CONSTRUCTION MANAGEMENT
SYSTEM

VOLUME III

RESIDENT AND DISTRICT ENGINEER
OPERATIONS MANUAL

Public Administration Service

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16. Abstract

Volume III, Resident and District Engineer Operations Manual details the manpower planning operations for field personnel. The manual details the required steps for the Basic Scheduling System, as well as how the Long-Range Forecasting System operates and will be used.

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1313 EAST SIXTIETH STREET · CHICAGO, ILLINOIS · 60637

January 31, 1978

Mr. John Tallant, Construction Engineer
Arkansas State Highway and Transportation Department
Post Office Box 2261
Little Rock, Arkansas 72203

Dear Mr. Tallant:

In accordance with the agreement between the Arkansas State Highway Commission and Public Administration Service, I am pleased to transmit this report, Volume III, Resident and District Engineer Operations Manual. This report represents one of the five volumes provided as part of the work performed by the Construction Management Research Project conducted jointly with the staffs of the Arkansas State Highway and Transportation Department and Public Administration Service.

The study was carried out and the report prepared under the supervision of Harold Rothbart. Mr. Rothbart participated actively in the study on site with Mr. William Copacino. Additional field support was provided by Mr. James Doyle. Headquarters supervision was provided throughout the project by Mr. Joseph Molkup and Mr. Maurie Kimbrough.

We wish to express our appreciation for the excellent co-operation extended to our staff by employees of the Department. We have appreciated the opportunity to serve the Arkansas State Highway and Transportation Department.

Sincerely yours,

William Hilty
Associate Director

WH/pt

ARKANSAS STATE HIGHWAY
AND
TRANSPORTATION DEPARTMENT

CONSTRUCTION MANAGEMENT SYSTEM

VOLUME III
RESIDENT AND DISTRICT ENGINEER OPERATIONS MANUAL

prepared by
ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
CONSTRUCTION DIVISION
CONSTRUCTION MANAGEMENT STAFF
and
PUBLIC ADMINISTRATION SERVICE, CONSULTANT
CONSULTANT STAFF
in cooperation with
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

January 1978

RESIDENT AND DISTRICT ENGINEER

OPERATIONS MANUAL

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INTRODUCTION

INTRODUCTION

PURPOSE

This Operations Manual provides information and procedures for two management systems developed during the Construction Management Research Project to the Resident and District Engineer. These systems are known as the Basic Scheduling System and the Long-Range Forecasting System.

The Basic Scheduling System is a step by step process which helps to determine the manpower needs on the construction projects assigned to the Resident Engineers. The Long-Range Forecasting System is a computer model that predicts or estimates the future manpower requirements for the Construction Division field operations. Field operations, as used here, involves all surveying, inspection, and documentation activities conducted by personnel assigned to a District or Resident Engineer office.

BACKGROUND INFORMATION

Public Administration Service, the Research Project consultant, has been actively working on this project with the Arkansas State Highway and Transportation Department Construction Management staff since February, 1976. During this time, the many activities undertaken have led to the development of the Basic Scheduling System and the Long-Range Forecasting System. Several particular components deserve mention because the information obtained has significantly contributed to this Volume and has been incorporated herein.

PILOT REPORTING SYSTEM - A method of collecting data and information on Construction Division work activities, contractor activities, personnel utilization and equipment usage. This data was collected in all Resident Engineer offices between July, 1976 and January, 1977 by the use of standard reporting forms.

LABORATORY PROJECTS - Four Arkansas State Highway and Transportation Department (AHTD) projects constructed in District Six managed under special conditions for testing the Basic Scheduling System along with personnel practices, equipment use, methods improvements and other procedures. These projects were: Maumelle New Town - Crystal Hill Road, (C-60-59); Markham Street Parkway (S-60-5); Hensley, Woodson and Bingham Interchanges, (6981); and Highway 65/167 Interchanges North (60074).

LABORATORY RESIDENCY - The Resident Engineer office in which the four Laboratory Projects were constructed. This office was designated as Resident Engineer office No. 69.

PLANNING UNITS - Mathematical ratios obtained primarily from the Pilot Reporting System designating the amount of work that can be accomplished in a unit of time. For a survey activity, this could represent the stations of survey work that can be accomplished per man-hour. For a construction activity, typical work accomplishment units represent the amount of pay quantity per unit of time, such as 200 cubic yards of subbase inspected per hour.

ENGINEERING ACTIVITIES - Those activities that are undertaken by Arkansas State Highway and Transportation Department personnel in the field construction of projects. These are listed in the Appendix.

ACTIVITY WEEK SCHEDULE - A contractor prepared schedule that identifies when and how much work on a specific activity the contractor intends to perform. This schedule is filled out for a twelve week period and updated by the contractor every four weeks.

TWO WWEK WORK SCHEDULE - An activity schedule of the contractor's planned work for a two week period. This is prepared by the contractor and Residency personnel immediately prior to the applicable two week period. Information is provided by the contractor on activities to be worked, station limits of planned work, estimated pay quantity, contractor equipment to be used, and estimated work force to be employed during the two week period.

FIXED STAFF - The assignment of Arkansas State Highway and Transportation Department construction personnel to an activity independent of the work quantity to be accomplished. This staffing is usually used on a contractor operation which has required documentation or is critically important to the construction of the highway. Personnel are assigned on a full-time basis to this type of operation as long as work is progressing. An example of this would be Activity 226I, Inspection Hot Mix Asphalt - Roadway. A listing of fixed staff requirements is contained in the Appendix.

KNOWLEDGE, ABILITY AND SKILLS STATEMENTS - A comprehensive listing of the individual requirements for field personnel so that they can successfully accomplish Arkansas State Highway and Transportation Department requirements and objectives for guaranteeing proper highway construction. The knowledge, ability and skills statements are defined on an activity basis. Each activity prescribes the work performed by Arkansas State Highway and Transportation Department personnel in connection with their

inspection, surveying, and documentation function. (The knowledge, ability and skills statements are available from the Construction Management office upon request).

OVERVIEW

This Operations Manual provides information on the Basic Scheduling System and the Long-Range Forecasting System (L.R.F.S.). Although the Resident Engineer will not be using the L.R.F.S. directly, he is encouraged to read the information contained in this operations manual. The same is true for the District Engineer with regard to the step by step detailed process for the Basic Scheduling System. Before presenting more specific information on the Basic Scheduling System and the Long-Range Forecasting System an overview of each System is presented.

Basic Scheduling System

The Basic Scheduling System is a step-by-step process that is followed by the Resident Engineer. The System results in the calculation and the comparison of the required and the available man-hours for inspection of the construction projects within a Residency. These calculations are performed by the Resident Engineer with assistance from the Construction Management office. The System then requires a meeting every four weeks between the District Engineer and all of the Resident Engineers within that District to discuss anticipated manpower surpluses or deficits. Temporary transfers of employees between Residencies may be made at this time. Finally, the Resident Engineer prepares a two-week schedule detailing the personnel assignments within his Residency. This process involves a Construction Management process and seven distinct steps which are outlined below:

Construction Management Office:-- The first process of the Basic Scheduling System is performed by the Construction Management Co-

ordinator and results in the calculation of the total man-hours required for each engineering activity for each construction project. This calculation is performed only one time when a project is first assigned to a Resident Engineer and the results are forwarded to the Resident Engineer.

For each project, the Construction Management Coordinator must identify the specific engineering activities and the associated planning quantities before the man-hour calculations can be performed. Then, the Construction Management Coordinator calculates the projected man-hours for each engineering activity by multiplying the planning quantities by the standard planning units. The results for each project are summarized and forwarded to the appropriate Resident Engineer. (The process undertaken by the Construction Management staff is not discussed in this Volume).

Step One: -- The Resident Engineer obtains the Activity Work Schedule from the contractor.

Steps Two and Three: -- The Resident Engineer uses the Activity Work Schedule (provided by the contractor) and the total man-hours for each engineering activity (provided by the Construction Management Coordinator) to determine the inspection man-hours required for the two-week periods for which calculations are required for each engineering activity for each project. This calculation is performed by applying the percentages of work for each two-week period from the Activity Work Schedule to the total projected man-hours for each engineering activity.

The results are summed to obtain the total inspection man-hours for each project for each of the two-week periods computed. These totals are in turn summed to obtain the total man-hours required for the Resident Engineer's office.

Step Four: -- The Resident Engineer computes the total available man-hours for his Residency for each of the two-week periods on which information is required. In doing so he considers the number of employees presently assigned, the number of employees expected to be added to or deleted from this total and the anticipated leave time that will be used by employees.

Step Five: -- The projected and available man-hours are compared for each of the two-week periods computed and the anticipated deficit or surplus for each period is noted.

Step Six: -- A meeting will be hald every four weeks at the District headquarters where the Resident Engineer will present his computations of available and projected man-hours. Significant differences (denoting under-staffing or over-staffing) will be rectified on a temporary basis through short-term (two-week increments) assignments at the District level between Resident Engineer offices in that District. Trends will be analyzed using the two-week projections that are prepared. Also, the Construction Management staff will work with the District Engineer on long-range planning to determine how many construction employees the District needs to stay adequately staffed for the future projects. General over-staffing in a District on a temporary basis will be handled by secondary assignments such as location surveys, temporary transfers or other appropriate actions.

Step Seven: -- The Resident Engineer propares a two-week work schedule detailing the assignments of personnel and equipment for each day of the period. In doing so, the Resident Engineer relies on the results of Steps One through Six and on the Two-Week Work Schedule that is provided by the contractor for each project in his Residency.

Summary: -- The Basic Scheduling System thus provides a framework whereby the Resident Engineer can systematically calculate an estimate of the Residency workload for two-week periods, determine the work force available for each period, and reconcile the resulting surplus or deficit. The System also results in the production by the Resident Engineer of a detailed schedule outlining the numbers of personnel and staff assignments for a two-week period. The benefits of better planning at the Resident Engineer level, including increased sharing of resources within a District and detailed scheduling of primary and secondary (alternate) assignments for all personnel, will be valuable to the Resident Engineer, the District Engineer, the Construction Engineer and the Department.

Long-Range Forecasting System

The Long-Range Forecasting System is a computer model that provides the monthly man-hours required to inspect on-going and future Arkansas State Highway and Transportation Department construction projects. The planning period is generally 24 months. The Long-Range Forecasting System uses mathematical relationships known as regression prediction equations to forecast the total man-hours required to inspect each construction project. These regression prediction equations are determined from historic Arkansas State Highway and Transportation Department construction projects and relate inspection man-hours to various project characteristics. The Long-Range Forecasting System then distributes the total man-hour estimates for each project over the anticipated duration of each project to obtain a monthly man-hour estimate for each project. These monthly man-hour estimates for each project can then be summed to obtain the manpower complement required for each Residency, each District and the entire State.

The Construction Management Coordinator periodically must provide the latest available information about on-going and future construction projects. Specifically, the Coordinator must identify the future projects that are planned for future construction and must record the estimated start date, estimated completion date, and other various project characteristics for each project. Also, the Construction Management Coordinator must yearly review and update the regression prediction equations.

The Long-Range Forecasting System relies on two sets of data or two data bases. One data base is called the Historic Data Base and contains information about already completed projects. This data is used to update the regression equations. The second data base is the Current/Future Data Base. This is used along with the regression prediction equations to forecast manpower requirements for future months.

As with any system, the output or prediction report of the Long-Range Forecasting System is not a solution to all manpower problems. However, it does provide information that will be useful to the District Engineers, the Construction Engineer, and the Department.

DETAILED INSTRUCTIONS

Chapter II provides detailed operations instructions for the Basic Scheduling System to be utilized by the Resident Engineer. Chapter III details the necessary information for the District Engineer to maintain his part in the Basic Scheduling System. Chapter IV provides general information and procedures of the Long-Range Forecasting System for the District Engineer.

CHAPTER II

RESIDENT ENGINEER

BASIC SCHEDULING SYSTEM

INSTRUCTIONS

STEP ONE

OBTAIN CONTRACTOR ACTIVITY WORK SCHEDULE

The special provision on Table 1, requiring an Activity Work Schedule from the contractor, will be incorporated into the District's construction contracts before the Basic Scheduling System becomes operational in any District.

It is the prime contractor's responsibility to fill out and submit one schedule every four weeks for the following twelve (12) weeks of the project - including work of subcontractors on the job (see Chart I and Figure I). The schedule is due in the Resident Engineers office on the Thursday prior to the beginning of the first of the two-week periods being scheduled. It is each Resident Engineer's responsiblility to see that these are submitted regularly and that the contractor's estimates of work on specific activities are reasonable. If they are not, a Resident should discuss the discrepancies with the contractor(s) involved and recitify them. An Activity Work Schedule should not be approved by a Resident Engineer unless it appears to be a reasonable estimate of the work the contractor intends to perform. If a Resident has problems obtaining the Activity Work Schedule on time from the contractor, he should enforce the Special Provision of the contract as he would any other specification.

Upon obtaining a letter of notification of a meeting of Resident Engineers from the District Engineer, a Resident Engineer should proceed to computations required by Steps Two, Three and Four of the Basic Scheduling System for those periods specified in the District Engineer's letter. A sample of the format for the District Engineer's notification of a Resident Engineer meeting is illustrated by Table 2.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

CONTRACTOR SCHEDULING REQUIREMENT

The contractor shall submit an "Activity Work Schedule" for a twelve (12) week period showing the anticipated beginning and ending dates of all major work items during the period, in accordance with the form and instructions provided by the Engineer. This "Activity Work Schedule" shall be updated every four weeks, and submitted to the Resident Engineer.

In addition, the contractor on the job shall submit at two-week intervals on the Thursday before the beginning of the schedule period, on a form provided by the Engineer, a scheduled estimate of the work that the contractor plans to perform during the following two weeks, and meet with the Resident Engineer or his representative at this interval to discuss the scheduled work. This Two-Week Work Schedule shall contain dates, station limits of operations, and sequence of operations on an activity basis. The contractor shall notify the Engineer two (2) work days prior to beginning a major activity not scheduled in this Two-Week Work Schedule, if significant inspection and/or survey work is required.

Changes in the contractor's operations contrary to the "Two-Week Work Schedule" due to changing weather conditions and other factors beyond his control, are considered unavoidable, and it is not the intent of these requirements to unduly delay the contractor when this occurs. The intent of these requirements is to allow the Engineer to accurately schedule his work in the most productive and economical manner while providing the necessary stakeout, inspection and documentation.

This Special Provision will apply only as the Construction Division's new manpower planning effort is implemented.

CHA

ACTIVITY WORK SCHEDULE

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

TWO-WEEK WORK SCHEDULE

ACTIVITY WORK SCHEDULE

Date (1) _____ Job No. (2) _____ Period Scheduled (3) _____

Cont. Act.	ACTIVITY	Day Date (4)		Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	Clearing and Removal Items (6) (5)		Sta.														
			↔														
2	Fencing Items		Sta.														
			↔														
3	Earthwork		Sta.														
			↔														
4	Shaping Roadway		Sta.														
			↔														
5	Reconstructed Base		Sta.														
			↔														
6	Subbase, base and/or Granular Surface		Sta.														
			↔														
7	Prime Coat		Sta.														
			↔														
8	Stabilized Base		Sta.														
			↔														
9	Hot Mix Asphalt		Sta.														
			↔														
10	Bituminous Surface Treatment		Sta.														
			↔														
11	Concrete Pavement		Sta.														
			↔														
12	Pipe Installation		Sta.														
			↔														
13	Concrete – RC Box Culverts		Sta.														
			↔														
14	Piling		Sta.														
			↔														
15	Bridge Concrete		Sta.														
			↔														
16	Structural Steel		Sta.														
			↔														
18	Incidental Bridge Work		Sta.														
			↔														
20	Curb and/or Gutter		Sta.														
			↔														
21	Miscellaneous Concrete		Sta.														
			↔														
22	Seeding Items		Sta.														
			↔														
23	Guard Fence		Sta.														
			↔														
24	Miscellaneous Items		Sta.														
			↔														
25	Riprap		Sta.														
			↔														
26	Sod Mulch		Sta.														
			↔														
27	Special Activity _____		Sta.														
			↔														

Weeks	2	4	6	8	10	12
Date (A)						
(c) %						
(b) ↔						

FIGURE 1

ACTIVITY WORK SCHEDULE CERTIFICATION

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

TWO-WEEK WORK SCHEDULE

(7) Stakes specifically requested by contractor during this two-week period are as follows:

Station	Station	Type Survey Work Requested
Week 1		
_____	_____	_____
_____	_____	_____
_____	_____	_____
Week 2		
_____	_____	_____
_____	_____	_____
_____	_____	_____

(8) I (intend/do not intend) to work Saturdays should inclement weather and/or breakdown prevent work during the week.

(9) Comments by Contractor:

_____

_____

_____

(10) Comments by Resident Engineer:

_____

_____

_____

The Arkansas State Highway and Transportation Department Two-Week Work Schedule is to be prepared every two weeks in compliance with the "Contractor Scheduling" Special Provision. The contractor preparing this schedule hereby certifies that the above schedule is an accurate estimate of the work, weather permitting, to be performed within the next two weeks; and that the Resident Engineer will be notified within two work days of any significant changes in this schedule.

Submitted: _____

(11) Contractor

Approved: _____

(12) Resident Engineer

ACTIVITY WORK SCHEDULE

Submitted: _____

(D) Contractor

Approved: _____

(E) Resident Engineer

Form 19-122—10M—7-77—C376-2767—II-2R—M.P.

TABLE 2

INTER OFFICE MEMORANDUM

SAMPLE MEMORANDUM FOR DISTRICT-WIDE
RESIDENT ENGINEER MEETING

DATE

TO: Resident Engineers, District _____

FROM: District _____ Engineer

SUBJECT: MEETING OF DISTRICT _____ RESIDENT ENGINEERS

Please be advised that the District _____ Resident Engineers will meet at (time) on (day of week, date) at (place of meeting). Personnel requirements and allocations for the periods between (date) and (date) will be discussed at that time.

Forms H,I, and J of the Basic Scheduling System are required to be submitted to the District office no later than (date) for the above periods and the following two week period (ending _____).

cc
Construction Management

STEP TWO

DETERMINE PROJECTED MAN-HOURS

FOR TWO-WEEK PERIODS

Step Two deals exclusively with the calculations a Resident Engineer is required to make to compute the projected man-hour requirements in his office for two-week increments. The calculations are made on Forms F and G. A Resident Engineer must have the contractor's Activity Work Schedule completed by the contractor and submitted prior to completing the calculations.

It should be noted that each contractor activity has specific Engineering Construction Activities (200) related directly to it. For instance, Earthwork, Contractor Activity 3, is directly related to Engineering Activities 219I, 219M, and sometimes 219C. These activity relationships are preprinted on Form F. For further descriptions of the contractor activities and engineering activities, refer to Appendices 1, 2, and 3, respectively.

To fill out Form F: [1/]

1. On Line 1, enter the applicable job number.
2. On Line 2, enter the date.
3. Sign Form F on Line 3.
4. The total Project Man-Hours for each applicable engineering activity will be provided by the Construction Management office in Column 4 of Form F.
5. Enter the applicable two-week periods corresponding to those on the contractor's Activity Work Schedule on Line 5.
6. Transfer the percent of projected work on a contractor activity from the Activity Work Schedule to Colume 6, "% Scheduled by Contractor" for each corresponding activity.

1/ Only those periods for which the District Engineer requested computations in his memorandum need be calculated.

FORM F

DETERMINATION OF PROJECT MAN-HOUR PROJECTIONS FOR TWO-WEEK PERIODS USING ACTIVITY WORK SCHEDULE

Job Number (1) _____

Date (2) _____

Calculated by (3) _____

Contractor Activity Number Scheduled	Related Engineering Activity	Total Project Manhours for Engineering Activity (4)	Period (5)		Period (5)		Period (5)		Period (5)		Period (5)		Period (5)	
			% Sch. by Contr. (6)	Manhours for Period (7)	% Sch. by Contr. (6)	Manhours for Period (7)	% Sch. by Contr. (6)	Manhours for Period (7)	% Sch. by Contr. (6)	Manhours for Period (7)	% Sch. by Contr. (6)	Manhours for Period (7)	% Sch. by Contr. (6)	Manhours for Period (7)

(4 x 6 = 7)

7. Compute the man-hours per period, Column 7, for applicable activities by multiplying the Total Project Man-Hours for Engineering Activity by the % sched. by Contr. (Column 4 X Column 6 = Column 7).

This completes the computation of man-hour projections per period for activities directly related to contractor activities. For those not directly related to specific contractor activities, Form G is filled out. This relates established percentages to activity projections already calculated in much the same way the total activity man-hour projections were calculated.

To fill out Form G:

1. On Line 1, enter the applicable job number.

2. On Line 2, enter the date.

3. Sign Form G on Line 3.

4. Enter the dates of the applicable two-week periods corresponding to those on Form F on Line 4.

5. For each Construction 200 Activity listed, compute the applicable planning quantities for each period scheduled and enter in Column 6. This planning quantity is computed by summing the projected man-hours of related activities (from Form F in the case of 200 Activities) for the corresponding period.

6. Multiply the applicable planning unit (Column 5) by the planning quantity (Column 6) to obtain the projected man-hours and enter the product in Column 7.

7. Sum all 200 Activities and enter the totals on Line 8.

8. Compute the Construction 100 Survey man-hours by repeating Steps Five and Six, using the Construction percentage on Line 9 (ratio of man-hours of contractor oriented survey activities to Construction 200 Activities) as the planning unit and the Total 200 Activities obtained on Line 8 for the applicable period as the planning quantity.

   To this, add any initial or final survey work (related to contractor schedules) deemed necessary during the applicable period and enter the sum on Line 9, Column 7. This type of work is discretionary. The Resident Engineer may schedule all or portions of the initial or final survey work before, during, and/or after construction, as his judgement dictates. However, the

FORM G

DETERMINATION AND SUMMARY OF PROJECT MAN-HOUR PROJECTIONS FOR TWO-WEEK PERIODS FOR SURVEYS, MISCELLANEOUS, AND OFFICE ACTIVITIES

Job Number (1) _____

Date (2) _____

Calculated by (3) _____

Activity	Activity Title	Unit	PLANNING UNITS (5) Urban	Rural	Statewide	Planning Quantity (6)	Projected Manhours (7)	Planning Quantity (6)	Projected Manhours (7)	Planning Quantity (6)	Projected Manhours (7)	Planning Quantity (6)	Projected Manhours (7)	Planning Quantity (6)	Projected Manhours (7)
	(4)														
200 CONSTRUCTION ACTIVITIES															
239M	Concrete Aggregate Test. (excluding Concrete Pavement)	% of 231I, 233I, 236I, 237I	3%	3%	3%										
240I	Concrete Plant	% of 231I, 233I, 236I, 237I	21%	21%	21%										
TOTAL 200 ACTIVITIES (8)															
100 SURVEY ACTIVITIES (9)		Construction % of 200 Activities	Initial		Final										
300 SUPERVISION AND MISCELLANEOUS															
347	Miscellaneous Survey Work	% of 100 Activities	12%	21%	18%										
348	Preparation of Grade Books	% of 100 Activities	5.0%	3.2%	3.8%										
349	Fabrication and/or Cast Yd.	As Needed		As Needed											
350	Miscellaneous Construction Work	% of 200 Activities	4.4%	6.3%	5.7%										
351	Project Supervision	% of 100, 200 Activities	7.5%	6.1%	6.6%										
352	Travel Time	% of 100, 200 Activities	4.7%	11.5%	9.3%										
353	Training	As Needed		As Needed											
TOTAL 300 ACTIVITIES (10)															
400 OFFICE ACTIVITIES															
460	Prep. of Final Estimates	% of 200 Activities	17%	5.0%	8.7%										
461	General Office Work	% of 200 Activities	12.2%	9.8%	10.3%										
TOTAL 400 ACTIVITIES (11)															
TOTAL PROJECTED MAN-HOURS PER PERIOD (12)															

cumulative quantity of discretionary man-hours scheduled may not exceed those set forth in the initial and final spaces of Line 9. Definitions of these three types of survey work are as follows.

1) Construction Survey Work includes all work required to give the contractor line, grade, and pay quantity documentation on which construction work is progressing.

2) Initial Survey Work includes running centerline, setting right-of-way stakes, taking topography, running check levels and cross sectioning the entire job. In addition, this includes some minor structure stakeout, bridge stakeout, staking by station as necessary, and some grading of right-of-way hubs.

3) Final Survey Work includes running centerline, taking topography, and cross sectioning right-of-way.

9. Repeat Steps Five and Six for 300, and 400 Activities listed.

10. Sum all 300 Activities for each period and enter the totals on Line 10.

11. Sum all 400 Activities for each period and enter totals on Line 11.

12. Sum all activities (200, 100, 300, 400) for each period and enter the totals on Line 12.

STEP THREE

SUMMARIZE PROJECT HOURS

FOR EACH TWO-WEEK PERIOD

FOR RESIDENT ENGINEER OFFICE

Once man-hours have been projected on a project basis, a Resident Engineer needs to summarize the information pertaining to his office for each period on a project-by-project basis for reference and for submission to the District and Construction Engineers. Form H has been designed to perform this function.

To fill out Form H:

1. Enter the Resident Engineer office number which the summary represents on Line 1.
2. Enter the date on Line 2.
3. Sign Form H on Line 3.
4. Enter the two-week periods which the projections represent on Line 4.
5. Enter the project numbers for which projections have been made on Line 5.
6. Under each project number, insert the man-hour projections made for each engineering function. These may be readily obtained from Form G for each project.
7. Total each line to obtain the projected Residency man-hour projection for each engineering function and enter in Column 6 and total all man-hour projections for a Resident Engineer office projection for the period specified.
8. Repeat Steps Six and Seven for each of the periods being computed
9. Send copies of Form H to the District and Construction Engineer.

FORM H

SUMMARY OF TOTAL PROJECT HOURS FOR TWO-WEEK PERIODS

RE Office No. (1) _____

Date (2) _____

Calculated by (3) _____

Period Projected (4) _____

PROJECT (5) / ACTIVITIES	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	RE Office Total (6)
Survey (100) Activities									
Construction (200) Activities									
Supervision and Miscellaneous (300) Activities									
Office (400) Activities									
TOTAL									

STEP FOUR

COMPUTE MAN-HOURS AVAILABLE

IN RESIDENT ENGINEER OFFICE

With the completion of Step Three the Resident Engineer has projected his man-hours needed. Now, he must project man-hours currently available for each period scheduled. Form I tabulates this information.

To fill out Form I:

1. Enter the Resident Engineer office number on Line 1.
2. Enter the date on Line 2.
3. Sign Form I on Line 3.
4. Enter in Column 4 each period for which man-hour availability is being computed.
5. Enter in Column 5 the number of employees anticipated to be working in the Resident office for each period, excluding the Resident Engineer.
6. Enter in Column 6 the number of man-hours that will normally be worked by an employee during each two-week period scheduled. (This is 80 hours less any Departmental holiday time).
7. Mulitply the Number of Employees in the office by the Man-Hours of Normal Work in Two-Week Period (Column 5 X Column 6) and enter the product in Column 7, Man-Hours in Two-Week Period for Office (excluding leave time).
8. In Columns 8, 9, and 10, enter the name, date(s), and hours of leave time anticipated for any employee that this is known. This includes extended illnesses, advance annual leave requests, and other similar reasons, of employees in the Resident office.
9. Compute the total hours unavailable by summing Column 10 and entering the total for each period in Column 11.
10. Subtract total Hours Unavailable (Line 11) from Man-Hours in Two-Week Period for Office (Column 7) to obtain Man-Hours Available for Period and enter the difference in Column 12.

FO[illegible]

COMPUTATION OF MAN-HOURS AVAILABLE PER PERIOD IN RESIDENT ENGINEER OFFICE

RE Office No. (1) _____

Date (2) _____

Prepared By: (3) _____

(5) X (6) = (7) (7) – (11) = (12)

Two-Week Period Scheduled (4)	Number Employees Projected In Office (5)	Man-Hours of Normal Work In Two-Week Period (For 1 Person) (6)	Man-Hours In Two-Week Period For Office (Excluding Leave Time) (7)	Anticipated Leave Time During Periods				Man-Hours Available For Period (12)
				NAME (8)	Date(s) Unavailable (9)	Hour(s) Unavailable (10)	Total Hours Unavailable (11)	

STEP FIVE

COMPARE MANPOWER AVAILABILITY

AND MANPOWER PROJECTIONS

FOR TWO-WEEK PERIODS

Man-hour projections have been made and man-hour availability estimated. The two are compared on Form J.

To fill out Form J:

1. Enter the Resident Engineer office number on Line 1.
2. Enter the date on Line 2.
3. Sign the form on Line 3.
4. Enter each period being scheduled on Line 4.
5. Transfer man-hours available (from Form I) to the corresponding period on Line 5.
6. Transfer man-hour projections (from Form H) to the corresponding period on Line 6.
7. Subtract Line 6 from Line 5 and enter on Line 7 for each period.
8. Submit copies of completed Form J to the District and Construction Engineer.

FORM J

COMPARISON BETWEEN PERSONNEL AVAILABILITY AND NEEDS AT RESIDENT ENGINEER OFFICE FOR TWO-WEEK PERIODS

RE Office No. (1) _____

Date (2) _____

Calculated by: (3) _____

Period Scheduled (4)						
Man-Hours Available for period (5) (From Form I)						
Man-Hours Projected for period (6) (From Form H)						
Net (+ or –) (7) (5 – 6 = 7)						

STEP SIX

RECTIFY SIGNIFICANT DIFFERENCES BETWEEN AVAILABILITY OF PERSONNEL AND MAN-HOUR PROJECTIONS FOR TWO-WEEK PERIODS

A meeting will be held every four weeks by the District Engineer where each Resident Engineer will present his computations of available and projected man-hours. Significant differences denoting understaffing or overstaffing will be rectified on a temporary basis through short-term assignments at the District level between Resident Engineer offices in that District. Trends will be analyzed using the Long-Range Forecasting System projections.

Further, the Construction Management staff will work with the District Engineer on long-range planning to determine how many Construction Division employees the District needs to stay adequately staffed for the future projects. General overstaffing in a District on a short-term basis will be handled by various approved methods including secondary assignments such as location surveys.

STEP SEVEN

SCHEDULE PERSONNEL AND

VEHICLES FOR TWO-WEEK PERIOD

Steps One through Five which are explained in this manual, were simple, straightforward, mathematical calculations which office personnel are capable of performing. In Step Six, however, judgement decisions have to be made which require the Resident Engineer's or his Assistant's knowledge.

In Steps One through Five, much work was done in projecting man-hours available and man-hours needed for a Resident Engineer during the two-week periods being analyzed. The best data available at the time was used. As each two-week period approaches, changes occur in construction due to weather, changes in the contractor work plan, contractor scheduling errors, and other similar circumstances. The Resident Engineer's personnel is established for the two-week period in Step Six and cannot be easily changed. These changes do not relieve the Resident Engineer of the responsibility of consistently inspecting and documenting contractor's work. There are items of work required of which only the Resident Engineer and his personnel are aware.

The contractor is required to submit a Two-Week Work Schedule, due Thursday morning prior to the beginning of the scheduling period (Chart II and Figure 2). It is strongly suggested that, during periods when the contractor or his representative is on the job or otherwise available, the Resident Engineer or his job inspector meet with the contractor and become familiar with the reasons behind formal requests for stakes and to learn of any significant changes in the contractor's work effort.

CHA... II

TWO-WEEK WORK SCHEDULE

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

TWO-WEEK WORK SCHEDULE | **ACTIVITY WORK SCHEDULE**

Date (1) ____________ Job No. (2) ____________ Period Scheduled (3) ____________

Cont. Act.	ACTIVITY	Day Date (4)	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Weeks	2	4	6	8	10	12
																	Date (A)						
1	Clearing and Removal Items (6) (5)	Sta. ↔															(c) % (b) ↔						
2	Fencing Items	Sta. ↔															% ↔						
3	Earthwork	Sta. ↔															% ↔						
4	Shaping Roadway	Sta. ↔															% ↔						
5	Reconstructed Base	Sta. ↔															% ↔						
6	Subbase, base and/or Granular Surface	Sta. ↔															% ↔						
7	Prime Coat	Sta. ↔															% ↔						
8	Stabilized Base	Sta. ↔															% ↔						
9	Hot Mix Asphalt	Sta. ↔															% ↔						
10	Bituminous Surface Treatment	Sta. ↔															% ↔						
11	Concrete Pavement	Sta. ↔															% ↔						
12	Pipe Installation	Sta. ↔															% ↔						
13	Concrete – RC Box Culverts	Sta. ↔															% ↔						
14	Piling	Sta. ↔															% ↔						
15	Bridge Concrete	Sta. ↔															% ↔						
16	Structural Steel	Sta. ↔															% ↔						
18	Incidental Bridge Work	Sta. ↔															% ↔						
20	Curb and/or Gutter	Sta. ↔															% ↔						
21	Miscellaneous Concrete	Sta. ↔															% ↔						
22	Seeding Items	Sta. ↔															% ↔						
23	Guard Fence	Sta. ↔															% ↔						
24	Miscellaneous Items	Sta. ↔															% ↔						
25	Riprap	Sta. ↔															% ↔						
26	Sod Mulch	Sta. ↔															% ↔						
27	Special Activity ________	Sta. ↔															% ↔						

FIGURE 2

TWO-WEEK WORK SCHEDULE CERTIFICATION

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

TWO-WEEK WORK SCHEDULE

(7) Stakes specifically requested by contractor during this two-week period are as follows:

Station	Station	Type Survey Work Requested
Week 1		
_____	_____	_____
_____	_____	_____
_____	_____	_____
Week 2		
_____	_____	_____
_____	_____	_____
_____	_____	_____

(8) I (intend/do not intend) to work Saturdays should inclement weather and/or breakdown prevent work during the week.

(9) Comments by Contractor:

_____

_____

_____

(10) Comments by Resident Engineer:

_____

_____

_____

The Arkansas State Highway and Transportation Department Two-Week Work Schedule is to be prepared every two weeks in compliance with the "Contractor Scheduling" Special Provision. The contractor preparing this schedule hereby certifies that the above schedule is an accurate estimate of the work, weather permitting, to be performed within the next two weeks; and that the Resident Engineer will be notified within two work days of any significant changes in this schedule.

Submitted: _____

(11) Contractor

Approved: _____

(12) Resident Engineer

ACTIVITY WORK SCHEDULE

Submitted: _____

(D) Contractor

Approved: _____

(E) Resident Engineer

As was stated earlier, the man-hour availability and needs projections for a period were obtained using the best information available at the time and personnel were assigned to a Resident Engineer on that basis. The Two-Week Work Schedule is the best information on contractor's work that is available. When the Two-Week Work Schedule is obtained, the number of personnel available to a Resident Engineer is relatively fixed.

After the Two-Week Work Schedule is obtained, Resident Engineer work is then scheduled using Form K.

To fill out Form K:

1. Enter the Resident Engineer office number of Line 1.
2. Enter the date on Line 2.
3. Enter the period being scheduled on Line 3.
4. In Column 4, list all personnel available during the period being scheduled. Omit the Resident Engineer. List the survey party(ies) on a separate Form K in a group or groups.
5. In Column 5, insert the vehicle numbers of equipment assigned to specific personnel under the appropriate columns. Assignment of floating vehicles (vehicles not specifically assigned to an employee) or excess vehicles should be assigned as required.
6. Using the Two-Week Work Schedule from the contractor and personal knowledge of an employee's capabilities, schedule personnel to handle work proposed by the contractor. Experience has shown that major operations such as Hot Mix Asphalt lend themselves well to assignment of personnel by job and activity. However, when the contractor proposes several activities with minor efforts in each, assignment of inspection personnel to a job is desirable e.g. reinforced concrete culvert and drop inlet work scheduled by a contractor on a job could require assignment of only one to two personnel if contractor efforts were not of major proportions work should be scheduled on a crew basis, that is, scheduled together. Here again, major work such as original or final right-of-way cross sections lend themselves well to scheduling by job and activity. Often though the Resident Engineer will know that a party is needed on a particular job for a period of time to perform numerous activities. The Engineer should schedule the crew to a job in these cases to handle work as required.

Period Scheduled (3)

From: ______________________
To: ______________________

Form K
Resident Office Two-Week Work Schedule

RE Office No. (1) ______________________
Date (2) ______________________

Name (4)	Vehicle Assignment (5)	PRIMARY ASSIGNMENTS (6)												SECONDARY ASSIGNMENT (7)
		MONDAY Proj./Act.	TUESDAY Proj./Act.	WEDNESDAY Proj./Act.	THURSDAY Proj./Act.	FRIDAY Proj./Act.	SATURDAY Proj./Act.	MONDAY Proj./Act.	TUESDAY Proj./Act.	WEDNESDAY Proj./Act.	THURSDAY Proj./Act.	FRIDAY Proj./Act.	SATURDAY Proj./Act.	

Special efforts should be made to provide stakes specifically requested by the contractor on his Two-Week Work Schedule Recommended staffing and ranges of desired crew sizes are included in Appendix 5 for use in scheduling.

Nothing, however, will replace an Engineer's judgement on day-to-day requirements on a construction job. The schedule, the system, and all the work done in these areas is to be used as a guide to construction manpower planning. Alterations in schedules can and should be made as situations change.

7. Secondary assignment for each employee should be made in Column 7 so that whenever there are breakdowns in contractor equipment, weather changes, and other similar changes that alter planned work, the employee knows what he is to do. Idle time should never be a secondary assignment. Self-help training, equipment servicing, final estimate preparation, office work, and when applicable, Leave at the Convenience of the Department (LCOD) are all examples of secondary assignments.

CHAPTER III

DISTRICT ENGINEER

BASIS SCHEDULING SYSTEM

INSTRUCTIONS

DISTRICT ENGINEER
BASIC SCHEDULING SYSTEM
INSTRUCTIONS

The District Engineer is the Resident Engineer's immediate supervisor. He initially approves all personnel actions, change orders, and other similar actions. Therefore, it is only appropriate that he allocate construction field personnel based on knowledge of his Resident Engineers personnel needs. The Basic Scheduling System gives the District Engineer more detailed information of those needs. Information obtained from the Resident Engineers in a District is gathered and computed from contractor schedules in the same manner in each office and is therefore considered consistent in its degree of reliability. This information aids the District Engineer in making the objective decisions that he must make in regard to Resident Engineer's staffing. The District Engineer must perform certain duties to fully utilize the Basic Scheduling System.

MEETING OF ALL RESIDENT ENGINEERS

A meeting of all Resident Engineers in the District must be called. This should be held approximately one week prior to the first of the two-week project planning periods to be discussed. Resident Engineers should be given notice of this meeting two weeks in advance. A sample memorandum informing Resident Engineers of a meeting of this nature is provided by Table 2 .

This meeting is the main involvement of the District Engineer in the Basic Scheduling System. This involvement, however, is critical to achieving the objectives of the Basic Scheduling System - consistent staffing of construction work at Resident Engineer offices in accordance with project requirements.

Form 19-122—10M—7-77—C876-2767—II-2R—M.P.

TABLE 2

INTER OFFICE MEMORANDUM

SAMPLE MEMORANDUM FOR DISTRICT-WIDE
RESIDENT ENGINEER MEETING

DATE

TO: Resident Engineers, District _____

FROM: District _____ Engineer

SUBJECT: MEETING OF DISTRICT _____ RESIDENT ENGINEERS

Please be advised that the District _____ Resident Engineers will meet at (time) on (day of week, date) at (place of meeting). Personnel requirements and allocations for the periods between (date) and (date) will be discussed at that time.

Forms H,I, and J of the Basic Scheduling System are required to be submitted to the District office no later than (date) for the above periods and the following two week period (ending _____).

cc
Construction Management

PREPARATION

For this periodic meeting with Resident Engineers, perparation is necessary. The District Engineer receives three (3) forms from each Resident Engineer prior to the meeting (see sample forms following pages):

Form H - Summary of Total Project Hours For Two-Week Periods

Form I - Computation of Man-Hours Available in Resident Engineer office

Form J - Comparison Between Personnel Availability and Needs at Resident Engineer office for Two-Week Periods

These forms should be studied by the District Engineer carefully.

+ If man-hour projections on Form H for particular project(s) seem exceptionally high or low, they should be noted for discussion at the meeting.

+ Excessive leave time anticipated on Form I should be noted for discussion at the meeting. The District Engineer should note here that the only leave time a Resident Engineer can anticipate is extended illnesses, employee's birthdays and annual leave requested well in advance. Column (12) of Form I therefore includes only these.

Over the last three (3) years (1974, 1975, and 1976) construction employee's sick leave amounted to 2.3 percent of the total work days and annual leave averaged 4.8 percent. The District Engineer should consider leave time in addition to that on Form I if he deems it significant. Also, Column 12 of Form I, Man-Hours Available For Period does not take into account overtime work. It considers 8 hours as a normal work day. However, it does take into account Department recognized holidays.

Form V, which is a summary of Forms H and I, compares man-hour availability of Resident Engineer office personnel with projected man-hour needs. This should be compared with those submitted by other Resident Engineer offices in the District. The District Engineer should keep in

FORM H

SUMMARY OF TOTAL PROJECT HOURS FOR TWO-WEEK PERIODS

RE Office No. (1) _____

Date (2) _____

Calculated by (3) _____

Period Projected (4) _____

PROJECT (5) / ACTIVITIES	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	Project No.	RE Office Total (6)
Survey (100) Activities									
Construction (200) Activities									
Supervision and Miscellaneous (300) Activities									
Office (400) Activities									
TOTAL									

F( )

COMPUTATION OF MAN-HOURS AVAILABLE PER PERIOD IN RESIDENT ENGINEER OFFICE

RE Office No. (1) _____

Date (2) _____

Prepared By: (3) _____

(5) X (6) = (7) (7) – (11) = (12)

Two-Week Period Scheduled (4)	Number Employees Projected In Office (5)	Man-Hours of Normal Work In Two-Week Period (For 1 Person) (6)	Man-Hours In Two-Week Period For Office (Excluding Leave Time) (7)	Anticipated Leave Time During Periods				Man-Hours Available For Period (12)
				NAME (8)	Date(s) Unavailable (9)	Hour(s) Unavailable (10)	Total Hours Unavailable (11)	

FORM J

COMPARISON BETWEEN PERSONNEL AVAILABILITY AND NEEDS AT RESIDENT ENGINEER OFFICE FOR TWO-WEEK PERIODS

RE Office No. (1) _____

Date (2) _____

Calculated by: (3) _____

Period Scheduled (4)						
Man-Hours Available for period (5) (From Form I)						
Man-Hours Projected for period (6) (From Form H)						
Net (+ or –) (7) (5 – 6 = 7)						

mind when comparing these figures the above discussion of Forms H and I in determining whether there is in reality a need for more or less personnel in a particular Residency for the period(s) reviewed.

A Resident Engineer office should be considered adequately staffed in terms of numbers if the man-hours projected and man-hours available are within 15 percent of each other.

At the meeting held between the Resident Engineers and their District Engineer, the District Engineer should question each Resident Engineer regarding on the forms submitted (H, I, J) giving the Resident an opportunity to express any additional man-hour needs. Any significant changes the Resident desires in the forms to make them reflect more accurate needs should be discussed. For instance, if Form H projects 300 man-hours on a project for a particular two-week period, and the Resident or District Engineer knows from experience on that job or jobs of that nature that two men full-time could handle the anticipated work adequately, then 140 hours (300-160) should be deducted from the Man-Hours Projected on Form J during the meeting if the District Engineer so desires. On the other hand if a Resident Engineer justifies, to the District Engineers satisfaction, man-hours in addition to those hours projected on Form H, these should be added to the projected man-hours on Form J.

After the above discussion, reasonably accurate estimates of man-hours needs on a bi-weekly basis will have been obtained. An accurate estimate of man-hour availability was available on Form I. It is the District Engineer's responsibility at this point to make the decision as to what constitutes consistent staffing of construction projects for each period based on the available information.

Those offices which reflect significant man-hour availability should:

+ Be given additional assignments such as surveys or training, generally the same as secondary assignments, and/or

+ Temporarily loan specific personnel to other offices, generally within the District, which reflect a need for them.

Designation of these activities is the District Engineer's responsibility. General guidance from the Central Office is provided but the District Engineer, with his knowledge of the local situations and his control of Construction Division field personnel in his District, is the logical person to be the final judge of manpower assignments.

There are several areas of caution:

Overtime assignment of personnel, when practical, can increase man-hour availability considerably. If this can satisfy the manpower needs during a specified period, it should be considered.

Man-Hours available many be within the desired tolerance ($\pm$ 15 percent) and the proper number of personnel may be available for a particular period. However, the District Engineer should satisfy himself, as should the Resident Engineers, that the quality of personnel staffing an office for the period is what it should be. That is, an office should have a proper blend of supervisory and non-supervisiory personnel and it should have knowledgble inspectors in charge of each of the various major operations of the contractor. For instance four Highway Engineer Aide I's, inexperienced in survey work, would not be considered an adequate survey party regardless of the man-hours of availability. On the other hand a survey party consisting of two Highway CE III's and one Engineer Assistant Highway II would be considered over qualified and therefore a waste of personnel resources.

Job classifications used by the Department, functional or otherwise, may not describe an employee's ability adequately. This points out another reason why it is critical that the District Engineer and his Resident Engineers discuss their personnel needs.

If general overstaffing occurs in a District, and there are no indications that additional personnel are needed in surrounding Districts, the District Engineer should assign surveys, training, and other work that may not be essential to the Construction Division but are productive when performed.

When general understaffing in an entire District occurs, the District Engineer should contact the construction office to determine the availability or additional personnel.

If there is still a shortage, the District Engineer should review closely each of his Resident office's manpower needs and then balance the staffing assignment among the Residencies.

In summary, the Basic Scheduling System is a managment system for use by the District Engineer and his Resident Engineers to staff construction projects for short periods of time. The District Engineer's major involvement in this Basic Scheduling System occurs during meetings held with his Resident Engineers. The Resident Engineer is the front-line supervisor of personnel on a day-to-day basis. He has been aided by consistent efforts to staff his work through the use of the Basic Scheduling System.

The next chapter provides background information on another system which aids the construction management process, namely the Long-Range Forecasting System.

CHAPTER IV

DISTRICT ENGINEER

LONG-RANGE FORECASTING SYSTEM

INSTRUCTIONS

DISTRICT ENGINEER

LONG-RANGE FORECASTING SYSTEM

INSTRUCTIONS

The Introduction to this Operations Manual has provided general information on the Long-Range Forecasting System which was developed for the Department as a result of the Construction Management Research Project. The purpose of this Chapter is to provide more detailed information for the District Engineer's understanding of the system to explain the role of the Construction Engineer's office with regard to the Long-Range Forecasting System; and to give an example with regard to the District Engineer's use of the system.

THE LONG-RANGE FORECASTING SYSTEM

The Long-Range Forecasting System refers to the prediction or the estimation of future manpower requirements for the Construction Division field operations on a job-by-job and District-by-District basis. Field operations, as used here, involves all surveying, inspection, and documentation activities conducted by personnel assigned to a District or Resident Engineer.

The Long-Range Forecasting System provides information on the number of total man-hours required for field operations for any future construction project; the number of man-hours, distributed by month, required for field operations for any future construction project; the monthly staffing required by each District and the entire State for field operations for the anticipated construction projects; and the importance of any future project and/or group of projects on the staffing of a District office or of the entire State.

The results of the forecast are obtained by means of a computer printout. The computer analysis is updated and rerun each month. This

model is extremely useful to the District Engineers, to the Construction Engineer and the Department in determining their future staffing needs.

In the Long-Range Forecasting System, there are special terms which describe the various components. Listed below are the key terms and their definitions:

Historic Projects - These are construction projects that have been completed and finaled. A project is designated as finaled when the project has been accepted and all of the documentation has been completed by the Resident Engineer and received by the Final Estimates Section.

Current Projects - These are on-going construction projects.

Future Projects - These are construction projects which have not yet been let to contract but which are programmed for a future letting.

Data Base - A data base is a collection of information. This system maintains two data bases, the Historic Project Computer File and the Current/Future Project Computer File. The Historic Project data base contains information about the various characteristics of completed Department construction projects. The Current/Future Project data base contains information about the various project characteristics of on-going and future Department construction projects. The data bases are seperately maintained and the only interaction occurs when a project is completed. Then the information about the project is moved from the Current/Future data base to the Historic data base.

Computer Files - There are two separate computer files. One file is sorted on disc and is called the Historic Computer File. This file contains all of the information about historic construction projects. The second computer file is stored on key punch cards, and contains all of the information on current and future projects. This file is called the Current/Future Computer File.

Physical Files - The physical files contain the data sheets on which all project information is originally collected and stored. This file is a duplicate of the Computer File. There are three sets of physical files: future projects, current projects, and historic projects.

Summary Table - This is the output display that lists, for each project, the monthly man-hour projections.

Job Data Sheet - This is the sheet on which original project information is recorded. They are kept in the Physical Files.

Computer Decks - These are decks of IBM computer cards that are used to make the appropriate additions, corrections and deletions to the Computer Files and the forecasting model. Each alteration to the Physical Files must eventually be made to the Computer Files. These computer decks are the vehicles for accessing and changing the Computer Files. There are seven computer decks for the Construction Management Coordinator. They are:

1) ADDITIONS - This deck is used to add information about a previously unlisted project to the Current/Future Computer File.

2) CORRECTIONS - This deck is used to update or change any data item or projects already a part of the Current/Future or Historic Computer File.

3) TRANSFER - This deck is used to transfer a project from the Current/Future Computer File to the Historic File.

4) MODELS - This deck is used to input regression prediction equations to the Long-Range Forecasting System.

5) REPORTER - This deck is used to generate a forecast report of the monthly inspection man-hours.

6) REGRESSION - This deck is used to perform a regression analysis on selected data.

7) PLOT - This deck is used to generate graphs of man-hours plotted as a function of any desired data item in order to view the relationships between those variables.

CONSTRUCTION ENGINEER OFFICE

The Construction Management Coordinator is responsible for identifying future and current construction projects, completing a data sheet for each project and regularly updating this data sheet with the most recent available information about each item on the data sheet. The Construction Management Coordinator will contact various sources (the Program Planning Section of the Planning and Research Division, the Accounting Section and the Final Estimates Section) on a regular basis in order to maintain this future and current file.

Information about specific State Aid funded projects is not avail-

for future projects because the State Aid Division cannot identify the specific projects that will be constructed beyond a one-month period. Therefore, because these future construction projects cannot be identified, the Construction Management Coordinator will utilize an estimate of the gross total of inspection man-hours for each District for each month for a two year planning horizon by means of a special component which has been added to the Long-Range Forecasting System.

USE OF THE SYSTEM

The computer model which was developed provides information on each future project programmed to begin during the planning period and presents a monthly estimate of the number of inspection man-hours required for each project. The planning period generally will be for 24 months. Two computer printout sheets are required to display the 24 months planning period. Two sample output sheets and a discussion of each item of these data sheets follow.

The first output sheet, Figure 2, displays the monthly man-hours forecasts for the first twelve months of the planning period for all the current and future projects in District 3. The second output sheet, Figure 4, displays the same information for the second twelve months of the planning period. Following is a discussion of each column.

1. County: The county code is displayed in this column. The first digit of this code indicates the District in which the project is located. All projects are first sorted by the county code in order to group all projects in the same District together.

2. Job: The project job number is listed in column 2. A second sort can be performed so that the projects within a District would be listed in order of the job number.

3. Start Date: The actual or estimated date the project was or will be started is listed in this column. A second sort may also be performed using this column rather than the job column.

TABLE 10

07/25/77 — MANHOUR FORECAST — PAGE 6

1 DIV CNTY	2 JOB	3 START DATE	4 COMP DATE	5 TOTAL MANHRS	6 ALREADY DISTRIB	7 JAN 77	8 FEB 77	9 MAR 77	10 APR 77	11 MAY 77	12 JUN 77	13 JUL 77	14 AUG 77	15 SEP 77	16 OCT 77	17 NOV 77	18 DEC 77	19 UNDISTRI BALANCE
31	S-29-2	5-76	5-77	652	480	29	28	28	32	31	0	0	0	0	0	0	0	0
31	S-29-3	7-76	12-76	1376	1376	0	0	0	0	0	0	0	0	0	0	0	0	0
31	S-29-6	6-77	7-77	715	0	0	0	0	0	0	373	341	0	0	0	0	0	0
31	S-29-7	7-77	4-78	2064	0	0	0	0	0	0	0	189	292	336	327	262	169	504
31	3821	12-76	3-77	942	206	274	265	196	0	0	0	0	0	0	0	0	0	0
31	3822	3-77	6-77	880	0	0	0	138	269	266	211	0	0	0	0	0	0	0
32	F-31-1	5-76	3-77	2276	1992	98	96	87	0	0	0	0	0	0	0	0	0	0
33	NS-41-1	6-76	1-77	1518	1422	95	0	0	0	0	0	0	0	0	0	0	0	0
33	S-41-4	1-77	6-77	876	0	76	124	166	189	167	151	0	0	0	0	0	0	0
33	S-41-5	6-77	4-78	1253	0	0	0	0	0	0	92	139	171	200	174	131	85	257
33	3-673	6-77	10-77	1007	0	0	0	0	0	0	151	245	275	215	120	0	0	0
33	3-674	6-77	11-77	1121	0	0	0	0	0	0	140	217	277	242	153	89	0	0
33	3776	9-77	3-80	8647	0	0	0	0	0	0	0	0	0	267	216	168	169	8024
34	GF-5-2	6-77	11-77	681	0	0	0	0	0	0	85	132	168	147	93	54	0	0
34	S-46-2	7-76	6-77	737	450	44	46	44	50	49	50	0	0	0	0	0	0	0
34	3-675	6-77	11-77	1147	0	0	0	0	0	0	144	222	283	248	158	91	0	0
34	3725	5-77	11-78	3547	0	0	0	0	0	121	152	229	247	280	256	211	153	1914
34	3729	6-76	9-77	8807	4296	412	420	447	539	531	596	552	531	477	0	0	0	0
34	3780	10-76	9-77	2494	484	147	137	212	247	257	273	252	232	196	0	0	0	0
34	3807	10-76	6-77	665	270	82	82	78	81	73	0	0	0	0	0	0	0	0
34	3812	10-76	5-77	665	408	39	88	72	0	0	0	0	0	0	0	0	0	0
34	3815	7-77	1-79	2728	0	0	0	0	0	0	0	125	136	193	159	143	105	1867
35	S-49-3	8-76	11-76	1067	1067	0	0	0	0	0	0	0	0	0	0	0	0	0
35	3-676	6-77	1-78	1464	0	0	0	0	0	0	143	218	281	308	220	146	84	60
35	3794	5-77	10-77	1674	0	0	0	0	0	172	301	389	359	281	170	0	0	0
35	3804	10-76	9-77	2221	500	157	191	205	241	244	248	250	199	0	0	0	0	0
36	F-50-1	10-76	9-77	2302	447	136	172	195	226	237	252	233	215	181	0	0	0	0
36	3XXX	3-78	3-80	12246	0	0	0	0	0	0	0	0	0	0	0	0	0	12246
36	3792	3-77	5-79	6429	0	0	0	0	0	0	0	0	275	275	302	252	198	5124
36	3816	10-76	12-76	1370	1370	0	0	0	0	0	0	0	0	0	0	0	0	0
37	F-55-1	2-77	9-77	1512	0	0	79	124	197	244	262	238	202	162	0	0	0	0
37	S-55-4	2-77	5-77	869	0	0	147	244	271	205	0	0	0	0	0	0	0	0
37	3-677	6-77	1-78	1563	0	0	0	0	0	0	153	233	300	329	295	156	93	64
37	3814	1-78	4-79	2626	0	0	0	0	0	0	0	0	0	0	0	0	0	2626
37	3823	4-77	5-77	1275	0	0	0	0	647	627	0	0	0	0	0	0	0	0
38	F-60-2	6-76	5-77	1736	1266	93	92	86	100	95	0	0	0	0	0	0	0	0
38	S-60-4	6-77	3-78	948	0	0	0	0	0	0	75	117	143	171	143	99	84	133
38	3657	3-79	3-80	5520	0	0	0	0	0	0	0	0	0	0	0	0	0	5520
38	3793	7-76	12-77	3337	1121	136	156	176	207	229	253	256	233	216	161	110	73	0
38	3795	1-78	10-79	6669	0	0	0	0	0	0	0	0	0	0	0	0	0	6669
20 39	STATEAID	1-77	12-78	19164	0	81	184	305	527	745	1084	1157	1221	1221	986	767	552	10328
21	DISTRICT 2			119000	17163	1957	2567	2813	3632	4294	5201	5724	6051	5955	5859	2681	1748	55339

FIGURE 3

LONG-RANGE FORECASTING SYSTEM OUTPUT (1977)

TAB 1

07/25/77 MANHOUR FORECAST PAGE 6

22 COU NTY	23 JOB	24 START DATE	25 COMP DATE	26 TOTAL MANHRS	27 ALREADY DISTRIB	28 JAN 78	29 FEB 78	30 MAR 78	31 APR 78	32 MAY 78	33 JUN 78	34 JUL 78	35 AUG 78	36 SEP 78	37 OCT 78	38 NOV 78	39 DEC 78	40 UNDISTRI BALANCE
31	S-29-2	5-78	5-77	632	632	0	0	0	0	0	0	0	0	0	0	0	0	0
31	S-29-3	7-78	12-78	1378	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	S-29-6	6-77	7-77	715	715	0	0	0	0	0	0	0	0	0	0	0	0	0
31	S-29-7	7-77	4-78	2084	1579	135	125	118	125	0	0	0	0	0	0	0	0	0
31	3821	12-76	3-77	942	942	0	0	0	0	0	0	0	0	0	0	0	0	0
31	3822	3-77	6-77	880	880	0	0	0	0	0	0	0	0	0	0	0	0	0
32	F-31-1	5-78	3-77	2276	2276	0	0	0	0	0	0	0	0	0	0	0	0	0
33	NS-41-1	8-78	1-77	1518	1518	0	0	0	0	0	0	0	0	0	0	0	0	0
33	S-41-4	1-77	6-77	876	876	0	0	0	0	0	0	0	0	0	0	0	0	0
33	S-41-5	6-77	4-79	1253	993	67	64	61	65	0	0	0	0	0	0	0	0	0
33	3-673	6-77	10-77	1007	1007	0	0	0	0	0	0	0	0	0	0	0	0	0
33	3-674	6-77	11-77	1121	1121	0	0	0	0	0	0	0	0	0	0	0	0	0
33	3776	7-77	3-80	8847	324	156	177	219	294	332	453	516	544	553	453	352	244	3723
34	GF-3-2	8-77	11-77	681	681	0	0	0	0	0	0	0	0	0	0	0	0	0
34	S-47-2	7-78	6-77	737	737	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3-675	6-77	11-77	1147	1147	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3725	5-77	11-78	3547	1626	138	149	154	191	204	223	216	208	195	138	100	0	0
34	3729	6-78	9-77	8807	8807	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3780	10-78	9-77	2494	2494	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3807	10-78	5-77	669	669	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3812	10-78	2-77	669	669	0	0	0	0	0	0	0	0	0	0	0	0	0
34	3815	7-77	1-79	2728	858	107	122	137	171	181	209	211	201	182	134	98	61	51
35	S-49-3	8-78	11-78	1067	1067	0	0	0	0	0	0	0	0	0	0	0	0	0
35	3-678	6-77	1-78	1464	1403	60	0	0	0	0	0	0	0	0	0	0	0	0
35	3774	5-77	10-77	1674	1674	0	0	0	0	0	0	0	0	0	0	0	0	0
35	3804	10-78	8-77	2221	2221	0	0	0	0	0	0	0	0	0	0	0	0	0
36	F-56-1	10-78	9-77	2302	2302	0	0	0	0	0	0	0	0	0	0	0	0	0
36	XXXX	5-78	3-80	12246	0	0	0	227	294	409	589	629	768	766	685	579	416	6879
36	3792	8-77	5-79	6439	1304	136	224	279	363	422	512	496	517	485	376	269	172	819
36	3810	10-78	12-78	1370	1370	0	0	0	0	0	0	0	0	0	0	0	0	0
37	F-55-1	2-77	5-77	1512	1512	0	0	0	0	0	0	0	0	0	0	0	0	0
37	S-55-4	2-77	5-77	869	869	0	0	0	0	0	0	0	0	0	0	0	0	0
37	3-677	6-77	1-78	1562	1498	64	0	0	0	0	0	0	0	0	0	0	0	0
37	3814	1-78	4-79	2626	0	61	81	111	162	195	275	299	319	289	224	162	101	341
37	3823	4-77	5-77	1275	1275	0	0	0	0	0	0	0	0	0	0	0	0	0
38	F-66-2	6-78	5-77	1736	1736	0	0	0	0	0	0	0	0	0	0	0	0	0
38	S-66-4	8-77	3-78	948	814	46	45	41	0	0	0	0	0	0	0	0	0	0
38	3681	5-78	3-80	5520	0	0	0	102	132	164	265	283	346	346	307	261	187	3101
38	3790	7-78	12-77	3337	3337	0	0	0	0	0	0	0	0	0	0	0	0	0
38	3797	1-78	10-79	6669	0	109	123	155	259	318	411	468	555	557	462	359	235	2622
39	STATEWI	1-77	12-78	19164	8329	489	552	610	791	894	1084	1157	1221	1221	986	767	552	0
DISTRICT 3				119000	83652	1821	1665	2259	2352	3141	4025	4279	4683	4597	3767	2949	1972	17539

FIGURE 4

LONG-RANGE FORECASTING SYSTEM OUTPUT (1978)

4. Comp date: The date the project is estimated to be completed is listed in this column.

5. Total Manhrs: The regression prediction equation estimate of the total man-hours required to inspect the project is listed in this column.

6. Already Distrib: The estimated man-hours that have been distributed over past months are listed in this column. This column will be zero for future projects and will display a value only for current (on-going) projects. This column displays the estimate of already distrubuted man-hours and not the actual amount of man-hours that were required to inspect the construction project to date.

7 through 18: The estimated inspection man-hours for each month for each project are listed in these columns for the first 12 months of the planning period. Column 7 represents the first month of the planning period.

19. Undistri Balance: The total inspection man-hours that have not been distributed prior to or during the past 12 months are listed in this column.

20. STATE AID: The estimate of the inspection man-hours for all future State-Aid funded projects are displayed on this row.

21. District 3: This row displays the sum of the monthly man-hours estimates for all current and future projects in the District.

22 through 26: Same as columns 1 through 5.

27. Already Distrib: This column displays the total inspection man-hours that have already been distributed either prior to or during the first year of the planning period.

28 through 39: The estimated inspection man-hours for the second 12 months of the planning period are listed in these columns.

40. Undistri Balance: The total inspection man-hours that have not been distributed prior to or during the 24 month planning period are listed in this column. Projects that are anticipated to be completed during the 24 month planning period will list a zero in this column. Projects that are anticipated to extend beyond the planning period will display the total undistributed inspection man-hours.

The information from the Long-Range Forecasting System can be utilized

to supplement information obtained from the Basic Scheduling System. It has been previously discussed that the Basic Scheduling System provides information for periods up to twelve weeks. If the District Engineer desires information for projects beyond the twelve week planning period, it can be obtained from the Construction Management Coordinator who will utilize the Long-Range Forecasting System printouts.

For example, if the District Engineer in District 3 wishes to know man-hour requirements for job number S-29-7 during the months of January, February, March and April 1978, the computer printout will show the results. For example:

22 County	23 Job	24 Start Date	25 Comp Date	26 Total Manhrs	27 Already Distrib	28 Jan 78	29 Feb 78	30 Mar 78	31 April 78
31	S-29-7	7-77	4-78	2084	1579	135	125	118	125

A partial listing of the information and courses of action available to the District Engineer includes:

a) the project requires a total of 503 man-hours during 1978 for completion.

b) manpower needs will be relatively constant in the months of January, February, March and April amounting to close to full time for one individual during each month.

c) if this project workload increases the staffing requirements on a Resident Engineer's office beyond current capacity, the District Engineer can increase the Resident Engineer's resources.

d) if Project S-29-7 increases the workload on a Resident Engineer office beyond capacity as determined by current and/or anticipated resource levels, the District Engineer can coordinate the project activity so that it is undertaken at a more favorable time or assign this project to another Resident Engineer.

Many other management decisions and capabilities in addition to those discussed above are now available as a result of the Long-Range Forecasting

System. It should be emphasized that the Construction Management Coordinator will be able to aid the District Engineers in the use of the Long-Range Forecasting System. For example, the Coordinator should indicate in his analysis that the projections do not include Resident Engineers and his staff who are considered "fixed staff".

The District Engineers now have a mechanism to determine trends toward future manpower requirements. Hiring of additional personnel can be justified on the basis of information provided, as can the permanent transfer of personnel who could be better utilized in other locations. These decisions have been made in the past by the District and Construction Engineers with little more than intuition to go on. The Long-Range Forecasting System, therefore, is a step toward systematic, consistent manpower planning.

APPENDIX

APPENDIX 1

ENGINEERING ACTIVITY LIST

Activity	Activity Title		Unit
100 SURVEY ACTIVITIES			
101	Run Centerline		Sta/Hr
102	Set R/W Stakes & Hub		Sta/Hr
103	Take Topography		Sta/Hr
104	Run Check Levels		Sta/Hr
105	Cross Section R/W		Sta/Hr
106	Minor Structure Stakeout		LF/Hr
107	Bridge Stakeout		Bridge/Hr
108	Staking by Station (e.g. Overlay)		Sta/Hr
109	Grade R/W Hubs		Sta/Hr
110	Stake R/W for Earthwork		Sta/Hr
111	Set Blue Tops		Sta/Hr
112	Curb and/or Gutter Stakeout		LF/Hr
113	Seeding Item Stakeout		Acre/Hr
114	Pit Cross Section		Pit/Hr
200 CONSTRUCTION ACTIVITIES			
217	Inspection	Clearing & Removal Item	Acre/Hr
218	Inspection	Fencing Item	LF/Hr
219	Inspection	Earthwork	CY/Hr
219	Checking	Earthwork	CY/Hr
219	Materials	Earthwork	CY/Hr
220	Inspection	Reconstructed Base Course	Sta/Hr
220	Materials	Reconstructed Bsse Course	% of 220I
221	Inspection	Shaping Roadway	Sta/Hr
221	Materials	Shaping Roadway	% of 221I
222	Inspection	Granular Material-Volume	CY/Hr
222	Checking	Granular Material-Volume	CY/Hr

200 CONSTRUCTION ACTIVITIES

222	Materials	Granular Material-Volume	% of 222C
223	Inspection	Granular Material-Weight	Ton/Hr
223	Checking	Granular Material-Weight	Ton/Hr
223	Materials	Granular Material-Weight	% of 223C
224	Inspection	Prime Coat	Gal/Hr
224	Checking	Prime Coat	Gal/Hr
225	Inspection	Stabilized Base	SY/Hr
225	Checking	Stabilized Base	SY/Hr
225	Materials	Stabilized Base	% of 225I
226	Inspection	Hot Mix Asphalt-Roadway	Ton/Hr
226	Checking	Hot Mix Asphalt-Roadway	Ton/Hr
226	Materials	Hot Mix Asphalt-Roadway	Ton/Hr
227	Inspection	Hot Mix Asphalt-Plant	Ton/Hr
227	Checking	Hot Mix Asphalt-Plant	Ton/Hr
228	Inspection	Bituminous Surface Treatment	SY/Hr
228	Checking	Bituminous Surface Treatment	SY/Hr
228	Materials	Bitiminous Surface Treatment	% of 228I
229	Inspection	Concrete Pavement, Base	SY/Hr
229	Checking	Concrete Pavement, Base	SY/Hr
229	Materials	Concrete Pavement, Base	% of 229I
230	Inspection	Pipe Installation	LF/Hr
231	Inspection	Concrete - RC Box Culverts	CY/Hr
232	Inspection	Piling	LF/Hr
233	Inspection	Bridge Concrete	CY/Hr
234	Inspection	Structural Steel	Lb/Hr
235	Inspection	Incidental Bridge Work	% of 233I

200 CONSTRUCTION ACTIVITIES

236	Inspection	Curb and/or Gutter	LF/Hr
237	Inspection	Miscellaneous Concrete	CY/Hr
239	Materials	Concrete Aggregate Testing (excluding Concrete Pavement)	% of 231I, 233I, 236I, & 237I
240	Inspection	Concrete Plant	% of 231I, 233I, 236I, & 237I
241	Inspection	Seeding	Acres/Hr
242	Inspection	Guard Fence Installation	LF/Hr
243	Inspection	Riprap, Dumped	SY/Hr
243	Checking	Riprap, Dumped	SY/Hr
244	Inspection	Sod Mulch	CY/Hr
244	Checking	Sod Mulch	CY/Hr

300 SUPERVISION AND MISCELLANEOUS

347	Miscellaneous Survey Work	% of 100 Activities
348	Preparation of Grade Books	% of 100 Activities
349	Fabrication and/or Casting Yard	As Needed
350	Miscellaneous Construction Work	% of 200 Activities
351	Project Supervision	% of 100, 200 Activities
352	Travel Time	% of 100, 200 Activities
353	Training	As Needed
354	Idle Time	None
355	Resident Engineer	None

400 OFFICE ACTIVITIES

460	Preparation of Final Estimate	% of 200 Activities
461	General Office Work	% of 200 Activities

APPENDIX 2

ENGINEERING ACTIVITIES DESCRIPTIONS

ENGINEERING ACTIVITIES DESCRIPTION

The following pages include general descriptions of each of the Construction Division work activities. These descriptions include a brief summary of the tasks that are involved in each activity.

The activities are divided into four functional areas. These are:

Survey	100
Construction	200
Supervision	300
Office Activities	400

When reporting Survey 100 Activities, it should be noted that and "S" or "R" should follow the activity. A "S" designates initial stake-out, while "R" represents replacement stakeout.

When reporting Construction 200 Activities, each should have "I", "C", or "M" follwoing the reported activity. "I" designates inspection, "C" represents checking, and "M" represents materials or test.

100 SURVEY WORK (100 S, 100 R)

Activity No.	Unit	Activity Title	Description
101	Sta.	Run Centerline	Includes: 1) Establishing control points; 2) Referencing control points (as needed); and 3) Running centerline
102	Sta.	Set R/W Stakes and Hub	Includes: 1) Measuring R/W distance off established ℄ or establishing the R/W line using a transit on R/W line (as one would run ℄); 2) Setting hub and guard stakes at each station and R/W change; and 3) Marking stakes with the station number and distance right or left of ℄.
103	Sta.	Take Topography	Includes: 1) Measuring off established ℄, the perpendicular distance of any and all objects on the R/W, e.g., trees, driveways, pipe, buildings, utilities, fences, etc; and 2) Drawing a sketch of same in field book showing all pertinent information.
104	Sta.	Run Check Levels	Includes: 1) Locating plan bench marks; 2) Setting additional and transferring existing bench marks out of construction limits; 3) Running accurate level circuit; 4) Recording the circuit and bench mark descriptions, along with elevations of same; and 5) Checking notes
105	Sta.	Cross Section R/W	Includes: 1) Taking cross sections (on roadway and channel, original and final) at proper intervals; 2) Checking and tying of final cross sections to originals; and 3) Keeping accurate and complete field notes.
106	L.F.	Minor Structure Stake Out	Includes: 1) Staking the centerline location of structure such as R.C. box and pipe culverts; 2) Profiling the existing drainage; 3) Establishing the desired flow line of structure; 4) Hubbing, grading, and computing cut or fill to flow line off hub; 5) Recording tasks 1-4 on a sketch in field book; 6) Marking stakes as needed; and 7) Staking headwall line as needed.

Activity No.	Unit	Activity Title	Description
107	Each	Bridge Stake Out	Includes: 1) Establishing bridge and bent ℄; 2) Offset stakes on same; 3) Referencing control points; 4) Transferring bench marks as necessary; and 5) Recording the above in field book.
108	Sta.	Staking by Station (e.g. overlay)	Includes: 1) Chaining distances; and 2) Setting stakes out at necessary in tervals (overlays, reconstructed base, etc.)
109	Sta.	Grade R/W Hubs	Includes: 1) Level work and note keeping; and 2) Grading R/W hubs, (if not already done with cross sections).
110	Sta.	Stake R/W for Earthwork	Includes: 1) Computing cuts and fills off R/W hubs, along with distances to edge subgrade, bottom of ditch, etc; 2) Marking stakes with appropriate information or slope staking; and 3) Recording pertinent information in field book.
111	Sta.	Set Blue Tops	Includes: 1) Establishing centerline and shoulder line (and any other break points); and 2) Driving hubs to grade at needed intervals.
112	L.F.	Curb and/or Gutter Stakeout	Includes: 1) Establishing line and grade for curb and/or gutter; 2) Setting offset line and grading same; 3) Figuring cuts or fills and distances to gutter line and grade; and 4) Placing information on stakes and in field book.
113	Acre	Seeding Item Stakeout	Includes: 1) Measuring, calculating and inserting in field book all areas to be seeded, overseeded, mulch covered, etc. (items by acre); and 2) Setting stakes out with appropriate notations.
114	Each	Pit Cross Sections	Includes: 1) Establishing a base line offset lines, and bench marks; 2) Referencing the same; 3) Cross sectioning pit (original and final); and 4) Tying the original and final cross sections.

200 CONSTRUCTION WORK (200I, 200C, 200M)

Activity No.	Unit	Activity Title	Description
217	Acre	Clearing and Removal Item	(I) Inspection Activity includes: 1) Inspection of Clearing, Grubbing and Removal Item work performed by contractor; 2) Calculations and field book notations necessary for Current Estimates; and 3) Diary submittal.
218	L.F.	Fencing Item	(I) Inspection Activity includes: 1) Inspection of the construction of fencing items on plans; and 2) Diary submittal.
219	C.Y.	Earthwork	(I) Inspection Activity includes: 1) Inspection of contractor's earthwork operations; 2) Stringlining finished grade; and 3) Diary submittal. (C) Checking Activity includes: 1) The filling out of any applicable daily reports used to document pay quantity (vehicle measure). (M) Materials and Tests Activity includes: 1) Proctors; 2) Densities; 3) Gradations; 4) P.I.'s (Plasticity Indices); and 5) Sample submissions to Central Office Lab.
220	Sta.	Reconstructed Base Course	(I) Inspection Activity includes: 1) Inspecting contractor's operations - line, grade, and compaction efforts; and 2) Diary submittal. (M) Materials and Tests Activity includes; 1) Proctors; 2) Densities; 3) Sounding; and 4) Sample submittals to Central Office Lab.
221	Sta.	Shaping Roadway	(I) Inspection Activity includes: 1) Inspecting contractor's operation - line, grade, and compaction procedures; (M) Materials and Tests Activity includes: 1) Proctors 2) Densities; and 3) Sample submittals to Central Office Lab.

Activity No.	Unit	Activity Title	Description
224 (continued)			(C) Checking Activity includes: 1) Filling out applicable daily report form to document pay quantity; 2) Taking and recording temperature of application; and 3) "Sticking" the distributor.
225	S.Y.	Stabilized Base	(I) Inspection Activity includes: 1) Inspecting equipment used; 2) Inspecting contractor operations (all phases - application of stabilizing material, mixing, compaction); 3) Stringlining finished product; 4) Diary submittal; and 5) Filling out applicable Inspector's report form. (C) Checking Activity includes: 1) Filling out documentation forms; and 2) Helping Inspector (M) Materials and Tests Activity includes: 1) Proctors; 2) Densities; and 3) Soundings.
226	Ton	Hot Mix Asphalt - Roadway	(I) Inspection Activity includes: 1) Inspecting equipment; 2) Inspecting placement and compaction methods; 3) Insuring rate of placement in accordance with plans; 4) Diary submittal; and 5) Obtaining proper scale calibration, and 6) checking finished surface with rolling straightedge. (C) Checking Activity includes; 1) Filling out applicable daily report form; 2) Checking and recording temperature; 3) Checking subtraction of scale man; and 4) Helping Inspector. (M) Materials and Tests Activity involves running of sand cone densities on Hot Mix Stabilized Base.

Activity No.	Unit	Activity Title	Description
222	C.Y.	Granular Material Volume	(I) Inspection Activity includes: 1) Inspecting placement and compaction efforts; 2) Stringlining finished product; 3) Measuring trucks; 4) Keeping rate of placement uniform; and 5) Diary Submittal. (C) Checking Activity includes: 1) Filling out applicable daily report form to document this pay quantity; and 2) Insuring that trucks deliver full loads. (M) Materials and Test Activity includes: 1) Gradations; 2) P.I.'s (Plasticity Indices); 3) Proctors, 4) Densities; 5) Soundings; and 6) Sample submittals to Central Office Lab.
223	Ton	Granular Material Weight	(I) Inspection Activity includes: 1) Inspecting placement and compaction efforts; 2) Stringlining finished product; 3) Keeping rate of placement uniform; 4) Obtaining proper scale certification; and 5) Diary Submittal. (C) Checking Activity includes: 1) Filling out applicable daily report form to document pay quantity; and 2) Subtracting tare from gross weights and checking same. (M) Materials and Tests Activity includes: 1) Proctors; 2) Densities; 3) Gradations; 4) P.I.'s (Plasticity Indices); 5) Soundings; 6) Moisture content; and 7) Sample submittals to Central Office Lab.
224	Gal.	Prime Coat	(I) Inspection Activity includes: Obtaining proper distributor calibrations and material certifications; 2) Inspecting equipment used; 3) Inspecting contractor's priming operations; 4) Insuring that rate of application is within permissible limits; and 5) Diary Submittal.

Activity No.	Unit	Activity Title	Description
227	Ton	Hot Mix Asphalt - Plant	(I) Activity includes: 1) Gradations; 2) Extractions; 3) Densities; 4) Inspecting plant and contractor's methods of producing Hot Mix; and 5) Submittal of Samples to Central Office Lab. Often, a man from Materials and Tests performs this activity. (C) Checking Activity includes: 1) Filling out applicable daily report form for documentation of pay quantity; 2) Checking and recording temperature of hot mix; and 3) Subtracting tare from gross weight and checking same.
228	S.Y.	Bituminous Surface Treatment	(I) Inspection Activity includes: 1) Inspecting equipment; 2) Inspecting contractor's methods; 3) Keeping rate of application as desired; 4) Measuring trucks or obtaining scale certifications; 5) Obtaining distributor calibration; and 6) Diary submittal. (C) Checking Activity includes; 1) Filling out applicable daily report(s); 2) Taking and recording temperature of asphalt; and 3) Helping Inspector. (M) Materials and Tests Activity includes: 1) Gradations; 2) Moisture Content; and 3) Sample submittals to Central Office Lab.
229	S.Y.	Concrete Pavement, Base	(I) Inspection Activity includes: 1) Checking equipment and obtaining proper scale calibration; 2) Inspecting forms and reinforcing steel placement; 3) Inspecting all contractor's operations - concrete placement, finishing, and curing; 4) Casting beam, cylinders, running slump, and air entrainment tests; 5) Diary submittal; 6) Filling out proper inspector's report. This activity includes bridge approach slabs and/or gutters.

Activity No.	Unit	Activity Title	Description
229 (Continued)			(C) Checking Activity includes; 1) Filling out applicable daily report form; and 2) Helping Inspector. (M) Materials and Tests Activity includes: 1) Gradations; and 2) Sample submittals to Central Office Lab.
230	L.F.	Pipe Installation	(I) Inspection Activity includes: 1) Checking location and grade; 2) Inspecting contractor operations - excavation, installation and backfill; 3) Documentation of pay quantity in field book; and 4) Diary submittal.
231	C.Y.	Concrete - R.C. Box Culverts	(I) Inspection Activity includes: 1) Checking culvert location and grade; 2) Inspecting contractor operations - forming, pouring, stripping forms, rubbing, and curing; 3) Casting of cylinders and running slump; 4) Documentation of pay quantity in field book; and 5) Diary submittal.
232	L.F.	Piling	(I) Inspection Activity includes: 1) Inspecting contractor's equipment; 2) Obtaining proper materials certification; 3) Giving contractor line and grade; 4) Inspecting contractor's pile driving operations; 5) Filling out proper report form for documentation of pay quantity; and 6) Diary Submittal.
233	C.Y.	Bridge Concrete	(I) Inspection Activity includes: 1) Inspecting contractor's operations - forming, pouring, stripping forms,rubbing, and curing; 2) Casting of cylinders, running slumps; 3) Giving and checking line and grade; 4) Documentation of pay quantity in field book; and 5) Diary submittal.

Activity No.	Unit	Activity Title		Description
234	Lb.	Structural Steel	(I)	Inspection Activity includes: 1) Obtaining proper material approval; 2) Inspecting of contractor steel erection activities; 3) Inspecting and checking torquing operations; 4) Inspecting painting operations; 5) Documentation of steel erection in field book; and 6) Diary submittal.
235	% 233I	Incidental Bridge Work	(I)	Inspection Activity includes: Inspecting and documenting properly the miscellaneous items not included in the bridge work activities - e.g., component and premolded joint sealer installation, bridge railing installation, application of boiled linseed oil, etc.
236	L.F.	Curb and/or Gutter	(I)	Inspection Activity includes: 1) Checking line and grade; 2) Inspecting contractor's operations - forming, pouring and curing; 3) Casting cylinders and running slump; 4) Documentation of pour in field book; and 5) Diary submittal.
237	C.Y.	Miscellaneous Concrete	(I)	Inspection Activity includes: 1) Inspecting contractor's operations; 2) Running slump and casting cylinders; 3) Documentation of pour in field book; and 4) Diary submittal. Examples of the type of items under this activity are: headwalls, concrete anchor posts, concrete ditch checks, concrete ditch paving and concrete rip rap.
239	% 231I, 233I, 236I, 237I	Concrete Aggregate Testing (excluding concrete pavement)	(M)	Materials and Tests Activity includes 1) gradations on aggregates; and 2) sample submittals to Central Office Lab.
240	% 231I, 233I, 236I, 237I	Concrete Plant Inspection	(I)	Inspection Activity includes: 1) Initial inspection of concrete plant; 2) Submittal of daily concrete plant inspection form; and 3) Batching concrete.

Activity No.	Unit	Activity Title	Description
241	Acre	Seeding Item	(I) Inspection Activity includes: 1) Inspecting equipment used; 2) Inspecting materials used; 3) Inspecting contractor's operations; 4) insuring proper amounts of materials are applied uniformly; 5) Inserting documentation of work performed in field book; and 6) Diary Submittal.
242	L.F.	Guard Fence Installation	(I) Inspection Activity includes: 1) Obtaining proper materials certification; 2) Inspecting contractor operations; and 3) Diary submittal.
243	S.Y.	Riprap, Dumped	(I) Inspection Activity includes: 1) Inspection of placement of filter blanket and riprap; 2) Documentation of riprap in the field book; and 3) Diary submittal. (C) Checking Activity includes: 1) Filling out applicable daily report form to document pay quantity.
244	C.Y.	Sod Mulch	(I) Inspection Activity includes: 1) Approving sod mulch pit; 2) Inspecting incorporation of lime and fertilizer; 3) Inspecting loading and placement on R/W; 4) Measuring trucks; 5) Field book documentation; and 6) Diary submittal. (C) Checking Activity includes: 1) Filling out applicable daily form; and 2) Helping inspector.

300 SUPERVISION AND MISCELLANEOUS

Activity No.	Unit	Activity Title	Description
347	% 100 Act.	Miscellaneous Survey Work	Includes stakeout of various miscellaneous items not included in other survey activities - a "catch-all" survey activity.
348	% 100 Act.	Preparation of Grade Books	Preparation of Grade Books includes: 1) Calculating or programming computer for calculating desired grades from plans that are needed for building the job; 2) Inserting the data in field book; and 3) Checking the data.
349	As Req'd	Fabrication and/or Casting Yard	This activity includes: 1) All work required by Construction Division Employees at permanent casting yards and 2) All Work required by Construction Division Employees at Foundries.
350	% 200 Act.	Miscellaneous Construction Work	This is a comprehensive activity including: water for grass, jute matting, solid sodding, traffic signalization items, signing, utilities, RR signalization, etc.
351	% 100, 200 Act.	Project Supervision	Project Supervision includes: Working with property owners; handling complaints; coordinating Inspectors, survey party, etc.
352	% 100, 200 Act.	Travel Time	Travel Time includes the time each employee is on pay status traveling to and from a job, time spent carrying samples to the District or Central Office Lab., and time spent in traveling on or between jobs to carry out assigned duties.
353	As Needed	Training	Training includes all time spent by Construction Division Employees while attaining knowledge and skills which enable them to more proficiently perform their assignments.

Activity No.	Unit	Activity Title	Description
354	No Unit	Idle Time	Idle Time includes time incurred by Construction Division Employees when they have no specific duties or assignments such as on rainy days when the contractor is not working on the job to which they are assigned or when work is disrupted due to extended mechanical breakdowns. This is not a scheduled activity and should be kept to a minumum through secondary assignments. However, it is recognized that idle time will occur.
355	None	Resident Engineer	Includes all time the Resident Engineer is activity working on pay status-(in conjunction with Function 705).

400 OFFICE ACTIVITIES

No.			
460	% 200 Act.	Preparation of Final Estimate	Preparation and Submittal of Final Estimate includes all necessary paper work for final submission.
461	% 200 Act.	General Office Work	Includes: 1) general start-up. Setting up files, field books, preconstruction conferences, studying plans; 2) General submissions; checking and completing all daily reports, writing and typing the Resident Engineer's Diary, filling out and submitting other construction job-related reports, EEO and Labor Compliance, checking payrolls, etc.

APPENDIX 3

CONTRACT PAY ITEMS

RELATED TO

ENGINEERING AND CONTRACTOR

ACTIVITIES

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
217	Acre	Clearing and Removal Item	1	Clearing and Removal Item

For planning work on the following pay items:

Spec.	Unit of Pay	Item
SP 201-4	Acre, Sta.	Clearing
	Acre, Sta.	Grubbing
	Acre	Selective Clearing
	Each	Clearing and Grubbing Trees
SP 201-3	LR,SY	Removal and Disposal of_____
205	LS	Removing old culverts
207	Bldg. Group of Buildings	Moving Buildings
208	No Pay	Moving Minor Obstructions
209	LF	Removal & Disposal of Curb
210	SY	Removal & Disposal of Concrete Pavement
211	SY	Removal & Disposal of Concrete Walls & Steps
213	LS	Removal of Existing Bridge Structures
214	LS	Demolition

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
218	L.F.	Fencing	2	Fencing Item

For planning work on the following pay items:

Spec.	Unit of Pay	Item
206	L.F.	Fence moved and reconstructed
SP 614-1	L.F.	Wire Fence (Type....)
SP 614-1	L.F.	Steel Chain Link Fence
614	Each	Steel gates
614	Each	Aluminum gates

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
219	CY	Earthwork	3	Earthwork

For planning work on the following pay items:

Spec.	Unit of Pay	Item
202	CY	Common Excavation
	CY	Rock Excavation
	CY	Unclassified Excavation
	CY	Borrow
	CY	Special Compaction of Earthwork
203	¼ mi. yd. or	
	½ mi. yd.	Overhaul
626	CY	Removing & Replacing Topsoil

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
220	Sta.	Reconstructed Base	5	Reconstructed Base

For planning work on the following pay items:

Spec.	Unit of Pay	Item
SP	Sta.	Reconstructed Base Course

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
221	Sta.	Shaping Roadway	4	Shaping Roadway

For planning work on the following pay items:

Spec.	Unit of Pay	Item
SP 202-1	Sta.	Shaping Roadway Section
SP 202-2	Sta.	Widening Roadway Section

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
222	CY	Granular Material Volume	6	Subbase, Base and/or Granular Surface

For planning work on the following pay items:

Spec.	Unit of Pay	Item
301	CY	Selected Material (Class SM...)
302	CY	Subbase
303	CY	Gravel Surface Course (Class GS...)
304	CY	Crushed Stone Surface (Class SS...)
305	CY	Gravel Base Course (Class GB...)
306	CY	Crushed Stone Base Course (Class SB...)
307	CY	Plant Mixed Crushed Stone Base Course (Class SB...)
308	CY	Gravel in Plant Mixed Bituminous Stabilized Base Course
	CY	Crushed Stone in Plant Mixed Bituminous Stabilized Base Course
	Gal.	Emulsified Asphalt in Plant Mixed Bituminous Stabilized Base Course
31	CY	Soil Aggregate in Cement Stabilized Base Course

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
223	Ton	Granular Material Weight	6	Subbase, Base and/or Granular Surface

For planning work on the following pay items:

Spec.	Unit of Pay	Item
302	Ton	Subbase
303	Ton	Gravel Surface Course (Class GS...)
304	Ton	Crushed Stone Surface Course (Class GB...)
305	Ton	Gravel Base Course (Class GB...)
306	Ton	Crushed Stone Base Course (Class SB...)
307	Ton	Plant Mixed Crushed Stone Base Course (Class SB...)
	Lb.	Calcium Chloride
308	Ton	Gravel in Plant Mixed Bituminous Stabilized Base Course
	Ton	Crushed Stone in Plant Mixed Stabilized Base Course (Class SB...)
	Gal.	Emulsified Asphalt in Plant Mixed Bituminous Stabilized Base Course
311	Ton	Soil Aggregate in Cement Stabilized Base Course

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
224	Gal.	Prime Coat	7	Prime Coat

For planning work on the following pay items:

Spec.	Unit of Pay	Item
401	Gal.	Prime Coat

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
225	SY	Stabilized Base	8	Stabilized Base

For planning work on the following pay items:

Spec.	Unit of Pay	Item
311	SY or Sta.	Processing Cement Stabilized Base Course
	Bbl.	Cement in Stabilized Base Course
313	SY or Sta.	Processing Lime Treated Subgrade
	Ton	Hydrated Lime in Treated Subgrade

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
226	Ton	Hot Mix Asphalt - Roadway	9	Hot Mix Asphalt
227	Ton	Hot Mix Asphalt - Plant	9	Hot Mix Asphalt

For planning work on the following pay items:

Spec.	Unit of Pay	Item
309	Ton	Gravel in Hot Mix Asphalt Stabilized Base Course
	Ton	Crushed Stone in Hot Mix Stabilized Base Course (Class SB..)
	Ton	A.C. in Hot Mix Asphalt Stabilized Base Course
310	Ton	Mineral Aggregate in Sand Asphalt Hot Mix Base Course

Spec.	Unit of Pay	Item
	Ton	A.C. in Sand Asphalt Hot Mix Base Course
SP314	Ton	Mineral Aggregate in Crushed Stone Bituminous Concrete Base (Type...)
	Ton	A.C. in Crushed Stone Bituminous Concrete Base
401	Gal.	Tack Coat
404	Ton	M.A. in DGHM Binder Course
	Ton	A.C. in AGHM Binder Course
405	Ton	M.A. in ACHM Binder Course (TY...)
	Ton	A.C. in ACHM Binder Course (TY...)
SP&406	Ton	MA. in DGHM SC (TY...)
	Ton	A.C. in ACHM Binder Course (TY...)
407	Ton	M.A. in Sand Asphalt HMSC
	Ton	A.C. in Sand Asphalt HMSC
408	Ton	M.A. in ACHM (TY...)
	Ton	A.C. in ACHM SC (TY...)

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
228	SY	Bituminous Surface Treatment	10	Bituminous Surface

For planning work on the following pay items:

Spec.	Unit of Pay	Item
402	CY or Ton	Mineral Aggregate in B.S.T. (Class...)
402	Gal.	Asphalt in B.S.T.

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
229	SY	Concrete Pavement, Base	11	Concrete Pavement, Base

For planning work on the following pay items:

Spec.	Unit of Pay	Item
313	SY	Portland Cement Concrete Base
313,501, 503	Each	Temporary Crossings

Spec.	Unit of Pay	Item
501	SY	Portland Cement Concrete Pavement (..."Uniform Thickness)
501	SY	High Early Strength Concrete Pavement
502	Lb.	Reinforcing Steel for Pavement (Bars)
	Lb.	Reinforcing Steel for Pavement (Bars) (Mesh Fabric-Type...)
503	SY	Continuously reinforced Protland Cement Concrete Pavement (..."Uniform Thickness)
	Each	Wide Flange Beam Joint
504	Each	Approach Slabs & Gutters (Type...)
SP506	Each	Approach Gutters (Type...)

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
230	LF	Pipe Installation	12	Pipe Installation

For planning work on the following pay items:

Spec.	Unit of Pay	Item
606	LF	..."Reinforced Concrete Pipe Culverts (Class...)
	LF	..."Corrugated Steel Pipe Culverts (...Gage)
	LF	..."Corrugated Aluminum Pipe Culverts (...Gage)
	LF	..."Bituminous Coated Corrugated Steel Pipe Culverts (...Gage)
	LF	..."Bituminous Coated Corrugated Aluminum Pipe Culverts (...Gage)
	LF	..."Bituminous Coated and Paved Corrugated Steel Pipe Culverts (...Gage)
	LF	..."Bituminous Coated and Paved Corrugated Aluminum Pipe Culverts (...Gage)
	LF	..."x..."Reinforced Concrete Arch Pipe Culverts (Class...)
	LF	..."x..."Corrugated Steel Arch Pipe Culverts (...Gage)
	LF	..."x..."Corrugated Aluminum Arch Pipe Culverts (...Gage)
	LF	..."x..."Bituminous Coated Corrugated Steel Arch Pipe Culverts (...Gage)

Spec.	Unit of Pay	Item
	LF	..."x..."Bituminous Coated Corrugated Aluminum Arch Pipe Culverts (...Gage)
		..."x..."Bituminous Coated and Paved Corrugated Steel Arch Pipe Culverts (...Gage)
	LF	..."x..."Bituminous Coated and Paved Corrugated Aluminum Arch Pipe Culverts (...Gage)
	Each	..."Flared Eng Section for.... Pipe Culverts
	Each	..."x..."Flared Eng Sections for... Arch Pipe Culverts
607	LF	Relaying Culvert Pipe (..."Reinf. Conc.)
	LF	Relaying Culvert Pipe (..."Cor. Metal)
		Relaying Culvert Pipe (..."x... "Reinf. Conc Arch) Relaying Culvert Pipe
	LF	(..."x..."Cor. Metal Arch)
608	LF	..."Structural Plate Pipe
	LF	..."x..."Structural Plate Pipe - Arch
	LF	..."x..."Structural Plate Arch
	LF	..."Pipe Siphons

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
231	CY	Concrete - RC Box Culverts	13	Concrete - RC Box Culverts

For planning work on the following pay items:

Spec.	Unit of Pay	Item
801	CY	Unclassified Excavation for Structures - Roadway
	CY	Common Excavation for Structures - Roadway
	CY	Rock Excavation for Structures - Roadway
802	CY	Class A Concrete
		Class S Concrete
804	Lb.	Reinforcing Steel

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
232	LF	Piling	14	Piling

For planning work on the following pay items:

Spec.	Unit of Pay	Item
805	LF	Precast Concrete Piling (..."...)
	LF	Cast in Place Concrete Piling (...)
	LF	Concrete Filled Metal Shell Piling (...)
	LF	Steel Bearing Piling (...)
	LF	Bearing Piling (...)
	Each	Loading Test Piles
818	LF	Untreated Timber Piling
	LF	Treated Timber Piling
	Each	Loading Timber Testing

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
233	CY	Bridge Concrete	15	Bridge Concrete

For planning work on the following pay items:

Spec.	Unit of Pay	Item
801	CY	Unclassified Excavation for Structures - Bridges
	CY	Common Excavation for Structures - Bridge
	CY	Rock Excavation for Structures - Bridge
802	Each	Precast slab and curb units.

For planning work on the following pay items:

Spec.	Unit of Pay	Item
802	CY	Class A Concrete
	CY	Class A (AE) Concrete
	CY	Class B Concrete
	CY	Class B (AE) Concrete
	CY	Class S Concrete
	CY	Class S(AE) Concrete
	CY	Class Y Concrete
	CY	Class Y(AE) Concrete
	CY	Seal Concrete
	CY	Rubble Concrete
804	Lb.	Reinforcing Steel

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
234	Lb.	Structural Steel	16	Structural Steel

For planning work on the following pay items:

Spec.	Unit of Pay	Item
807	Lb.	Structural Steel in Beam Spans (...)
	Lb.	Structural Steel in Truss Spans (...)
	Lb.	Structural Steel in Suspension Spans (...)
	Lb.	Structural Steel in Plate Girder Spans (...)

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
235	% of 2331	Incidental Bridge Work	18	Incidental Bridge Work

For planning work on the following pay items:

Spec.	Unit of Pay	Item
803	Gal.	Boiled Lineseed Oil
806	LF	Concrete Bridge Railings
	LF	Concrete & Metal Bridge Railings
	LF	Metal Bridge Railing (Type...)
	LF	Aluminum Plate Guard Bridge Railing

For planning work on the following pay items:

Spec.	Unit of Pay	Item
	LF	Steel Plate Guard Bridge Railing
808	LF	Preformed Joint Sealer
812	Each	Bridge Name Plate (Type...)
817	MFBM	Untreated Bridge Timber
	MFBM	Treated Bridge Timber

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
236	LF	Curb and/or Gutter	20	Curb and/or Gutter

For planning work on the following pay items:

Spec.	Unit of Pay	Item
616	LF	Integral Curb
	LF	Concrete Curb
	LF	Concrete Combination Curb and Gutter, Type.....

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
237	CY	Miscellaneous Concrete	21	Miscellaneous Concrete

For planning work on the following pay items:

Spec.	Unit of Pay	Item
505	SY	Portland Cement Concrete Driveway
604	CY	Concrete Spillways
605	CY	Concrete Ditch Paving (Type...)
609	Each	Manholes
	Each	Drop Inlets (Type...)
	Each	Junction Boxes (Type...)
613	Each	Guard Rail Anchor Posts
615	SY	Concrete Walks
	SY	Concrete Steps
619	CY	Concrete Ditch Checks
802	CY	Concrete (Class...) (For headwalls on pipe)
815	CY	Concrete Riprap
SP	LF	Median Barrier

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
239	% of 231I, 233I, 236I, and 237I	Concrete Aggregate Testing	All contractor activities that involve the use of ready mix concrete excluding concrete pavement.	

For planning work on the following pay items:

Spec.	Unit of Pay	Item
Concrete batched from Ready-Mix Concrete Plant (excluding concrete pavement)		

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
240	% of 231I, 233I, 236I, 237I	Concrete Plant	All contractor activities that involve the use of ready-mix concrete	

For planning work on the following pay items:

Spec.	Unit of Pay	Item
Concrete batched from Ready-Mixed Concrete Plant		

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
241	Acre	Seeding Item	22	Seeding Item

For planning work on the following pay items:

Spec.	Unit of Pay	Item
620	Acre	Seeding
620,621,622	Acre	Mulch Cover
621	Acre	Temporary Seeding
622	Acre	Overseeding Sod Mulch
623	Acre	Second Seeding Application

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
242	LF	Guard Fence Installation	23	Guard Fence

For planning work on the following pay items:

Spec.	Unit of Pay	Item
613	LF	Aluminum Guard Rail (Type...)
	LF	Steel Guard Rail (Type...)
	Each	Terminal Anchor Posts (Type...)

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
243	SY	Riprap, Dumped	25	Riprap

For planning work on the following pay items:

Spec.	Unit of Pay	Item
816	CY	Stone Riprap
	CY	Grouted Riprap
	CY	Mortored Riprap
	CY	Sacked sand cement riprap
	CY	Foundation riprap
	CY	Dumped Riprap
	CY	Filter Blanke

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
244	CY	Sod Much	26	Sod Mulch

For planning work on the following pay items:

Spec.	Unit of Pay	Item
622	CY	Sod Mulch

Engineering Activity			Related Contractor Activity	
No.	Unit	Title	No.	Title
350	CI	Miscellaneous Construction Work	24 27	Miscellaneous Items Special Activities

For planning work on the following pay items:

Spec.	Unit of Pay	Item
602	Bldg.	Furnishing Field Office
602	Bldg.	Furnishing Field Laboratory
610	Each	Manholes Adjusted to Grade
	Each	Drop Inlets Adjusted to Grade
	Each	Junction Boxes Adjusted to Grade
617	Each	Automatic Flood Gates
618	Each	Guard Posts
619	MFBM	Treated Timber Ditch Checks
620,621	MG	Water for Grass
622	Ton	Lime
624	SY	Solid Sodding
625	SY	Jute Matting
		All Signing & Pavement Marking Items
		All Traffic & RR Signalization Items
802	Each	Precast Slab Curb Units
		Precast Slab Interior Units
		Prestressed Precast Slab Interior Units
		Prestressed Precast Slab Curb Units
		All public utilities adjustments

APPENDIX 4

STANDARD PLANNING UNITS

STANDARD PLANNING UNITS

Activity	Activity Title		Urban Jobs	Rural Jobs	Statewide Average
101	Run Centerline	Sta/Hr	0.87	1.39	1.14
102	Set R/W Stakes & Hub	Sta/Hr	1.33	2.23	2.04
103	Take Topography	Sta/Hr	0.96	5.26	4.37
104	Run Check Levels	Sta/Hr	1.82	2.53	2.41
105	Cross Section R/W	Sta/Hr	0.80	1.62	1.41
106	Minor Structure Stakeout	LF/Hr	12.9	9.2	10.3
107	Bridge Stakeout	Bridge/Hr	0.011	.020	.015
108	Staking by Station (e.g. Overlay)	Sta/Hr	4.04	7.01	5.41
109	Grade R/W Hubs	Sta/Hr	1.30	1.50	1.47
110	Stake R/W for Earthwork	Sta/Hr	0.62	1.28	1.01
111	Set Blue Tops	Sta/Hr	0.75	1.04	0.95
112	Curb and/or Gutter Stakeout	LF/Hr	35.2	55.7	45.8
113	Seeding Item Stakeout	Acre/Hr	0.44	0.46	0.45
114	Pit Cross Section	Pit/Hr	0.041	0.078	.059
200 CONSTRUCTION ACTIVITIES					
217	Inspection Clearing & Removal Item Removal Item	Acre/Hr	0.70	0.10	0.20
218	Inspection Fencing Item	LF/Hr	203	69	108.
219	Inspection Earthwork	CY/Hr	171	93	117.

Activity	Activity Title		Unit	Urban Jobs	Rural Jobs	Statewide Average
219	Checking	Earthwork	CY/Hr	64	64	64
219	Materials	Earthwork	% of 219I	6.2%	11.5%	10%
220	Inspection	Reconstructed Base Course	Sta/Hr	5.2	5.5	5.2
220	Materials	Reconstructed Base Course	% 220I	8%	7%	8%
221	Inspection	Shaping Roadway	Sta/Hr	5.2	5.2	5.2
221	Materials	Shaping Roadway	% of 221I	8%	7%	8%
222	Inspection	Granular Material-Volume	CY/Hr	126	126	126
222	Checking	Granular Material-Volume	CY/Hr	77	77	77
222	Materials	Granular Material-Volume	% of 222C	71%	67%	71%
223	Inspection	Granular Material-Weight	Ton/Hr	45.1	93	86
223	Checking	Granular Material-Weight	Ton/Hr	71	134	121
223	Materials	Granular Material-Weight	% of 223C	33%	45%	43%
224	Inspection	Prime Coat	Gal/Hr	157	372	333
224	Checking	Prime Coat	Gal/Hr	153	503	486
225	Inspection	Stabilized Base	SY/Hr	290	734	645
225	Checking	Stabilized Base	SY/Hr	1232	767	790
225	Materials	Stabilized Base	% of 225I	31%	46%	43%
226	Inspection	Hot Mix Asphalt-Roadway	Ton/Hr	50.9	99.2	80.6
226	Checking	Hot Mix Asphalt-Roadway	Ton/Hr	56.1	11.6	88.3

Activity	Activity Title		Unit	Urban Jobs	Rural Jobs	Statewide Average
226	Materials	Hot Mix Asphalt-Roadway	Ton/Hr	453	916	734
227	Inspection	Hot Mix Asphalt-Lant	Ton/Hr	64.9	59.4	61.5
227	Checking	Hot Mix Asphalt-Plant	Ton/Hr	58.5	100	86.4
228	Inspection	Bituminous Surface Treatment	SY/Hr	1792	1907	1792
228	Checking	Bituminous Surface Treatment	SY/Hr	1925	2003	1925
228	Materials	Bituminous Surface Treatment	% of 228I	8%	8%	8%
229	Inspection	Concrete Pavement, Base	SY/Hr	99.5	91.8	99.5
229	Checking	Concrete Pavement, Base	SY/Hr	287	291	287
229	Materials	Concrete Pavement, Base	% of 229I	20%	9%	20%
230	Inspection	Pipe Installation	LF/Hr	13	12	12
231	Inspection	Concrete - RC Box Culverts	CY/Hr	2.92	1.98	2.31
232	Inspection	Piling	LF/Hr	10.5	27.2	23.1
233	Inspection	Bridge Concrete	CY/Hr	1.43	1.85	1.65
234	Inspection	Structural Steel	Lb/Hr	3245	2688	3100
235	Inspection	Incidental Bridge Work	% of 233I	7%	15%	11%
236	Inspection	Curb and/or Gutter	LF/Hr	35.4	57.9	42.5
237	Inspection	Miscellaneous Concrete	CY/Hr	2.25	2.70	2.25
239	Materials	Concrete Aggregate Testing (excluding Concrete Pavement)	% of 231I,233I, 236I, & 237I	3%	3%	3%

Activity	Activity Title		Unit	Urban Jobs	Rural Jobs	Statewide Average
240	Inspection	Concrete Plant	% of 231I,233I, 236I, & 237I	21%	21%	21%
241	Inspection	Seeding	Acres/Hr	0.57	0.35	0.42
242	Inspection	Guard Fence Installation	LF/Hr	44.1	16.0	20.5
243	Inspection	Riprap, Dumped	SY/Hr	33.6	8.0	20.9
243	Checking	Riprap, Dumped	SY/Hr	66.2	66.2	66.2
244	Inspection	Sod Mulch	CY/Hr	38.8	9.6	33.9
244	Checking	Sod Mulch	CY/Hr	88.3	43.6	54.7
245	Inspection	Fabrication and/or Casting Yard	As Needed		As Needed	
300 SUPERVISION AND MISCELLANEOUS						
347		Miscellaneous Survey Work	% of 100 Activities	12%	21%	18%
348		Preparation of Grade Books	% of 100 Activities	5.0%	3.2%	3.8%
349		Fabrication and/or Casting Yard	As Needed		As Needed	
350		Miscellaneous Construction Work	% of 200 Activities	4.4%	6.3%	5.7%
351		Project Supervision	% of 100 200 Activities	7.5%	6.1%	6.6%
352		Travel Time	% of 100 200 Activities	4.7%	11.5%	9.3%
353		Training	As Needed		As Needed	

Activity	Activity Title	Unit	Urban Jobs	Rural Jobs	Statewide Average
354	Idle Time	None		None	
355	Resident Engineer	None		None	
400 OFFICE ACTIVITIES					
460	Preparation of Final Estimate	% of 200 Activities	17%	5.0%	8.7%
461	General Office Work	% of 200 Activities	12.2%	9.8%	10.3%

APPENDIX 5

RECOMMENDED STAFFING

AND

CREW SIZES

RECOMMENDED
SURVEY ACTIVITY STAFFING

Activity No.	Activity Title	Fixed Data Recommended Crew Sizes* Urban	Rural	Recommended Crew Size*	Recommended Range*
101	Run Center Line	4	4	4	3-5
102	Set R/W Stakes and Hib	3	4	4	3-5
103	Take Topography	4	2	2	2-4
104	Run Check Levels	3	3	3	2-4
105	Cross Section R/W	4	4	4	3-5
106	Minor Structure Stakeout	3	4	4	3-5
107	Bridge Stakeout	2	3	3	3-6
108	Staking by Station (e.g. Overlay)	4	4	4	3-5
109	Grade R/W Hubs	4	4	4	2-4
110	Stake R/W for Dirtwork	4	4	4	3-5
111	Set Blue Tops	3	3	3	3-6
112	Curb and/or Gutter Stakeout	3	4	3	3-5
113	Seeding Item Stakeout	3	2	2	2-5
114	Pit Cross Section	4	4	4	3-5
347	Miscellaneous Survey Work	3	3	3	2-5
	Full Time Survey Party	4	4	4	3-5

* Does not include Flagmen

RECOMMENDED CONSTRUCTION
ACTIVITY STAFFING

ACTIVITY NUMBER	INSPECTION CHECKING MATERIALS	ACTIVITY TITLE	RECOMMENDED STAFFING FIXED STAFF		INTERMITTENT STAFF
217	Inspection	Clearing & Removal Item			1
218	Inspection	Fencing Item			1
219	Inspection	Earthwork	1		
219	Checking	Earthwork	1		
219	Materials	Earthwork	1	or	1
220	Inspection	Reconstructed Base Course -			1
220	Materials	Reconstructed Base Course -			1
221	Inspection	Shaping Roadway			1
221	Materials	Shaping Roadway			1
222	Inspection	Granular Material-Volume	1	or	1
222	Checking	Granular Material-Volume	1		
222	Materials	Granular Material-Volume			1
223	Inspection	Granular Material-Weight	1	or	1
223	Checking	Granular Material-Weight	2		
223	Materials	Granular Material-Weight			1
224	Inspection	Prime Coat	1		
224	Checking	Prime Coat	1		
225	Inspection	Stabilized Base	1		
225	Checking	Stabilized Base	1-2		
225	Materials	Stabilized Base	1		
226	Inspection	Hot Mix Asphalt - Roadway	1		
226	Checking	Hot Mix Asphalt - Roadway	1		
226	Materials	Hot Mix Asphalt - Roadway			1

ACTIVITY NUMBER	INSPECTION CHECKING MATERIALS	ACTIVITY TITLE	RECOMMENDED STAFFING FIXED STAFF		INTERMITTENT STAFF
227	Inspection	Hot Mix Asphalt - Plant	1		
227	Checking	Hot Mix Asphalt - Plant	1		
228	Inspection	Bituminous Surface Treatment	1		
228	Checking	Bituminous Surface Treatment	1-2		
228	Materials	Bituminous Surface Treatment			1
229	Inspection	Concrete Pavement, Base	2		
229	Checking	Concrete Pavement, Base	2		
229	Materials	Concrete Pavement, Base	1		
230	Inspection	Pipe Installation	1		
231	Inspection	Concrete - RC Box Culverts	1	or	1
232	Inspection	Piling			
233	Inspection	Bridge Concrete	1-2	or	1-2
234	Inspection	Structural Steel	1		
235	Inspection	Incidental Bridge Wrok	1	or	1
236	Inspection	Curb and/or Gutter	1-2	or	1
237	Inspection	Miscellaneous Concrete	1	or	1
239	Materials	Concrete Aggregate Testing			1
240	Inspection	Concrete Plant	1	or	1
241	Inspection	Seeding Item	1		
242	Inspection	Guard Fence Installation	1		
243	Inspection	Riprap, Dumped	1	or	1
243	Checking	Riprap, Dumped	1		
244	Inspection	Sod Mulch	1	or	1
244	Checking	Sod Mulch	1		

RECOMMENDED CONSTRUCTION INSPECTION

CREW SIZES

Type of Inspection Crew	Related Nos.	Activity Title	Recommended Size of Crew	Recommended Type of Personnel in Crew	Fulltime		Intermittent	Recommended Range of Crew Size
Earthwork	219 I	Earthwork	2	Inspector	1			2-3
	219 M	Earthwork		Materials Inspector	1	OR	1	
Granular Mat'l. Volume	222 I	Granular Material-Vol	3	Inspector			1	2-3
	222 C	Granular Material-Vol		Checker	1			
	222 M	Granular Material-Vol		Materials Inspector			1	
Granular Mat'l. Weight	223 I	Granular Material-Wt	4	Inspector			1	3-4
	223 C	Granular Material-Wt		Checker	2			
	223 M	Granular Material-Wt		Materials Inspector			1	
Soil Cement Lime Stabilized Base	225 I	Stabilized Base	3	Inspector	1			2-4
	225 C	Stabilized Base		Inspector-Checker	1			
	225 M	Stabilized Base		Materials Inspector	1	OR	1	
Hot Mix Asphalt	226 I	Hot Mix Asphalt-Rdwy	3*	Inspector	1			3-5*
	226 C	Hot Mix Asphalt-Rdwy		Checker	2			
	226 M	Hot Mix Asphalt-Rdwy						
	227 I	Hot Mix Asphalt-Plant						
	227 C	Hot Mix Asphalt-Plant						
Bituminous Surface Treatment	228 I	Bituminous Surface Treatment	3 OR 4	Inspector	1			3-4
	228 C	Bituminous Surface Treatment		Checker(s)	1 OR 2			
	228 M	Bituminous Surface Treatment		Materials Inspector			1	
Concrete Pavement Base	229 I	Concrete Pavement, Base	5	Inspector-Roadway	1			4-6
	229 C	Concrete Pavement, Base		Jr.Inspector-Roadway	1			
	229 M	Concrete Pavement, Base		Checker-Roadway	1			
	240 I	Concrete Plant		Concrete Plant Inspector	1			
				Materials Inspector	1			

*ACHM Stabilized Base requires Intermittent use of a Materials Inspector for density each day. Additional Plant Inspector needed if not provided by M & T Division.

RECOMMENDED CONSTRUCTION INSPECTION CREW SIZES

Type of Inspection Crew	Related Nos.	Activity Title	Recommended Size of Crew	Recommended Type of Personnel in Crew	Fulltime		Intermittent	Recommended Range of Crew Size
RC Box Culvert	231 I	Concrete-RC Box Culverts	3	Inspector	1			2-3
	239 M	Concrete Aggregate Testing		Jr.Inspector-Concrete Plant Checker	1	OR	1	
	240 I	Concrete Plant		Materials Inspector			1	
Bridge Concrete	233 I	Bridge Concrete	4	Inspector	1			3-4
	239 M	Concrete Aggregate Testing		Jr. Inspector	1			
	240 I	Concrete Plant		Concrete Plant Checkers			1	
				Materials Inspector			1	
Curb and/or Gutter	236 I	Curb and/or Gutter	3	Inspector	1			
	239 M	Concrete Aggregate Testing		Concrete Plant Checker			1	
	240 I	Concrete Plant		Materials Inspector			1	
Piling	232 I	Piling	2	Inspector	1			1-2
				Jr. Inspector	1	OR	1	

RECOMMENDED CONSTRUCTION

RESIDENT OFFICE WORK STAFFING

Every Resident Engineer has a certain amount of Office Work that must be performed regardless of the workload of contract jobs he is handling. Bills must be paid, reports checked, final estimates prepared, supplies ordered, etc. For this reason, it is recommended that a Resident Engineer use a "Fixed Staff" in his office of one Clerk-Typist and one Office Technician.

Some offices in the State may find that only "Intermittent" use of an office technician is needed. This is not recommended. Secondary assignments should be employed to retain a full-time two-person office staff. This will prevent the Resident Engineer from having to perform office work which should be left to his office staff.