By setting up a scale length representing time, the scale may be physically slid back and forth to produce realistic schedules of total elapsed time. This period then may be fitted into the complete advance highway program schedules and shifted bodily as may be necessary.

In case program is accelerated or additional funds become available, the 1-year program is planned to be held firm, but additional projects may be advanced from the second year approved program for current year award. These, of course, would be selected from among those for which necessary preliminaries had been or could easily be completed.

State 26: Final program for two ensuing years is contained in a manual that includes the scheduled months for lettings and public hearings and the months that the project is to advance from survey, design and right-of-way.

State 28: No advance schedule of engineering operations pursuant to advance construction program.

State 29: Staff meetings held approximately every three months set target dates for new work and review and reestablish target dates for precontract engineering under way.

State 31: Each district is responsible for execution of projects within district boundaries. No formal precontract schedules or target dates are set, but bureau of design maintains a working estimate of probable letting dates for each project and status of plans, right-of-way, and agreements.

Phasing tables included in control section program charts contain a rough schedule of both preconstruction engineering and construction for several years in advance.

State 32: Programing office makes up a rough approximation of 5-year construction program schedule showing by quarters the proposed letting periods for each project. Information is based on judgment of time requirements for staff to produce plans, etc. A committee of division heads, chaired by deputy commissioner and chief engineer, may change initial proposals and shift timing. Once accepted, each division is committed to the schedule.

An engineering management team under general chairmanship of chief engineer meets to set letting date. This group does not look at financial limitations either by quarters or by years. Their job is to look at the physical prospects of getting surveys, plans and right-of-way 12 to 24 months ahead. There is generally one letting per month and detail is judged carefully. Bonding authority permits flexibility so that little attention is paid to availability of funds. The five-year schedule includes precontract engineering necessary for projects planned for succeeding 5-year period.

State 33: In 1959, an 18-month program was established. Projects were selected from commissioners' priority lists. Program conferences are called by planning director approximately three weeks ahead of monthly highway commission meeting. These meetings, attended by full staff, establish monthly letting schedules and an approved working program. Projects for which design can be completed and for which funds are available are submitted to the commission each month. Approved projects are let in following month. Lead time is always a problem, particularly in acquisition of right-of-way. An Interstate schedule has been prepared for programing of entire Interstate system.

State 34: Annual construction program contains scheduled date of R/W acquisition, date of P. S. & E. submission to main office, and letting date. List of anticipated letting dates is circulated, noting deadline dates for various general submissions to main office. Thus, should district engineer contemplate letting a project by a certain date, he must accomplish various work according to the established schedule for this letting date.

State 35: An anticipated work schedule (bar) chart maintained by design division schedules work by month for 5 years in advance. Information includes current design, future design, suspended design, program letting date, date construction limits are sent to right-of-way, surfacing.

2. Control and Adjustment of Time Schedules

(Information available for 29 of 35 states)

State 2: Monthly report on status of funds is submitted by auditor. Also included is a list of projects programed and not contracted.

State 3: A project progress record card is maintained by highway planning survey division. This card, which outlines various phases that enter into preparation and letting of a project to contract, is used both to establish project schedules and to control project progress. Each project of the 5-year program has a record card, for which information is obtained through progress reports submitted between the first and tenth of each month by all divisions and engineers that have responsibility for any phase of pre-letting action. Closer supervision of progress reports is maintained for projects to be let on next scheduled letting. Progress reports are submitted weekly and any appearance of a delay is brought to attention of assistant state highway engineer. If a situation exists that will delay letting, project is rescheduled and efforts are made to advance a project originally scheduled for a later letting.

State 4: Commissioner holds conferences every two weeks with principal persons involved in precontract engineering projects. Discussions are centered around reasons for delays and methods to advance projects more rapidly. Progress is portrayed on charts.

State 5: Advance plans section maintains control of schedules through weekly or biweekly progress reports. Status boards portray information.

State 9: All engineering controls and adjustments within central office are handled by engineer of plans and contracts, who twice each year (December and June) canvasses districts and reviews status of each project in approved annual program in conjunction with his staff and with divisions of utilities, right-of-way, and bridges. Any revisions to due dates are reported back to the district in a memo. Actual scheduling of manpower to meet advance target dates rests solely with district engineer.

State 10: Preletting activities are coordinated by office engineer. Weekly staff meetings are held.

State 11: General policy is to build a reservior of plans, with special reference to Interstate and urban routes that will have usable sections upon construction completion. Districts are authorized and urged to initiate all engineering on 4-year program list, with their own judgment used as to choice of project. Weekly plan status reports are submitted to head office.

Every six months the status of all projects on 4-year list is reviewed for major changes that should be made. Each week assistant chief engineer for design conducts a staff meeting to review districts' plan status reports. Advertising dates are controlled by plan completion and R/W acquisition.

Although there is central reconciliation and coordination, state does not exercise centralized control or planning. Assistant chief engineer for design is responsible for keeping track of the situation through plan status reports, through weekly and semi-annual staff meetings, and through three regional engineers who have authority to deal directly with districts in name of chief engineer.

State 12: It is a continuing and practically full-time job for at least one person in main office to be in constant touch with program scheduling. It is necessary to pay particular attention to beginning and end of each scheduled activity. Proper progress of work within time period scheduled is responsibility of district personnel. District engineers have put one man in charge of scheduling to make final review of all proposed schedules and to make certain that the various activities are properly timed and correlated.

Districts on first of every month submit reports on projects which are in schedule status and these are checked with previously prepared basic schedule in main office file. If, for instance, it is found that survey work did not start as contemplated, and it is still anticipated that original estimated time will be necessary for surveys, entire schedule is adjusted all the way to letting date. A similar situation could develop should survey not be completed as scheduled. This procedure is followed through at main office level on first of each month for each phase of activity which has a critical point of either beginning or ending at that time. State highway commissioners and other division heads affected by a failure to meet scheduling are advised by memorandum of such change in status.

State 13: Bimonthly meetings of bureau heads review project progress in order to schedule lettings. Status of projects is maintained in chief engineer's office through monthly reports.

State 14: Engineering control is generalized in advance engineering program but is more detailed for current annual construction program. All major prior actions necessary to contract awards are shown in schedule maintained for annual construction program. This schedule is subject to frequent revision, obtained mainly through weekly staff meetings.

State 15: Central office holds triweekly meetings to adjust advertising dates in accordance with progress.

State 16: Districts submit monthly reports to headquarters office on status of Interstate programs, non-Interstate programs, and non-Interstate advance planning.

State 18: Budget and program engineer is in informal communication with districts, particularly as letting dates approach. He attempts to resolve apparent delays.

State 19: Every six months program engineer calls for a complete review of status of plans and proposed advertising dates. Adjustments are then made to previous schedules. In addition, monthly meetings are called by program engineer to include all major department heads to coordinate and revise schedules.

State 20: A monthly report on status of authorized projects shows percent of work accomplished for current and previous month.

State 21: Division of planning and programing maintains a punch card record of each programed item from inception to contract sale. Both estimated and actual progress are maintained.

State 22: Department's monthly report to highway commission gives status of surveys, plans and construction.

State 23: A bar chart is used to portray schedule and status of surveys, bridge design, roadway design, and right-of-way acquisition for each project in the 5-year

program. This state has adopted an outline of steps necessary to advance a project from inception to construction in a 5-year period. This document designates the year the action should take place, responsibility for the action, and the order of the action within each year.

State 24: Schedules are reviewed monthly. Design office maintains a status board that indicates project name, type, location; percent completion of survey, design, right-of-way purchase; dates of program, P. S. & E. inspection, public hearing.

State 25: Planning and programing division meets weekly with engineering and right-of-way divisions and bureau heads to check current status of plans and right-of-way. These meetings also serve to estimate status for three months ahead.

State 26: Administrative assistant to director of highways maintains status of each project. A card is initiated for each project. As progress is reported on a work area, a completion date is inserted.

The ten engineers and their work areas are:

1. Testing Engineer— Design recommendation made.
2. Traffic and Planning Engineer—System rev. req. BPR, system rev. approved BPR, urban limits to BPR, urban limits approved, traffic data distributed.
3. Right-of-Way Engineer—R/W plans received, property map to roadway design, BPR auth. to acquire R/W, abstracting started, appraisals started, acquisition started, acquisition deeds/parcels, pit acquisition deeds/parcels.
4. District Engineer—Program submitted, design record submitted, street design for pavements, survey auth. requested, complete survey in, traffic agreements in, city agreements in, county agreements in, drainage agreements in, letter to maintain engineer to take over on completing.
5. Construction Engineer—Design data to BPR, design concurrence to BPR, design distribution made, control of access order passed, survey data to roadway design, P. S. & E. plans to utility company, P. S. & E. plans to BPR, field P. S. & E. made, P. S. & E. report to roadway design, pit data to R/W division, plans to roadway design for correction, completed plans to BPR for office review, auth. for P. S. & E. assembly, utility agreements forwarded, utility agreements returned/number, small blues and proposal to office engineer, pit data and preliminary estimates to office engineer.
6. Director's Office—Public hearing scheduled, certificate and transcript to BPR.
7. Maintenance Engineer—Take-over order from county, take-over accepted by commission, take-over conditions accomplished.
8. Roadway Design Engineer—Preliminary plans to bridge division, P. S. & E. plans to construction division, property map with R/W limits to office engineer, plan to construction division for office review, plans to R/W division and utility section, completed plans to construction division, to printer for small blues, small blues to construction division.
9. Bridge Engineer—USGS data requested, USGS data received, USED permits applied for, USED permits approved, borings contracted, boring data reported, preliminary plans from roadway design, preliminary plans to RR, commission auth. for RR agreement, agreement forwarded to RR, agreement returned from RR, bridge stations and grades to roadway design, site inspection, preliminary plans and data to BPR, BPR approval of preliminary plans, estimated quantities to roadway design, special provisions to construction division, completed plans to roadway design.
10. Office Engineer—Program to BPR, program approved, program revision to BPR, program revision approved, wage requisition to U. S. Labor Dept., wage decision received, property map to BPR, P. S. & E. assembly to BPR, BPR auth. to advertise, advertised, bids received, contract executed.

Monthly meetings are held with appropriate engineers to discuss progress, ascertain reason for delays, etc.

State 27: Division of highway planning reports on quarterly status of preparations for contract letting. With the exception of the Interstate program, this report maintains progress of precontract engineering for all Federal-aid construction contracts.

A route section progress chart is maintained for Interstate projects. A separate chart is maintained for each project and greater detail is recorded. In addition to descriptive material (location, length, project numbers), the form gives an estimate of progress on location and design, right-of-way, and details of progress on subordinate activities. By arbitrarily establishing that location and design is 60 percent of total cost of precontract engineering, and right-of-way 40 percent, an estimate of costs to date can be computed.

State 28: Design is nearly all by state's forces and work is assigned by head office either to a district or to the head office. Each division keeps separate schedules; chief engineer calls bimonthly conferences to review progress.

Right-of-way division condemns all property and at that time department has right of entry. Therefore, advance operations of right-of-way are not as significant as in some other states. Right-of-way gets a priority list from construction and design division and works down the list as rapidly as possible.

State 29: A coordinator under the contract engineer maintains schedule of agreed target dates and generally "rides herd" on operations. Staff meetings are held approximately every three months to review progress.

State 31: Bureau of design is responsible for coordination of plans, estimates, right-of-way and utility agreements. Coordination is by letter, phone, and personal contact. Each district is contacted about eight weeks in advance of a letting as to status of jobs.

State 32: An engineering management team under general chairmanship of chief engineer revises letting dates as necessary. Major effort is to insure that projects listed in initial 5-year program remain in this program. Each division sends its own status report to division of records and reports, where they are consolidated. Projects related to a particular route are accumulated on status charts for this route. Column headings include project description, route planning, surveys, R/W plans, roadplans, title search, appraisals, acquisition, right of entry, letting schedule, remarks. Both scheduled date and percent complete are recorded for each action.

Records and reports division does not control operations, but merely provides a centralized organization for reporting project status. There is no central control exercised except informally through general meetings and cross-connection efforts of staff members.

State 33: Status of projects is maintained on a reference card. Monthly program conference, attended by full staff, establishes and adjust working program.

State 34: Control of time schedules can be assembled into three major reporting areas: district engineers' monthly design progress statements, a questionnaire, and "Productrol" status boards. District engineers submit monthly design progress statements that include identification, estimated costs, date design started, percentage of completion of each phase of work, total project percent completion, estimated design completion date, estimated construction time, consultant or DPW staff, remarks indicating reason for delay, etc.

Lettings are generally held semimonthly, but preceding reports are not considered adequate to properly assure specific dates for specific projects. Therefore, design and construction bureau issues a questionnaire to district offices to get latest information on proposed dates and R/W and bridge problems. Presumably these questionnaires will firm up final operations barring some emergency. This information is related to the original construction program schedule, a new letting date is suggested, and this is circulated to districts and to others involved in the main office. Three months prior to a letting date the letting list is firmed. All concerned are obligated to have material in to permit proper advertising. In case of major delays in design operations, work is to be given out to consulting engineers.

Programing section in planning bureau maintains a set of "Productrol" (visual status) boards. Details of projects, priority ratings, etc., and listing of various actions taken with respect to each individual job, are recorded thereon.

Bureau of research and statistics publishes a report showing (a) total number of contracts let in current calendar year for districts and state, (b) total dollar amount of construction under way for districts and state, (c) summary information of each contract under way, and (d) status in terms of percent of time elapsed and percent completed for each contract under way.

State 35: Responsibility for coordination of preletting activities and control of progress rests on assistant chief engineer. Mechanics for scheduling and control, however, are accomplished by road design engineer, who maintains bimonthly status report giving project number, location, length, type of work, designer, right-of-way information, estimated right of entry date, preliminary engineering, design authority approved, municipal and utility agreement completed, RR involved, RR agreement completed, soils data received, detailed plans estimated completion date (road), detailed plans estimated completion date (bridges), municipal grade approval, programed letting date, remarks. Periodic conferences are called by chief engineer to assure that construction program schedules are being met.

3. Control and Adjustment of Financial Schedules

(Information available for 26 of 35 states)

State 3: A monthly report on status of funds is submitted by auditor. Also included is a list of projects programed and not contracted.

State 4: State budget commissioner provides periodic allotments to highway department. Allotments are based on Federal-aid matching funds and are within annual legislated appropriation. State has authorization to issue short-term anticipation bonds to insure availability of cash. Long-term bond issues have been used in the past to accelerate highway construction program.

State 5: Control of work initiation is exercised through an authorization for expenditure issued by construction engineer and approved by commission. Letting of a contract encumbers entire amount of contract.

State 6: A monthly budget report indicates current authorization of funds, carryover funds authorized in previous budget period, expenditures to date, encumbrance of future funds, net charges to current budget, and budget balance. This information applies to administrative, engineering, construction, maintenance, equipment, planning, capital outlay, and miscellaneous funds.

State 9: After legislative approval of budget, comptroller sets up his books on budget items. District engineers then initiate request for funds through work control project engineer for preliminary engineering, right-of-way, or construction. This request sets project in motion. Funds are available and expenditures can be incurred against project by type of work. Each month a work program ledger, prepared by comptroller and distributed within highway department, shows program status of each item, by number, as it appears in annual program.

For revisions of highway program a request may be made to works control engineer. He prepares a work program revision form and enters these in highway commission monthly agenda, which usually is in three parts—request for funds not previously budgeted, revision of work on projects within budget, approval of unprogramed projects.

State 10: A status sheet is maintained by office engineer. Projection of receipts, disbursement and commitments by month is basic object of form. Space is also applied to post actual quantities. Headings include (a) receipts (beginning monthly cash balance, state funds received, F/A reimbursement, total receipts), (b) disbursements (maintenance and operations, construction expenditures, right-of-way expenditures, total disbursements), (c) construction—State/Federal participation (state share—construction, F/A reimbursable, F/A ratio, state share—right-of-way, F/A reimbursable, F/A ratio), and (d) commitments (monthly letting plus 10% E & C, right-of-way allotment, state share—construction and R/W, F/A obligation).

State 11: All accounting and actual budget control is responsibility of an assistant state comptroller who works exclusively for highway department, but is responsible only to state comptroller. Fiscal management, however, is responsibility of depart-

ment and is centered in deputy for administration and director of bureau of fiscal management. The latter organizes budgets and maintains reports in cooperation with comptroller's office. All revisions in accounts and budgets flow through fiscal management bureau with major changes approved by higher authority (some of these requiring action by governor's office).

Following general budget decisions, bureau of fiscal management prepares a "spread sheet." Beginning with actual cash balance, anticipated revenue and cash expenditures by budget items are projected by months. For each projected month, a new estimated cash balance is entered. As budget year continues, a statement is prepared monthly substituting actual receipts, expenditures and balances for estimated values.

Monthly budget meetings are held by top management to review status and make such adjustments as appear necessary. This may involve stepping up portions of program or slowing down if it appears that some future month's cash balance might become dangerously low. Sometimes, it is necessary to shift budget authorizations from one account to another. If changes require revisions in governor-approved main budget plans, such requests must be approved by governor's office.

State 12: In operation of construction schedules, total of contracted awards or work authorizations (including those to county forces which do state maintenance work) are encumbered against current budgeted funds. This includes preliminary engineering, right-of-way, and construction, as well as any extra work orders, etc.

A status report showing the amounts actually encumberd and the remainder unencumbered is updated every two months. No futher accounting reports are provided for programing purposes until conclusion of the work. Overruns are encumbered by work authorization and are reflected in status report from accounting records. Underruns are simply accounted for in total when projects are final. That is, each project is not credited with a saving, but savings simply are credited to the particular fund used for payment. There is no concern about status of cash because appropriations are made for a full year, and, there is no requirement to check cash status by months. If delays of plans or other factors appear to prohibit award of certain work within the fiscal year, other jobs may be inserted to encumber available funds.

If estimates are revised prior to award stage, or changes are made in proposed contracts as to limits, class of work, etc., original total as shown in estimated program of expenditure is divided or replaced with most recent estimates. All of these changes flow through programing office of division of planning and research. Such estimates, however, are not often changed within current fiscal year unless revised project estimate is greater than ± 20% of original. If outside those limits, design office will question the matter and make final decision, in cooperation with district.

Accounting advises programing office how much and what funds can be added or deleted as year progresses. Some $2 million is held in reserve annually until near the end of fiscal year for possible overruns or late additions. If unused, fund is made available late in season for a quick resurfacing program.

State 14: Financial control is maintained through state road commission comptroller, who is mainly concerned with future cash position and that individual project expenditures stay within official authorizations. Major program control, however, is centered in programing engineer. As work advances from one stage to another original docments pass through program office, eventually including "state authorizations" for contract awards and for emergency and supplemental work or overruns—on basis of which current annual construction program is revised monthly. Underruns or other savings are not seen by program office. These are accounted for by comptroller in the form of a net reduction of authorized expenditures as shown in annual carry-over amounts for uncompleted work.

Comptroller operates on a cash expenditure budget control and monthly revises and summarizes project description, estimated costs (segregating construction, right-of-way, engineering) and expenditures to date for both state funds and Federal funds. Also included are estimates for remainder of current year and estimates for following year. Totals are checked against anticipated cash available each month.

When this procedure was initiated several years ago, it superseded full contract encumbrance against current budget authorization. It was recognized that many en-

cumbrances would not be fully spent in the then current year. Accordingly, new starts were authorized by which current cash balances could be reduced. Next year's carry-over is assumed to roughly equal current year carry-over for programing purposes. Thus, program engineer deals primarily with full amount of annual construction funds available and merely balances estimated total costs of all new starts against funds, without concern for carry-over requirements. Comptroller's office warns program engineer of any major change in cash position that would require a program revision.

State 15: Highway department's comptroller submits quarterly report on project status to governor and members of assembly.

State 17: Highway commission does not need cash in bank to award a contract. Contracts are let against anticipated revenues.

State 18: Budget is considered a fiscal program which reflects objectives determined by commission. It is developed on an annual basis, while advance planning program anticipates the future. Highway commission looks only at annual budget; therefore, revisions are difficult. However, it is flexible within the year to the extent that a few jobs can be added or deleted by commission action upon recommendation of division of highways.

Projects not placed under construction may or may not be carried over into succeeding years. Each annual budget must provide specifically for jobs that failed to start in previous year. Commission votes each project and estimates of cost. If a low bid runs over the estimates, extra funds must be voted. If bid is under the estimate, remaining budgeted funds are transferred to contingency fund. This fund operates, therefore, as a pool from which overruns may be paid and new projects may be financed.

Accounting department operates controls on basis of work order allotments. These are based on contract awards plus 5% plus extra work orders. Contract awards are fully encumbered against current budget.

State 19: Since highway commission allocates funds annually, they have no legal authority to commit construction beyond ensuing fiscal year. For large contracts, or for continuing extensive activities that extend beyond a year, supplemental allocations for outstanding projects must be made in the extended year's budget. Thus the budgets include such items of expenditure as "supplemental new construction."

Depending on the situation, a contract at a particular location may be awarded even though the amount considerably exceeds current allocation of funds to that location. This is possible because the state as a whole, including the highway department, operates on a cash basis. Thus, contracts are not encumbered against current budget allocations. This places a special responsibility on the program office and the fiscal director to make certain future cash requirements will not exceed cash income.

Fiscal director requires district and resident engineers to submit monthly reports of their forecasted estimated cash expenditures for a 12-month period. These forecasts are made for awarded contracts or currently operating state force projects only and do not include anticipated future awards. To develop total cash expenditure requirements by month, fiscal director adds other monthly estimates for administration, supplies, equipment, maintenance, etc. Estimated receipts are then compared with estimated expenditures.

It was noted that deficits reached as high as $8,982,000 in October. However, by the following May a balance of $89,000 was indicated. Monthly cash deficits are acceptable to State Treasurer when other non-highway cash is available to pay monthly bills.

Contracts permit variations from initial total bid price. However, all overruns must be authorized by program office. Underruns are not accounted for by program office, but are credited to a construction reserve account in each district.

State 21: A monthly financial statement is submitted to director of highways by division of administration. This statement is included in department's monthly report, which describes progress in terms of budgeted funds. Also included are graph of construction and R/W payments by month, graph of cumulative construction and R/W payments, graph of monthly value of projects awarded and R/W purchased, graph of receipts and revenues by months, and bar charts of relationship between total budgeted items and expenditures to date.

State 22: Highway department's monthly report to commission outlines financial status of funds.

State 24: Fiscal control sheets are furnished monthly to all divisions.

State 25: Each month comptroller provides report which shows estimated receipts available and anticipated to satisfy encumbrances through current fiscal year. Against the expected funds are shown all awards and other work authorization, bids received and contracts advertised, leaving a net available for new encumbrance. When either an award is made or work is authorized, the full amount is encumbered against current year's budget. This is true even though work will not be completed in current budget year. Comptroller certifies to roads commission that funds sufficient to satisfy the obligation will be provided from balance in present funds and anticipated receipts. In case actual expenditures exceed forecasted rate for program as a whole, comptroller may sell bonds earlier than otherwise anticipated. There is further control of R/W expenditure. These must not exceed $1 million per month (average) for a fiscal year.

State 26: Districts are advised monthly of program status of funds for each project. Program status is maintained by IBM tabulating runs.

State 28: A request for project funds initiates action on a proposed project. At every change of project status (revised estimates, change of work, change of location or length) a revised request is submitted. Budget control is established project by project, based on these requests. As expenditures for projects exceed estimates, budget officer submits a request to chief engineer for an estimate of additional funds necessary to complete project. This applies to all phases of engineering and construction.

State 29: Expenditures are encumbered against budget through authorization-for-expenditure sheets. These are directed by contract engineer to district engineers as their authority to expend specified amounts for construction, right-of-way, or contract engineering. Authorizations for expenditure are evaluated individually for rate of cash disbursement. A spread sheet prepared for each project provides a record of monthly disbursements and summaries of underruns or overruns to be carried to next fiscal year. Chief accountant prepares a monthly status report that compares estimated annual program expenditures (with additions and deletions) against obligated authorizations for expenditure.

State 30: A general fund state, and no bonds are issued for state highway purposes. State budget bureau sets up allotments on a quarterly basis and changes must be approved by that bureau. A project is encumbered for total amount of funds at time project is approved.

State 31: Bureau of construction prepares monthly estimates of payments to contractors and receipts of Federal and county funds for calendar year. Breakdown shows carry-over obligations from previous year, value of awards from beginning of year to date of report, value of awards pending, including last letting, and estimated value of work to be awarded during remainder of year. Administrative and engineering expenses are charged against operating budget and are not reflected in capital improvement costs. Contract engineering costs are, however, included.

State 32: The five-year estimate of monthly income, together with a similar estimate of monthly expenditures, is programed for the IBM 650. Thus, the relationship between planned work and probable income is controlled and adjusted through a computer operation. Punch cards record original cost estimates from programing office. As project proceeds from route location section, to design section, to contract award, to contract payments and final payment, cards are pulled and replaced by current data.

For revised costs estimates (prior to contract award) programing office maintains a plus-minus sheet to determine status of total annual expenditures. In this way certain projects will be deleted or added to maintain desired rate of expenditure. Authority to sell a limited amount of bonds permits highway department some flexibility.

State 33: Full bid price must be encumbered upon award of contract. This assures that highway department has cash on hand to pay warrants presented for payment. Allotments of funds are made to highway department on basis of anticipated revenue (½ on July 1, ¼ on January 1, ¼ on April 1).

These allotments are for anticipated obligations and are based on an average of past three years.

State 34: Operation of budget is largely under control of budget director, who is primarily concerned with availability of cash to meet bills as they come due. Appropriations, made for one fiscal year only, are in effect authorization of more expenditures. However, budget bureau does provide highway department with a "certificate of availability" of funds. Issued quarterly, they are given to highway department as a lump sum, and department encumbers all obligations against these sums. Full amount of contract is encumbered upon award. Regular appropriations for capital improvements are reappropriated annually in amount of those which remain both unencumbered and cash available from encumbered amounts. Extra work orders or any other cost increases, after necessary approval, are also encumbered. Underruns on close-out of projects simply increase general unobligated balance.

State 35: Program devlopment section of planning and programing division maintains a tabulation of construction program progress. These sheets, updated monthly, record program estimation of monthly expenditure, actual expenditures, difference, and percent variation. This tabulation is kept for each district by type of work. A monthly report prepared by this same section displays distribution of obligated Federal funds and unobligated balance as of date of report.