IMPLEMENTATION

OF

A CONSTRUCTION ENGINEERING MANPOWER MANAGEMENT SYSTEM

FHWA CONTRACT NUMBER DOT-FH-11-9122

FINAL REPORT

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16. Abstract

This report documents the implementation of a Construction Engineering Manpower Management System (CEMMS) for the Field Operations Division of the Minnesota Department of Transportation (Mn/DOT). The report describes the problems encountered during the implementation and makes suggestions for nuetralizing similar problems that might be encountered during comparable implementation in other states.

The CEMMS is designed to provide a uniform method for controlling and estimating construction manpower. The system employs micro-computer software that runs in each of Mn/DOT's nine districts. The system was designed and the system software written by the field engineers that use the system.

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Informational Abstract

Organization

Rising inflation, increased labor costs, controlling engineering costs and maintaining high quality construction have all required the Minnesota Department of Transportation (Mn/DOT) to implement a Construction Engineering Manpower Management System (CEMMS). The CEMMS is designed as a management tool to control manpower hours, increase manpower efficiency, provide a uniform method of controlling and predicting manpower, and consequently reduce engineering costs. The system will also justify the construction personnel complement to our state legislature.

Twenty-one states pooled funds to develop a model Construction Engineering Manpower Management System during the early 1970s. The study was coordinated by the FHWA and developed by a management consultant (Roy Jorgenson and Associates). Minnesota's CEMMS organization follows the recommended organizational structure applied in the design manual developed during the pooled fund study. The Mn/DOT CEMMS organizational structure is composed of a Steering Committee, Technical Panel, and Project Staff (See Appendix "A" for Mn/DOT Construction Engineering Organizational Charts). The Steering Committee consists of top Mn/DOT construction management personnel. The Technical Panel is composed of top District Contruction Personnel. The Project Staff members are field construction engineers and high level field technicians. The Project Staff was assisted by two part-time computer programmers and a word processor operator.

The plan was to implement a pilot project in two of Mn/DOT's nine districts in order to test the system and fine tune it for statewide implementation. The pilot project employed manual bookkeeping methods for planning and monitoring reporting. The manual bookkeeping method employed by the system was awkward and time consuming. Consequently, the decision was made to computerize the system prior to statewide implementation. The Steering Committee authorized the Technical Panel and the Project Staff to do the system analysis and develop the software, i.e. A system designed by field engineers for field engineers. At this time the system is completely computerized and computer generated reports are available for Mn/DOT's engineering managers.

System Specifications and Design

The basic elements of the Mn/DOT-FHWA Contract system specifications were to develop, implement, and monitor a construction engineering manpower management system based on the System Design Manual prepared by the FHWA consultant. The goal was to develop a system whose basic elements are planning, budgeting, scheduling, and monitoring. The Minnesota system also includes staffing and forecasting subsystems, and a system update procedure. The contract specifications required that the entire network be documented in the users manuals as appropriate.

Implementation

The Steering Committee made a solid committment early in the system development to support the technical panel and the project staff during the design and implementation. It was apparent to those involved with the system development that top management was sincerely interested in "finding a better way". The pilot project was implemented in Districts 6 and

7 and one project in District 8 in 1979. These Districts are located in the southern half of Minnesota. The system was implemented statewide in the spring of 1980. Only new projects were placed into the system.

Monitoring

The Mn/DOT CEMMS monitoring function gathers the field information and generates the desired reports. The function employs a single form for gathering the information. The activity is supervised by the field engineers.

The monitoring function generates a report for the Project Engineer and also a report for the Assistant District Engineers (Construction). The monitoring function is completely automated and the reports are generated on the micro-computers residing in each of the nine district offices.

The monitoring function also generates information for man-power forecasting. Factors are derived that compare manhours to dollars by contract type. The factors are generated through a direct comparison that yields an average and through a regression analysis that yields an analytical curve. The comparison procedure consists of calculating the manmonths per $100,000 of contract value for each contract type.

Summary

The CEMMS Steering Committee is confident that their decision to develop a CEMMS employing field engineers and high level technicians for that development was correct. This unique concept coupled with the small starting size of the system has allowed the Mn/DOT CEMMS to grow into a powerful management tool. Much of the system's success can be

charged to the straight-forward, simple, field manual developed for the statewide implementation. The CEMMS automation applies computer programs that run on district based micro-computers and truly takes advantage of modern micro-computer technology.

Introduction

The final report purpose is to document implementation of Construction Engineering Manpower Management System (CEMMS) in Minnesota. The various system components, implementation problems and implementation procedures are discussed in detail. The report is divided into seven major parts: organization, specifications, design, implementation, monitoring, updating, and recommendations. Excerpts from the operations manual that are pertinent to the report have been included in Appendix "B".

Chapter 1 - Organization

Background

Many state agencies recognized the need to develop manpower management systems, consequently extensive studies to develop such systems began in various states in the early 1970's. Twenty-one state highway agencies, including Minnesota, pooled HPR funds and financed a study[1] to develop a "model" construction engineering manpower management system. The study was coordinated by the FHWA. Roy Jorgensen and Associates (Management Consultants) were selected to design the system. Primary research data sources were Louisiana, Michigan, North Dakota and Washington. The study was limited to construction engineering and work performed at the district office managment levels[2]. Two of the study objectives were to develop a construction manpower management system and a system design manual for interested highway agencies. The study was completed in April of 1978.

The Minnesota Department of Transportation (Mn/DOT) also recognized a need to develop a construction manpower management system. Each of Mn/DOT's nine districts employed unique systems that grew out of management styles peculiar to those districts and a need existed at the State level to implement a uniform method to control and predict construction manpower.

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[1] See Report No. FHWA-TS 78-226

[2] See TRB Report No. 51 "Construction Contract Staffing"

Consequently, in November of 1978 Mn/DOT held a training workshop dedicated to implementing a construction manpower management system. In January of 1979, the Commissioner of Transportation appointed a Steering Committee, Technical Panel and a Project Staff to design and implement such a system for Mn/DOT.

Steering Committee

The Steering Committee is composed of Mn/DOT's top construction managers. They gave the Technical Panel and Project Staff the authority to design and implement the system. The Committee made a solid commitment early in the design process to support the CEMMS concept and the efforts of the Technical Panel/Project Staff. It was apparent to those involved with the system design that top management was sincerely interested in finding a better way to manage and forecast manpower.

The Steering Committee is composed of[1] the Assistant Commissioner Bureau of Operations, the Field Operations Engineer, a District Engineer, the Construction Engineer, the Contract Administration Engineer, a representative of the FHWA, and the Field Operations Administrative Manager.

Technical Panel

The Technical Panel is composed of top district construction personnel. The panel was authorized to develop:

- A time table for implementation.
- The specifications for a CEMM System.
- A procedure for implementing a pilot study in districts 6 and 7.
- A procedure for implementing the system statewide.

[1] See Mn/DOT Construction Organization Chart on Appendix A1

The members of the Technical Panel are Assistant District Engineers (Construction) and a Resident Engineer. They were given this assignment because of their interest and willingness to invest time and effort to develop a worthwhile, meaningful management tool.

Project Staff

The Project Staff is composed of field construction engineers and high level technicians. They were assigned to:

- Prepare an operations manual
- Conduct a pilot project in Districts 6 and 7
- Prepare formal and informal proposals for CEMMS modifications
- Conduct CEMMS workshops in each of the districts prior to the CEMMS statewide implementation.
- Periodically review operation of the system.

The members of the Project Staff were given this assignment because of their construction experience, their dedication to their work, their ability to work with people, their innovative thinking and their acceptance of a new method to deal with construction manpower management.

The Project Staff is composed of three senior engineers, one principal engineering specialist, and one senior highway technician. The Project Staff is assisted by parttime computer programmers and a parttime word processor operator.

Conclusion

After reviewing the FHWA system design manual, Mn/DOT top management recognized that the design manual addressed the construction manpower planning problems found in the Mn/DOT.

Since the FHWA design manual was very well written and easily understood, the Mn/DOT Operations Division decided that they could produce a system, and a manual for that system, without outside assistance. Consequently, top management policy was to let the system users design a system that was user oriented, i.e. a system designed by field engineers for field engineers. The system design was started with that concept in mind and that concept is one of the unique aspects of the Minnesota System.

Another interesting aspect regarding the Minnesota System is that none of those assigned to the Project Staff are assigned full-time. During the construction months the construction takes priority over the CEMM System development and maintenance. The remaining months are sufficient to update the System and study the data generated by the System. The System was designed to run at the District level and as a tool primarily for the Engineers engaged in construction activities. However, how that tool is employed is the option of the system users. The data generated by the system is analyzed once each year in order to test the planning values, activity codes, and establish a data bank for generating manpower forecasting factors from the correlation between manhours and contract values. The only necessary staffing is a technician or a computer programmer available to answer questions regarding the software operation. The system reports can be generated every two weeks or at intervals set by the Engineers using the system.

FHWA Contract Compliance

The system was developed on schedule and implemented in accordance with Task A of the FHWA contract. The Technical Panel/Project Staff produced an operations manual for the pilot implementation and subsequently an updated operations manual for statewide implementation.

Chapter Two - System Specifications

Background

The CEMMS Specifications are as follows:

- Develop, implement, and monitor a construction engineering manpower management system for Mn/DOT
- Base the Mn/DOT system design on the system design manual prepared under FHWA contract DOT-FH-11-9122.
- Demonstrate to the highway community the benefit of implementing a CEMM System.
- Develop a complete system, whose basic elements are planning, budgeting, scheduling, monitoring.
- Document specifications and procedures in users manuals.
- Documentation shall include organization, definitions, activities, standards, procedures, resource requirements, and instructions for computer use.

Two manuals were developed, the operations manual and the field operations manual. These two manuals are described in detail in Chapter Three - "Planning" on page 8 of this report.

Conclusion

No problems were encountered during the specification development. The goal, to develop a workable manpower management system, was well defined early in the system organization and development.

System automation was added to Mn/DOT CEMMS. The addition was made:

- To facilitate implementation
- To save manpower during the monitoring function

The quarterly reports required by the FHWA contract were factual and addressed the contract requirements.

Specification changes will be added to this system as more input is generated by the system users.

FHWA Contract Compliance

Mn/DOT system specifications fit those described in task "C" of the statement of work included in the FHWA contract. No extraordinary problems were encountered during the development of the users manuals and the computer software. The "model" system design manual provided by the FHWA was straight forward and covered the major system design problems. The CEMMS pilot study manual and the updated version developed for the statewide implementation were prepared on schedule with the CEMMS implementation plan. The system documentation manual was prepared in accordance with the FHWA contract.

Chapter Three - System Design

Background

Minnesota elected to design their system for the planning, staffing, scheduling and monitoring functions. Forecasting, and updating, were subsequently developed and sub-systems will be added to the operations manual. The design plan was to apply the national pooled fund study recommendations embodied in the FHWA system design manual.

Planning

The title "Construction Engineering Manpower Management System" (CEMMS) seemed to describe the Minnesota system. Consequently, the system title was not changed from the one recommended by the system design manual.

Two CEMMS manuals have been prepared, an operations manual that contains the entire system and a field operations manual that consists of planning, staffing, scheduling, and monitoring sections and that portion of the appendix relating to these activities. The operations manual is placed in the Resident Engineer's office and with the Assistant District Engineer (Construction). The field operations manual is employed at the Project Engineer, Project Supervisor level. All references in this report are to the operations manual.

The Minnesota system is designed to employ two of the methods recommended by the system design manual for planning manpower;

The method of "defined contract quantities" is the most accurate method and is employed when these quantities are known.

The method of "program dollar amounts" is employed when the contract quantities are unknown. This method can be used for long range forecasting, however, the forecast accuracy is controlled by the accuracy of the estimated "program dollar amount" and the program stability.

Planning - Defined Contract Quantities

The nine contract types recommended by the design manual were used for the pilot implementation in District 6 and 7 for the first construction year of statewide implementation. Another contract type (Bridge Replacement) was added during the 1981 system updating process. The contract types are shown on page 1-2 of the operations manual (See Appendix "B"). Definitions for the contract types were modified slightly to better fit the construction conditions found in Minnesota.

The Technical Panel/Project Staff adopted 47 planning activities. The planning activity definitions shown in the design manual were modified to conform to the activities performed in Minnesota. The Mn/DOT Pay Quantity Documentation Manual was used to determine the activity definition modifications.

Mn/DOT Construction Engineering practices made it necessary to modify the standard planning values described in the design manual. The modifications consisted of changing some of the planning values, deleting some, and creating others to fit current construction practices and the Mn/DOT Pay Quantity Documentation Manual.

The standard planning values are listed by contract type on pages 1-21 thru 1-35 in the operations manual (See Appendix "B"). The standard planning value computations are found in Appendix A of the operations manual.

The planning units of measure described in the design manual were modified to reflect the planning activity changes, the field and contract conditions, and pay quantity documentation unique to Mn/DOT. A description of the planning units of measure can be found on pages 1-17 thru 1-19 of the operations manual (See Appendix "B").

Minnesota highways are exposed to heavy frost action and large summer-winter temperature differentials that enhance roadway deterioration, consequently materials and workmanship must be of the highest quality. Projects must be adequately staffed to ensure that these high quality standards are satisfied. The Technical Panel/Project Staff adopted near "maximum staffing guidelines" as described in the FHWA Design Manual. The guidelines are reflected in the Mn/DOT standard planning values.

Planning-Program Dollars

Program dollar amounts are employed to plan manpower when the contract quantities are unknown. The procedure relates program dollars to manhours or manmonths for each contract type. The forecasting subsection in this chapter will discuss the subsystem employed by Mn/DOT in detail.

Staffing

Staffing is the second element of the Mn/DOT CEMMS. The staffing process is designed to distribute manpower over the

calendar year. The Mn/DOT staffing process applies the "planning activities-engineering judgment" technique to their method of manpower distribution.

Engineering judgment is exercised to distribute manmonths planned for each project activity on the "Construction Manpower Planning Report" over the calendar year. The distribution is made by the project engineer on the "Annual Construction Project Staffing Plan" (see operations manual page 2-4 Appendix "B"). The staffing plan is employed by the Project Engineer to:

- Identify skill level needs.
- Balance manpower skills among projects.

The staffing plan is submitted to the Assistant District Engineer (Construction) and compiled on the "Annual District Construction Staffing Summary" shown on page 2-7 of the operations manual. The summary interpretation is employed by the District Engineer and Assistant District Engineer (Construction) to:

- Balance the employee complement among the resident offices.
- Identify and plan for off season assignments.
- Maximize employee complement effectiveness by adjusting contract letting dates.
- Identify seasonal manpower needs early.
- Identify personnel shortages or excesses.

The summaries are used by Assistant Commissioner of Operations to balance manpower among the Districts.

The Mn/DOT CEMMS does not address staffing by skill levels as outlined in the FHWA Design Manual. However, skill levels are recognized at the project engineer management level when staffing a particular project. The reasons for

not incorporating staffing by skill levels in the Mn/DOT system are as follows:

- Mn/DOT employs a Junior/Senior plan for technician classifications which is, of course, advocated by the strong employee union. The plan provides rapid advancement to the classification of Technician Intermediate (See Organization Chart Appendix "A" page A-2). Consequently, Mn/DOT really employs only two levels of technicians in a non-supervisory capacity. Technician certification is not recognized by either the Union or the State, therefore, skill level determination is based on the judgement of the resident and project engineers.

- Most Mn/DOT field technicians have many years of construction experience and possess diversified inspection and surveying skills.

- Field Construction Engineers did not want to obligate to a strict project staffing procedure.

More discussion is planned in the area of skill level determination and staffing by skill levels as outlined in the FHWA Design Manual. An indexing system (not related to CEMMS) is planned for cataloging employees and their particular skills and other studies that address employee skills are being made in Mn/DOT.

More work also remains in the area of staffing from the reduced personnel complement mandated by the State Legislature and justification of future personnel complements. These problems will be considered during the system update process and future system enhancements will reflect these considerations. Some of the considerations may consist of:

- Contractor staking
- End result specifications
- Independent inspection
- Automatic weigh scales
- Reduced testing rates

Scheduling

Scheduling is the third element of the Mn/DOT CEMMS. The scheduling process is designed to employ the "Primary-Secondary Assignment" method. The primary assignment is based on the contractors schedule and is influenced by the weather, equipment breakdowns, short notice changes in the contractors schedule, and other factors. Secondary assignments are intended to provide a smooth transition to useful work on days when the contractor is not working.

Written schedules are not widely used since the resident office staffs are adjusted to the work load at the beginning of the construction season. The resident offices are usually located more than one hour apart and personnel are assigned on a long term basis. The size of most resident offices permits efficient oral scheduling. A list of scheduling benefits may be found on page 3-1 of the operations manual (See Appendix "B").

Monitoring

Monitoring is the fourth element found in the Mn/DOT CEMMS. The process is designed to gather information for the forecasting subsystem, provide information for updating standard planning values, and evaluate work performance. The process also evaluates construction progress and it provides data for making staffing adjustments. The field reporting for the monitoring process is the responsibility of the project

engineer. The monitoring process is based on planning activities and generates three reports. These reports will be covered in detail in chapter Four.

Forecasting

The forecasting subsystem is designed to predict manpower from program or contract dollars. A forecast is made at the state program level, district program level and the project level. The forecast is made by dividing the construction program into the ten contract types recognized by the Mn/DOT CEMMS. The program dollars for each contract type are used to forecast manpower at one of the three levels. The forecasts are based on the average man months per 100 thousand dollars for each contract type.

Future forecasting at the project level will be based on regression equations which will be based on historical data being generated by the monitoring process. The procedure will be as follows:

1 Manhours expended are compared to contract dollar amounts for contracts of the same type.
2 The analysis is made for each of the ten contract types.
3 A graph of the equation is made for each of the contract types to expedite the calculation.
4 The equation resulting from the regression analysis is used to calculate manpower for any dollar amount.
5 The intent is to update the factors in the graph and to place the revisions into the operations manual.

A factor must be applied to the manpower estimate that reflects the time allowed for vacation, sick leave, and

holidays. The factors are derived in each district from historical data available from the payroll record. That factor in Mn/DOT is approximately 15%. The forecast must also consider the estimated average Minnesota construction season of seven months.

The forecasting subsystem was designed as a tool for top management to predict construction engineering manpower. It is also intended that the subsystem will help predict training needs and will help justify the construction personnel complement. The subsystem can be used as a vehicle to build manpower scenarios and consequently the forecasting system will be sensitive to the rapidly changing construction program.

Budgeting

The budgeting subsystem described in the FHWA Design Manual is not used by the Minnesota Department of Transportation. The described subsystem is not used primarily because the CEMMS staffing process does not address staffing by employee classification or skill level. That task is usually delegated to the Resident Engineer at the time the manpower is divided among the the construction projects. The manpower budget is determined by the personnel complement which in turn is mandated by the State Legislature. At times the District complement need either lags or is ahead of the workload to such an extent that it is necessary to shift men among districts or change the district construction program. The workload is related directly to the annual district construction program. The more that program fluctuates the more difficult it is to staff and budget manpower for construction projects and maintain an adequate complement.

Computer Software

Mn/DOT made an early decision to develop CEMMS computer software for the newly installed district micro-computers. The decision was made to eliminate as much CEMMS "Paperwork" as possible. Another reason was to save time and money, since the only other automation alternate was to program the system to run at the state computer center. The Mn/DOT data processing professionals were busy with other systems and a two year delay would have been experienced. Consequently, the programming was delegated to the project staff members assigned to Construction District 7. The system operations manual generated by the pilot study in District 6 and 7 was used as guide for the program coding. Mankato State University (located at Mankato, Minnesota) is noted for its computer science degrees and two of the intermediate technicians assigned to the District 7 Headquarters (also located at Mankato) had taken some of the computer science courses offered by the University. These two intermediate technicians were given the responsibility of coding the program for the CEMMS software.

The CEMMS software designed for the statewide implementation was completed in April of 1980. The software was enhanced during statewide implementation to include an engineering cost report. A second enhancement was made during the winter of 1980-1981. The enchancement reflected adjustments to the planning values, added one contract type, made major changes to the software architecture, and added a summary printout for the Assistant District Engineers (Construction) (See Appendix "C"). The estimated to date cost of the software developed for the Mn/DOT CEMMS is $20,000. The program coding took approximately twelve months. It is estimated

that Mn/DOT saved approximately $100,000 by doing the computer programming by the system users. The reports generated by the software replaced five of seven report forms used in the pilot study, they are:

- Construction Project Manpower Planning Report
- Annual Construction Project Staffing Plan
- Annual District Construction Staffing Plan
- Construction Activity Ledger
- Monthly Construction Project Manpower Report

The automation also saves approximately 1,000 manhours per year by elimination of the manual reporting and bookkeeping.

The software resides on a Texas Instrument Bronco Micro-Computer with a 48K memory and a dual 8" floppy disk drive. The software was written in the basic programming language and it is thought that the program can be easily adopted to other micro-computer systems. Examples of the computer printouts are shown in Appendix "C" of this report.

The software was designed to simplify the planning function for the project engineer. The data processing sequence is as follows:

- Project Engineer requests a computer printout for planning data input for each of his construction projects.
- Project Engineer enters the number of planning units on the computer printout
- Project Engineer sends the printout back to the computer operator.
- Computer operator inputs the data

- Computer prints the "Construction Project Manpower Planning Report" (see Page 1-38 and 1-39 of the Operations Manual) and builds the master file on the "project files" disk.

The software was also designed to simplify the monitoring function as shown by the following data processing sequence:

- Project Engineer submits the "Biweekly Activity Report" (field form) to the computer operator
- Computer operator inputs the data
- The computer prints the "Biweekly Construction Manpower Report" for the Project Engineer
- The computer prints "Monthly Construction Payments and Engineering Costs " for the Assistant District Engineer (Construction).

Software has been developed to facilitate the staffing function as shown by the following data processing sequence:

- Project Engineer requests a computer printout for data input for each of his projects (printout is similar to the "Annual Construction Project Staffing Plan" shown on page 2-4 and 2-5 of the operations manual shown in Appendix "C").
- Project Engineer distributes manpower over the construction season and sends the printout to the computer operator.
- Computer operator enters the data and two reports are printed; the "Annual Construction Project Staffing Plan" and the "District Construction Staffing Summary" (shown on pages 2-4, 2-5 and 2-7 of the operations manual see Appendix "C").

The Mn/DOT CEMMS software creates "Master Files" that contain all the data necessary to print the information con-

tained on the reports shown in Appendix "C". The data contained in the master files can be manipulated, by writing additional software, to provide:

- exception reports
- monitoring of individual activity codes
- monitoring of only personal expense or construction engineering costs
- monitoring of vehicle costs

Other reports may require revision of or addition to the master file data.

Another unique aspect of the Mn/DOT system is that the software was developed without help from the data processing professionals from the Mn/DOT Central Office. All systems analysis and program coding was accomplished by the Project Staff and their staff assistants. The procedure truly took advantage of the modern user oriented micro-computers now available on todays computer market. The system design and programming experience gave those associated with the system an understanding of the system's capabilities and a sense of real accomplishment. Therefore, it is suggested that other states use this approach for their software development.

System Updating

The procedures embodied in the Mn/DOT operations manual follow the recommendations included in the FHWA System Design Manual. The procedure provides for updating:

- Contract types
- Planning activities
- Planning units of measure
- Standard planning values
- Procedures for planning, staffing, scheduling, budgeting and forecasting

System updating will be discussed in detail in chapter 6.

Conclusion

The Technical Panel/Project Staff used the FHWA System Design Manual for designing the Mn/DOT CEMMS. The design manual provided an excellent guide, was easily adoptable to the Mn/DOT operations and was easily understood by those involved in the design. The Mn/DOT CEMMS was designed by field engineers for field engineers. The design was started January of 1979 and three months later the operations manual was ready for the pilot implementation in Districts 6 and 7.

FHWA Contract Compliance

The Mn/DOT system design is in accordance with task B of the statement of work included in the FHWA contract. All of the elements included in that task are either incorporated into the Mn/DOT CEMMS or they will be incorporated into the CEMMS in the very near future. No problems were encountered during the system design procedures and all implementation was on schedule. The Mn/DOT CEMMS accomplishes all the elements required by the contract. Computer software was also developed to facilitate the implementation. The computer software development, however, was not part of the FHWA contract. Mn/DOT did not develop a budgeting process in accordance with the guidelines and recommendations embodied in the FHWA System Design Manual. However, a budgeting process is being studied for possible implementation.

Chapter Four - Implementation

Background

The Mn/DOT CEMMS was implemented in two stages. The pilot study was implemented in Districts 6 and 7 and one project in District 8 in the spring of 1979. The system was updated in the period from December 1979 to the Spring of 1980. Difficulties with the system were studied and the appropriate corrections were made. The system was implemented statewide in the Spring of 1980. The decision was made to place only the new projects into the system. This decision rendered the statewide staffing function ineffective, since all projects were not planned and monitored by the CEMMS in 1980.

Pilot Project Implementation

Problems were minimized during the pilot project implementation, because members of District 6 and 7 were assigned to the Project Staff. Forty-four contracts were planned and monitored during the pilot study. During the winter of 1979/80 planning results were analyzed to varify the planning values developed from those found in the FHWA System Design Manual. The analysis indicated a close correlation between the manhours planned and the manhours used. A composite summary of the pilot study in Districts 6, 7 and 8 can be found on page 22 of this report. The Project Staff worked closely with District 9 in order to get "Metro Input"[1] into the system. District 9 has monitored their projects since the spring of 1979 to determine engineering costs. Actual hours used on several of their projects were compared with manhours planned employing the CEMMS planning values.

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[1] Minneapolis and Vicinity (District 5)
St. Paul and Vicinity (District 9)

COMPOSITE SUMMARY DISTRICT 6, 7 and 8 11-30-79

NO. OF CONTRACTS	CONTRACT TYPE	PROJECT ACTIVITIES PLANNED	USED	%	CONTRACT TIME PLANNED	USED	%	CONTRACTOR PAYMENTS PLANNED	USED	%
11	1	48,970	44,535	91	958	723.5	76	19,060,325	13,585,182	71
5	2	16,277	14,087	87	335	273.8	82	4,367,465	3,467,951	79
4	3	28,755	20,898	73	254	220.6	87	5,131,672	4,850,628	95
1	4	2,748	1,567	57	30	23	77	736,538	621,992	84
2	6	1,754	958	55	50	52.4	105	133,291	132,209	99
5	7	1,689	1,417	84	141	88.8	63	428,377	367,187	86
13	8	8,271	3,193	39	418	221.9	53	1,481,473	901,702	61
3	9	8,417	2,218	26	230	126	55	1,296,650	431,377	33
44	Contracts	116,881	88,873	76	2,407	1,730	72	32,635,791	24,358,228	75

The analysis varified that the CEMMS planning values were close to "On Target" for Minnesota.

Statewide Orientation

In December of 1979, upon recommendation of the Technical Panel/Project Staff, the Steering Committee authorized statewide implementation. Two members of the Project Staff conducted workshops in each district and explained the system to the construction forces. The workshops took place in late January and early February of 1980 at which time the CEMMS Operations Manuals were distributed. After the Workshops most of the questions arising after the workshops were answered by telephone. Special visits were made to those districts requesting special assistance. Some of the potential CEMMS users were not convinced of the System benefits but were willing to "give the System a try". Cooperation is now excellent and enthusiasm for the System is gaining momentum.

Computer software was sent to each district in May of 1980. The software facilitated the planning and monitoring functions. Initially some of the Resident Engineers elected not to use the micro-computer facilities at their district headquarters and the system was operated manually. However, all resident offices are now using their computers.

The Project Staff/Technical Panel worked closely with the Assistant District Engineers (Construction) in order to facilitate the implementation. These engineers influence the Construction Operations Division, in developing policy, work methods improvements, specification changes, and other things that effect contract management and staffing. The support of this group helped to minimize resistance to change during the statewide implementation.

Planning

Manpower requirements were planned for all new projects by the engineers in charge of those projects. The planning was facilitated by the computer software written for the microcomputers.

Vehicle assignments are made by the resident engineer for each resident office at the beginning of the construction season. Vehicle assignments are made on a need basis and are not part of the Mn/DOT CEMMS.

Staffing

Since the decision was made to place only new construction projects under the CEMM System, the staffing function could not be fully implemented. All the construction projects in Minnesota should be under the CEMM System during the 1983 construction season at which time the staffing subsystem will be fully operational.

The Mn/DOT CEMMS does not employ the staffing procedures outlined in the FHWA Design Manual. Staffing assessments are restricted to the "Annual District Construction Staffing Summary" found on page 2-7 of the operations manual shown in Appendix "C".

Scheduling

The Mn/DOT scheduling function is restricted to the project engineer level and the decision for formal scheduling is at that level. Scheduling has been tried on limited basis and is not generally employed. Implementation of the scheduling system can be classified as unsuccessful in Minnesota. Failure can be attributed to those elements discussed in the Scheduling section of Chapter Three on page 13 of this report.

Monitoring

Monitoring was implemented manually during the pilot study. It was found that the manual method was ackward and slow. Therefore, the project staff was authorized to develop software for the micro-computers to facilitate the statewide implementation. Those using this system were eager to cut-down on paperwork and their cooperation was readily secured. The only report that has to be hand written generated by the monitoring process is the field reporting form "Bi-Weekly Construction Activity Report" (shown on page 4-2 of the Operations Manual excerpt in Appendix "B").

Top Management Involvement

Four joint meetings of the Project Staff, Technical Panel and the Steering Committee were held during the design and implementation procedure. The meetings provided the Steering Committee with an update of the system progress. Top Management recognized the system benefits and encouraged the Technical Panel/Project Staff members to maintain their progress.

Conclusion

The CEMMS was developed by field engineers for field engineers and consequently those charged with implementation could relate to those responsible for maintaining and using the system. The Mn/DOT system was designed simple, however, it is expected to grow as management needs change. The simple design was one of the main objectives. Another objective was to design software to eliminate some of the "paper work". Cooperation among the Project Staff and the various district CEMMS contact personnel is excellent and CEMMS enhancement implementation problems are minor.

FHWA Contract Compliance

The Mn/DOT CEMMS implementation was accomplished according to the schedule required by task "D" in the contract statement of work.

Chapter Five - Monitoring

Background

Monitoring began during the pilot implementation. The monitoring process permitted those charged with the system development to evaluate the system, identify difficulties, and gather information for a forecasting subsystem. The monitoring process was also used to insure compliance with the Mn/DOT CEMMS procedures.

Monitoring is an ongoing process and provides a continuous evaluation and continuous information for system updating. The process tests the planning values, the contract type definitions, identifies problem areas of inadequate staffing, and it provides staffing information for top management. It also provides information for personnel complement.

Project Level

Monitoring at the project level is supervised by the project engineer and project supervisors. The monitoring process yields a "Bi-weekly Construction Project Manpower Report" for each construction project. The report is employed by the project engineer for analyzing his project activity staffing and the progress of the contract. The report lists the to date number of manhours planned and used by project activity; the number of working days planned and used; and the contract funds planned and used during the previous two week period. A copy of the report can be found in Appendix "C".

District Level

The monitoring process also yields a "Monthly Construction Payment and Engineering Cost Report". The report is a summary of the Bi-weekly Construction Project Manpower Reports used by the Project Engineers. The report lists the following data by project:

- Number of manhours planned and used
- Number of working days planned and used
- Contract funds encumbered and used
- Personal expenses
- Engineering costs

The report is employed to determine contract progress and as a management tool for distributing and planning for manpower. The report can also be used at the Resident Engineer level to control manpower and monitor contract progress. The bi-weekly project reports can be requested for any project that is not progressing smoothly.

Conclusion

Analysis of the data generated by CEMMS after the statewide implementation prompted the following recommendations from the Project Staff:

- Add contract type "Bridge Replacement" in order to avoid planning split contracts (Construction and Reconstruction)
- Change some of the planning activities. The changes allow planning activities to better fit contract activities and the construction practices in Mn/DOT.
- Change several of the planning values to reflect more realistic planning for certain contract types.

The above recommendations were implemented in early 1981.

The monitoring process was designed to gather information and is functioning as planned. The information generated (man months/$100,000 by contract type) is now being used at the state level to forecast manpower needs. Accuracy of the data being generated by the monitoring process can be credited to the deligence and cooperation of the Project Engineers and the Project Supervisors. The Project Staff, during the infancy of this system, has attempted to impress on those using the system the philosophy that with any system, "it's garbage in equals garbage out". The philosophy was effective because the information now being generated is giving the desired result.

FHWA Contract Compliance

The Mn/DOT CEMMS monitoring process is continuous and is intended to support the forecasting subsystem with the information it generates. The monitoring procedure employed by Mn/DOT satisfies the requirement of task "E" in the contract statement of work.

Chapter Six - System Updating

Background

The Mn/DOT CEMMS updating procedure employs the methods suggested in the FHWA System Design Manual. The procedure is performed annually by the Technical Panel/Project Staff. The updates are then incorporated into the operations manual. The system updating work is facilitated thru use of the Word Processor located in District 7.

Planning

The planning process is updated by analyzing the results of the previous construction season. The contract types, planning values or the units of measure, are modified, if necessary, to reflect inconsistencies in planning. The planning values and the units of measure are "fine tuned" at the end of each construction season. Work methods improvements, or changes in construction methods are also considered during the updating process. The planning values or units of measure are modified to reflect the changes. Activity codes are added or deleted as necessary.

Monitoring

The monitoring process update consists of studying the process for better ways to gather field data. The update also studies and develops better methods for analyzing the data generated by the process. The computer printouts are studied for possible improvments and the software is updated accordingly.

Work Methods Improvements

Mn/DOT addresses Work Methods Improvements in three ways none of which are connected to the CEMMS. They are:

- Mn/DOT retains a full time Value Engineer that coordinates preletting value engineering studies for construction projects and coordinates work method improvement studies initiated by the part-time Work Methods Engineer and Technicians assigned to each of the nine districts. The Value Engineer also supervises the Mn/DOT Cost Improvement Program.

- The Mn/DOT Assistant District Engineers (Construction) Committee maintains sub-committees that study field construction problems and make recommendations for solutions to those problems.

- The Mn/DOT Construction Practice Advisory Committee studies construction problems, and new construction methods and concepts. The studies result in recommendations for Work Methods Improvements.

Conclusion

The Mn/DOT CEMMS updating process was completed for 1981 in early June. The computer software was also updated to reflect the system changes made in early 1981. The system must constantly change to reflect changes in:

- Complement
- Work Methods
- Union Contracts
- Design
- Policy
- Etc.

If the system is allowed to become obsolete the information generated by the system will be meaningless.

FHWA Contract Compliance

The system update procedure employed by Mn/DOT follows the FHWA Systems Design Manual very closely. The procedure includes all of the elements required by task "B" of the contract statement of work.

Chapter Seven - Recommendations and Conclusions

System Design Recommendations

- Start system small (maybe develop just planning and monitoring the first year) then let system grow as data becomes available.

- Assign well experienced Field Engineers and high level Technicians to the Technical Panel and Project Staff. This will allow the potential system users to design the system and will eliminate the need for training computer consultants or in house computer professionals in engineering jargon and practices. This also minimizes the communication problem usually found between the system designers and the system users.

- Allow micro-computer program coding to be accomplished by those designing the system.

- Require the Technical Panel and Project Staff to Work with all districts in an attempt to satisfy the various management styles and report preferences.

- Keep in mind that user designed systems have a greater chance of success, since "selling" of the system is easier.

- Design an uncomplicated system in a short time - show results at the end of the first year after starting work on the system. Some systems take years to complete and some of the top managers retire before the system can give them the information that they need for their decisions.

Implementation Recommendations

- Inform field personnel as to how top management is planning to use the system.

- Do not try to implement computer programs or program modifications until they are working as designed. Such premature implementation can be disasterous.

- Try to secure the cooperation of the Field Engineers through visits to each of the districts and establish good communications between them and the system designers.

- Depend on the influence of top managment to gain some of the cooperation from the field personnel.

- Implement at least the planning and monitoring functions during the first year after the start of the design work.

- Do not try to force system on the Field Engineers and Technicians since without their full support the system will not produce accurate results, confidence in the system will be lost, and the system will fail.

- Try to down play the feeling of "Big brother is watching" i.e. explain to the Field Engineers that the System is designed as a tool for estimating and predicting manpower on a District or at the State level and not as an instrument for scruitinizing individual projects.

Savings From CEMMS Implementation

The only tangible savings that can be recognized at this time is the savings made during the system software develop-

ment and savings made during the subsequent use of the software.

- CEMMS developed by Field Engineers and Technicians $100,000

- Approximately 1000 manhours per year saved by employing CEMMS Software 1000 hours x $14.00/hour x 2 years $ 28,000

Some of the intangible savings are preceived as being:

- Better utilization of Construction Manpower by properly distributing the manpower among the Construction Districts.

- Increasing morale and consequently production by maintaining the optimum number of personnel in each District which results in "meaningful work" for everyone and abolishes the need for temporary transfers among the Districts.

- Providing an adequate experienced staff for each construction project which will minimize construction defects and consequently give the public more for their construction dollars.

Conclusion

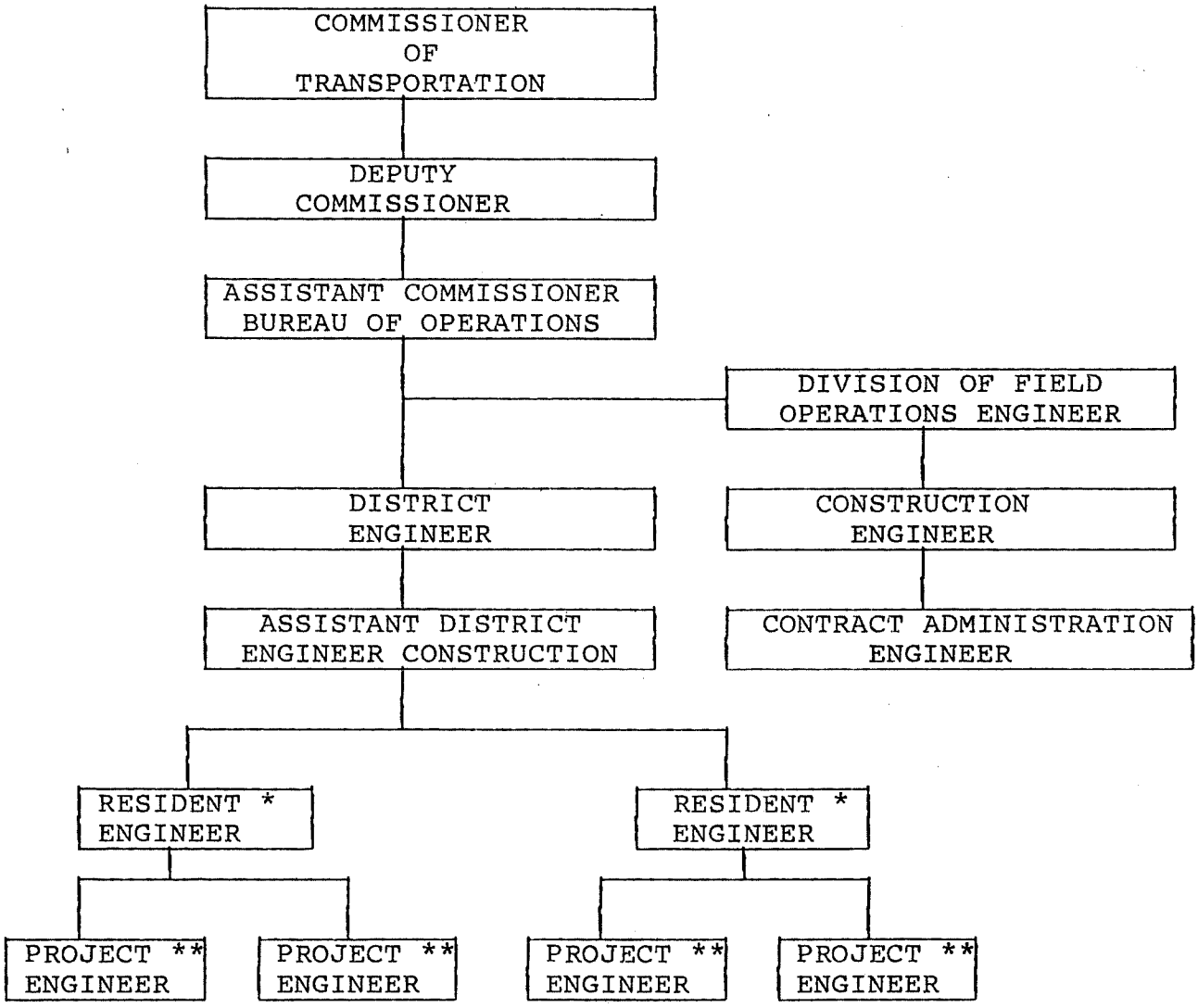
Success of a CEMMS rests in the hands of Top Management and the Field Engineers. If Top Management does not need or does not use the information generated by a CEMMS then use of the system should be discontinued. The Field Engineers are responsible for gathering the system data and generating

the manpower reports. Consequently, without their cooperation the system cannot function. The input data must be as accurate as possible in order for reports generated by the CEMMS to possess validity and to guarantee that decisions made from the reports will not be based on erroneous data. Success of a CEMMS is a joint effort of all those involved, motivated by a determination to "make it work".

APPENDIX "A"

MN/DOT CONSTRUCTION ENGINEERING

ORGANIZATION CHART



* One or more Resident Engineers under each Assistant District Engineer.

** Two or more Project Engineers or Project Supervisors under each Resident Engineer.

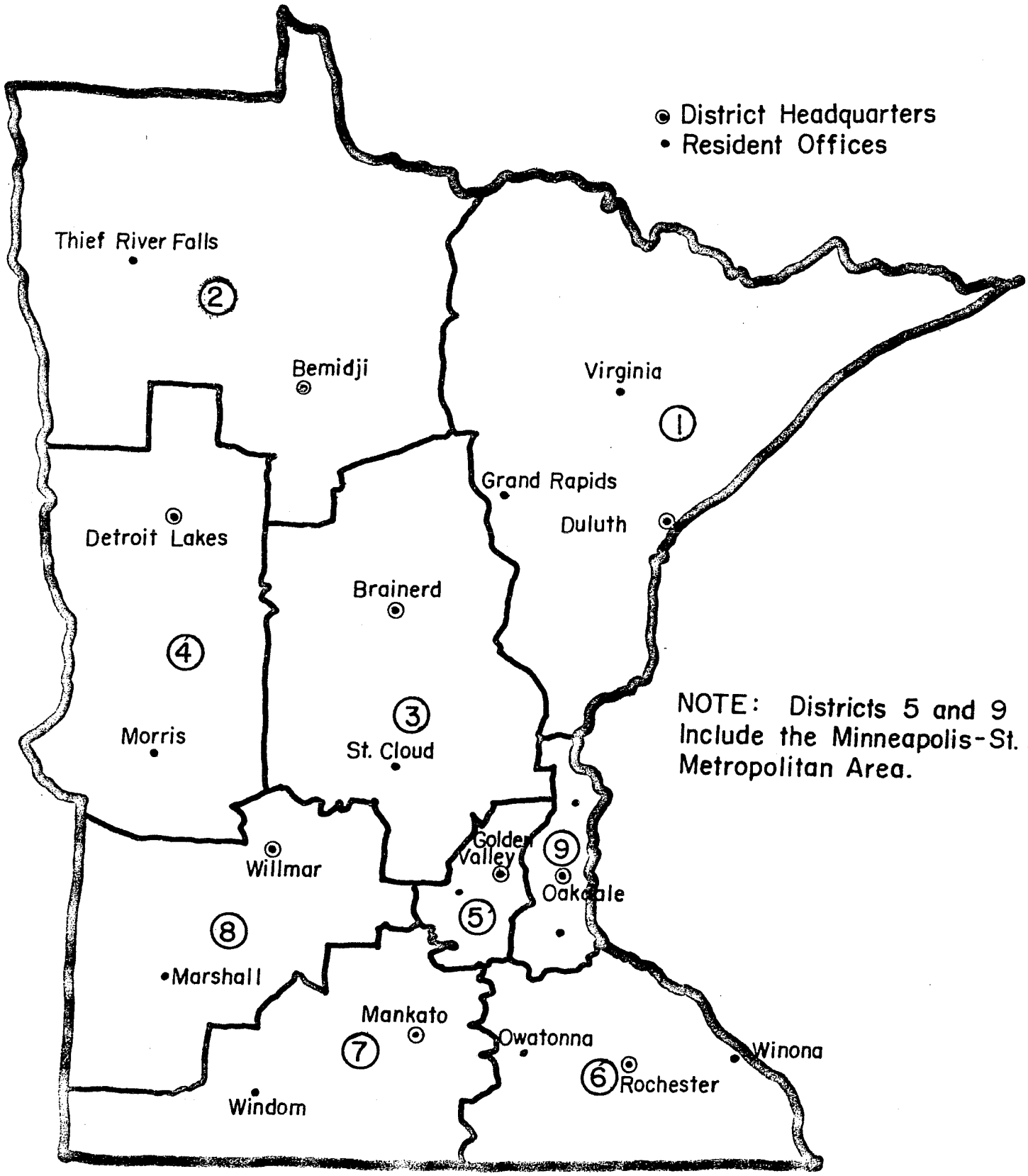
Minnesota Department of Transportation

Construction Personnel Classifications

DUTIES	ENGINEERS/SUPERVISORS	TECHNICIANS
District Engineer	Senior Administrative Engineer	
Assistant District Engineer Construction	Administrative Engineer	
Resident Engineer	Principal Engineer	
Project Engineer	Senior Engineer	
Project Supervisor	Engineer in Training II or Principal Engineering Specialist	
Trainee	Engineer in Training I	
Various Construction Related		Senior Highway Technician
Various Construction Related		Technician Intermediate
Various Construction Related		Technician
Various Construction Related		Seasonal

Minnesota Department of Transportation

DISTRICTS



APPENDIX "B"

Excerpts from the Mn/DOT CEMMS Operation Manual

Revised 2/6/81

PART ONE
Planning

The planning function is the first element of the Construction Engineering Manpower Management System. The objective of the planning function is to determine the total manpower for field construction engineering activities. These activities include surveying, inspection, office work, supervision, travel time, and all other work performed by the Engineer and his staff necessary for the satisfactory completion of a project.

The Construction Project Manpower Planning Report (page 1-38) will be initiated in the district by the Resident/Project Engineers. The procedures for developing this report are discussed in detail on pages 1-36 and 1-37 in this section of the manual.

Some advantages to manpower planning include:

1. Uniformity - Estimates of manpower needs for each project will be based on the standard planning values, consequently, projects will be uniformly staffed.
2. Flexibility - The Standard Planning Values are the core of the CEMMS and are used to plan the number of manhours for each construction activity. The Technical Panel should consider adjusting those planning values which are obviously wrong for a particular planning activity. Planning values should only be adjusted in very special cases, however, remember that they can be adjusted.
3. Control - The Engineer has direct control of the manhours used on a project and this planning system is based on manhours derived from contract quantities rather than dollars budgeted for engineering costs.

It is obvious that all Contracts are not alike and that the system must recognize those differences. With this concept in mind the Contracts were separated by their unique characteristics and the similarity of their staffing needs. The various contract types are defined in the following pages.

Revised 2/6/81

Contract Types (Detailed Quantities)

MASTER LIST
OF
CONTRACT TYPES
(Detailed Contract Quantities)

Code	Type
1	Construction*
2	Reconstruction*
3	Bridge Replacement*
4	Widening and Resurfacing*
5	Resurfacing*
6	Bridge Repair*
7	Intersection Improvements*
8	Safety and Traffic Control
9	Miscellaneous
10	Unique

* May be modified to reflect the following exceptional conditions:
  - Under Traffic
  - Urban
  - Hilly (Construction, Reconstruction and Bridge Replacement) see page 1-20 for definition of the three modifications.

Occasionally contracts are composed of more than one contract type. The Engineer must recognize this condition and divide the contract into major contract types. A Construction Project Manpower Planning Report is then completed for each of the contract types and the Planning Activity Manhours are then totaled and combined on a composite report.

CONTRACT TYPE DEFINITIONS

Code	Definition
1	Construction. New construction of, additions to, or major reconstruction of divided or undivided highways. Includes all major phases of construction--site preparation, earthwork, drainage, structures, paving, etc. -- whether contracted separately or as a complete project. Minor items such as signing, landscaping and guardrail are included unless they are in separate specialty contracts. They are then included in their respective types as defined below. New construction -- covers highways built at new locations. Additions -- includes construction to expand an existing facility such as interchanges, structures, ramps, dual roadways, and rest area sites. Major reconstruction -- the alteration of an existing facility where earthwork quantities per roadway mile are similar to those for new location construction. Structures -- includes complete bridges, and may include the removal and replacement of existing structures.
2	Reconstruction. The removal and replacement, rebuilding or upgrading of an existing roadway. There may be grade changes but normally the changes will not be significant. Includes all phases of construction. May include short relocations. Includes widening equivalent to one lane width or wider. Includes structures when decks are widened and substructures extended.

Code	Definition
3	Bridge Replacement. The removal and replacement of an existing bridge and reconstruction of the adjacent roadway. Includes all phases of Construction. May include short relocations and/or widening of the inplace roadway. This contract type is intended for use on projects that are less than one mile in length.
4	Widening and Resurfacing. Widening and resurfacing of existing highway facilities when the total added width is equivalent to less than one lane width and grades are not changed. Includes minor grading, extending culverts, curb and gutter, etc. Includes bridge deck widening without substructure changes.
5	Resurfacing. Overlaying existing highways and surfacing or overlaying existing shoulders with asphaltic material. Includes joint repair, minor widening with asphaltic materials, some base corrections or asphaltic base, curb and gutter replacement, and adjustments at structures, drives and street returns, and turn lanes when they are the only widening on a project. Also includes rebuilding shoulders with aggregate materials. Does not include extensive reconstruction, pavement replacement or construction of new pavements, excavation, utility, or sewer work.
6	Bridge Repair. Repair of bridges includes repairs to decks, curbs, rails, beams and structures. If total deck removal and replacement is required, the contract should be classified as reconstruction.
7	Intersection Improvements. Minor construction or reconstruction of streets or highways usually requiring fewer than 50 working days for completion. Normally includes some removal, grading, drainage, and paving. May include curb and gutter.

Code	Definition
8	Safety and Traffic Control. Placement or replacement of guardrail, signs, lighting, traffic signals, and other safety and traffic control devices when let on a specialty contract basis. If safety and traffic control devices are included as a part of a major contract type, they should be included under the miscellaneous activities for that type.
9	Miscellaneous. Includes all small projects -- which do not fit any of the above types. Includes landscaping, fencing, etc., when let on a specialty contract basis.
10	Unique. Includes all large projects which occur so infrequently that separate contract types are not necessary. Includes construction of buildings for rest areas, offices, scale houses, tunnels, etc.

PLANNING ACTIVITIES

Planning activities are used to describe work that must be performed by field construction personnel on the various types of contracts. A master list of those activities has been compiled and is intended to cover only those activities that require a significant number of manhours. Only those planning activities that apply to a project should be used when doing the manpower planning report.

Activities that are not performed by field construction personnel have been omitted. Examples include:

1. Inspection at culvert producing plants performed by District or Central Office personnel.
2. Densities and gradations performed by District Laboratory personnel on base and bituminous work.

The Master List of Individual Planning Activities and their definitions follows:

Revised 2/6/81

MASTER LIST

INDIVIDUAL PLANNING ACTIVITIES

Code	Description
	EARTHWORK
01	Roadway Layout Staking
02	Cross-Sectioning and Slope Staking
03	Grade Control -- Subgrade
04	Removal and Relocation Inspection
05	Earthwork Inspection
06	Density -- Earthwork and Drainage
07	Preparation for Construction -- Office
08	Earthwork -- Office
	DRAINAGE
11	Drainage Structure Staking
12	Drainage Structure Inspection
13	Drainage Structure -- Office
14	Cast-in-Place Box Culvert Staking
15	Cast-in-Place Box Culvert Inspection
16	Cast-in-Place Box Culvert Inspection-Office
	AGGREGATE
21	Line/Grade Control -- Aggregate Construction/Paving
22	Aggregate Construction Inspection
23	Density -- Aggregate Construction
24	Gradation -- Aggregate Construction
25	Weigh Aggregate Materials
26	Check Aggregate Construction Materials
27	Aggregate Construction -- Office
	ASPHALT PAVING
31	Asphalt Paving Inspection
32	Asphalt Plant Inspection
33	Weigh/Check Asphalt Mixture
34	Asphalt Paving -- Office

Revised 2/6/81

Code	Description
	PCC PAVING
41	Portland Cement Concrete Paving Inspection
42	PCC Plant - Paving
43	Joint Repair Inspection
44	PCC Paving - Office
	STRUCTURE
51	Structure Staking
52	Structure Inspection
53	PCC Plant - Structure
54	Structure - Office
	MISCELLANEOUS
61	Staking Miscellaneous Items
62	Inspection of Miscellaneous Items
63	Office Work for Miscellaneous Items
64	R/W Staking and Monumentation
65	Staking Turn Lanes
66	Inspection for Turn Lanes
67	Office Work for Turn Lanes
	SPECIAL FEATURE
71	Special Feature Staking
72	Special Feature Inspection
73	Special Feature -- Office
	GENERAL
81	General Office Work
82	Project Supervision and Management
83	Standby
84	Travel

Revised 2/6/81

INDIVIDUAL PLANNING ACTIVITY DEFINITIONS

Code	Description
	EARTHWORK
01	Roadway Layout Staking. Staking for road layout includes locating or re-establishing control points, staking or restaking centerline, establishing reference lines, and elevation control; staking for clearing, grubbing, tree removal and miscellaneous items; right-of-way staking; and staking for all utility relocation and construction. FIELD WORK ONLY. (SEE CODE 21)
02	Cross Sectioning and Slope Staking. Re-establishing centerline, slope staking, cross sectioning and final measurements for roadway earthwork. Includes cross sectioning of borrow pits, subcut areas and channel changes. FIELD WORK ONLY.
03	Grade Control -- Subgrade. Re-establishing centerline, setting offset stakes, and establishing grade for roadway excavation, and embankment. FIELD WORK ONLY. (SEE CODE 21)
04	Removal and Relocation Inspection. Inspection of clearing and grubbing, building or structure relocation or demolition; relocation of all utilities and new utility construction of water lines, electrical cables, sanitary sewers, and other removal items. FIELD WORK AND FIELD DOCUMENTATION ONLY.
05	Earthwork Inspection. All earthwork inspection, including topsoil removal, stockpiling, and placing inspection; slope shaping and grade inspection. Excludes moisture and density testing. FIELD WORK AND FIELD DOCUMENTATION ONLY.

Code	Description
06	Density -- Earthwork and Drainage. Density and moisture determination tests on earthwork and drainage construction.
07	Preparation for Construction -- Office. All office engineering necessary to prepare for road layout staking, utility relocation, clearing and grubbing, other removal items, and traffic control during construction. Also includes preparation of field books, sketches, and computations required to determine final quantities for these items of work. FIELD PERSONNEL ONLY
08	Earthwork -- Office. Office work in the preparation of slope stake books, grade books, and the computation and preparation of final quantities for earthwork. FIELD PERSONNEL ONLY
	DRAINAGE
11	Drainage Structure Staking. Layout, staking, and final measurements for all subsurface drainage, pipes, underdrains, storm sewers, headwalls and other related drainage facilities. Excludes cast-in-place box culverts. FIELD WORK ONLY.
12	Drainage Structure Inspection. Inspection for installation of pipes, under drains, storm sewers, headwalls, manholes, catch basins and other related minor structures. Includes inspection of installation -- location, trench width, bedding, placement and joints; and inspection of backfill. Includes gradation testing for backfill material. Excludes cast-in-place box culverts. FIELD WORK AND FIELD DOCUMENTATION ONLY.

Code	Description
13	Drainage Structure. Office work in the preparation of field book, grade computations, checking documentation and preparation of final quantities for all drainage structures. Excludes cast-in-place box culverts. FIELD PERSONNEL ONLY
14	Cast-in-Place Box Culvert Staking. Layout staking and final measurements.
15	Cast-in-Place Box Culvert Inspection. Inspection for bedding, forms, reinforcing steel, and backfill. Includes gradation and density tests for bedding and backfill materials and all field plant concrete inspection.
16	Cast-in-Place Box Culvert Inspection - Office. Office work in the preparation of field books, grade computations, checking documentation and preparation of final quantities. FIELD PERSONNEL ONLY
	AGGREGATE
21	Line/Grade Control--Aggregate Construction/Paving. Resetting reference lines, setting offset stakes, setting grades, and final measurements for all aggregate construction and paving courses. FIELD WORK ONLY. (This code may not be needed if codes 01 and 03 are used)
22	Aggregate Construction Inspection. Inspection of aggregate bases and surface courses. Includes subgrade preparation for aggregate placing; computing and checking yield, inspecting aggregate placing, shaping and width, depth and crown checks. Excludes testing. FIELD WORK AND FIELD DOCUMENTATION ONLY.

Code	Description
23	Density -- Aggregate Construction. Field density testing for aggregate bases or surface courses on the roadway. Includes moisture and density tests. By project personnel only.
24	Gradation -- Aggregate Construction. Field gradation testing for aggregate bases or surface courses at the aggregate source and on the roadway.
25	Weigh Aggregate Materials. Weighing of aggregates for aggregate base and surface construction.
26	Check Aggregate Materials. Street checking of aggregates for aggregate base and surface construction.
27	Aggregate Construction -- Office. Office work, checking documentation and preparation of final quantities for all aggregate base and surface construction. FIELD PERSONNEL ONLY
	ASPHALT PAVING
31	Asphalt Paving Inspection. Roadway inspection of asphalt paving operations. Includes checking grade preparations; inspection of contractor's equipment, tacking, joints, mix placement, mix temperature,and rolling. Includes field testing on the roadway. FIELD WORK AND FIELD DOCUMENTATION ONLY.
32	Asphalt Plant Inspection. All plant testing and inspection for asphalt paving operations. Includes aggregate gradation tests, spot checks, plant calibration checks, and inspecting methods of storing and stockpiling materials.

Code	Description
33	Weigh/Check Asphalt Mixture. Weighing asphalt material mixture (scaleman) collecting weigh tickets (street checker).
34	Asphalt Paving -- Office. Office work in the preparation of field books, checking weigh ticket tally accumulation sheets, checking documentation, and preparation of final quantities for asphalt paving. FIELD PERSONNEL ONLY
	PCC PAVING
41	Portland Cement Concrete Paving Inspection. Roadway inspection of Portland cement concrete paving operations. Includes checking grade preparation, inspection of forms condition and placement, inspection of methods of storing and handling material, inspection of contractor's equipment, inspection of installation of transfer devices, inspection of steel placement and concrete placement--including finishing, edging, curing, straight-edging, grinding, sawing and joint installation. Includes field concrete testing on the roadway. FIELD WORK AND FIELD DOCUMENTATION ONLY.
42	PCC Plant -- Paving. All plant testing and inspection for concrete paving operations. Includes aggregate gradation and moisture determination tests.
43	Joint Repair Inspection. Inspection of joint repair operations. Includes layout of pavement to be removed; and the inspection of sawing of joints, subgrade preparation and placement of concrete or asphalt pavement. FIELD WORK AND FIELD DOCUMENTATION ONLY.
44	PCC Paving -- Office. Office work in the preparation of field books, checking documentation and preparation of final quantities for all concrete paving. FIELD PERSONNEL ONLY

Code	Description

STRUCTURE

51 Structure Staking. All layout of structures with a clear span of 20 feet or more. Includes staking working points and establishing vertical control. FIELD WORK ONLY.

52 Structure Inspection. Inspection of structures with a clear span of 20 feet or more. Includes inspection of structures excavation and backfill, inspecting piling operations, inspecting reinforcing and structural steel placement, stool shots and determining stool heights, inspecting substructure and superstructure concrete placement, and inspecting project cleanup. Includes all field testing and materials control at structure site. FIELD WORK AND FIELD DOCUMENTATION ONLY.

53 PCC Plant -- Structure. All plant testing and inspection of concrete for the construction of structures with a clear span of 20 feet or more. Includes aggregate gradation and moisture determination tests.

54 Structure -- Office. Office work in quantity computations, field book preparation, checking documentation, deck grade computations, and preparation of final quantities for structures with a clear span of 20 feet or more. FIELD PERSONNEL ONLY

MISCELLANEOUS

61 Staking Miscellaneous Items. Staking for fence, traffic control, permanent signs, curb, gutter, guardrail and all other items not identified in other activities. Includes all staking on smaller projects such as landscaping, intersection improvements, and safety and traffic control. FIELD WORK ONLY.

Code	Description
62	Inspection of Miscellaneous Items. All inspection, testing and final measurement for curb, gutter, sodding, seeding, erosion control, guardrail, fence, permanent signs, delineators, riprap, striping, final trim and cleanup, and other items not identified in other inspection activities. Includes all inspection on smaller projects such as landscaping, intersection improvements and safety and traffic control.
63	Office Work for Miscellaneous Items. Office work in the preparation of field books, checking documentation and preparation of final quantities for signs, seeding, sodding, guardrail, fence, and other items not identified in other office activities. FIELD PERSONNEL ONLY
64	R/W Staking and Monumentation. Includes all survey work necessary to establish the R/W and monument locations.
65	Staking Turn Lanes. All survey work necessary to stake turn lanes including cross-sectioning, slope staking and drainage staking.
66	Inspection for Turn Lanes. All inspection for drainage, earthwork, and turf establishment.
67	Office Work for Turn Lanes. Office work for drainage, earthwork and turf establishment including preparation of field books, and preparation and checking of final quantities.

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Code	Description

SPECIAL FEATURE

71 Special Feature Staking. Staking of major features unique to the projects. Includes all staking for rest area facilities such as buildings, wells, flow chambers, and pump houses; also staking for barriers, tunnels, retaining walls, and other specialty contract items. Includes staking on unique projects. FIELD WORK ONLY.

72 Special Feature Inspection. Inspection of major features unique to the projects. Includes all inspection for rest area facilities such as buildings, wells, flow chambers, and other specialty items. Includes inspection of unique projects.

73 Special Feature--Office. Office work for major features uni que to the projects. Includes all office work for rest area facilities such as buildings, wells, flow chambers, and pump houses; also barriers, tunnels, retaining walls and other contract items. Includes office work for unique projects. FIELD PERSONNEL ONLY

GENERAL

81 General Office Work. General office work in establishing and maintaining files and record keeping systems; preparation of reports, final "As Constructed" plans, time sheets; and maintaining the office. Includes all office work on projects such as deck repair, landscaping, intersection improvement and safety and traffic control.

Code	Description
82	Project Supervision and Management. Project management relative to supervision of surveying, inspection and office activities; meeting with representatives of other divisions or agencies, contractors, land owners, or the public; personnel management, manpower evaluations, training, and other project management including travel time. Note: In most cases the usage of this activity will be confined to the Project Engineer or persons acting as his designated representative for substantial periods of time.
83	Standby. All non-productive time equal to or greater than one hour, spent while waiting for the contractor to commence or resume work, waiting for the weather to improve so work may commence or continue, or other non-productive time for any reason.
84	Travel. Travel time equal to or greater than one hour per person per day.

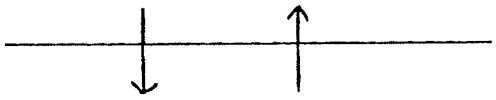
NOTE: Inspection of signs, barricades, lighting, detours, and temporary roads needed to maintain traffic flow during construction is included in each inspection activity.

PLANNING UNITS OF MEASURE

A Planning Unit of Measure is the "yardstick" used for measuring the engineering work required for each Individual Planning Activity. Individual Planning Activities are related to the contract types through the planning units of measure.

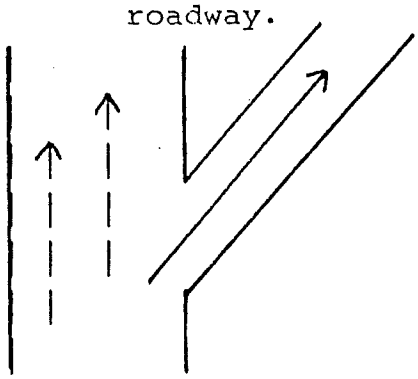
DEFINITIONS OF PLANNING UNITS OF MEASURE FOR INDIVIDUAL ACTIVITIES

Roadway Mile is the linear length of a roadway of independent, or relatively independent, alignment. Multiple-lane, divided or undivided highways are considered as two roadways. The number of lanes is not important -- as shown by the examples below.

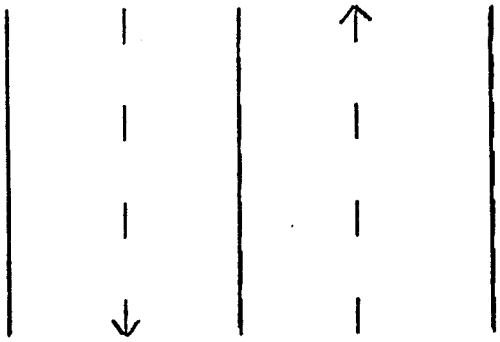


A two-lane highway is one roadway.

A divided highway is two roadways.



A ramp or connecting road is a roadway. The above example shows two roadways -- main line and ramp.



An undivided multilane highway is two roadways.

The number of roadway miles is not necessarily equal to project length. On projects where the number of roadway miles is less than one use one roadway mile for the number of planning units on the Construction Project Manpower Planning Report.

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Definitions

10,000 Cubic Yards is a unit based on Earthwork quantities. The quantities include only those excavation and borrow items shown in the contract proposal.

Each Individual Box Culvert Locations, without regard to number of barrels.

1,000 Tons is based on bid item quantities which are used for aggregate construction and asphalt paving inspection.

1,000 Square Yards is based on bid item quantities which are used for Portland cement concrete pavement.

100 Square Yards is based on bid item quantities which are used for joint repair on Portland cement concrete pavement.

Span-Lane is the number of spans multiplied by the number of lanes of each structure with a clear span of 20 feet or more. When the bridge shoulder width is 8 feet or more, the shoulder shall be considered as another lane.

Bent is the number of substructure abutment or pier locations. It is used for structure staking on major contracts.

Span is the number of spans on a structure with a clear span of 20 feet or more. It is used on bridge repair contracts.

Lump Sum is used for special features on major or unique contracts.

Working Day is the number of working days allowed or estimated for the contract to be completed. It is used on the minor contracts--intersection improvements, landscaping, and safety and traffic control.

Percent of Sum of Man-Hours for Inspection Activities is used for General Office Work. It is a standard allowance based on the total number of direct man-hours planned for all inspection activities.

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Standard Planning Values

Standard planning values uniformly quantify the work which must be performed by field construction engineering personnel. Standard planning values have been established to determine the construction engineering manpower requirement for each contract type and planning activity. Each standard planning value is composed of a base planning value plus necessary modifiers. The base planning value represents the construction engineering effort (in manhours) per unit of measure for a standard construction project (rural with no traffic). The modifiers reflect additives to the base planning value. Modifers are added to the base planning values when projects are constructed under traffic, in urban areas, or in hilly terrain. The application of those modifers is described as follows:

Under Traffic - should be applied selectively to planning values for activities on only that portion of the project that carries traffic while construction operations are in progress.

Urban Modifer - applied to planning values for activities on projects or segments of projects that contain utilities and other structures usually found in well developed urban areas. The corporate limits of a city or municipality should not be considered when determining whether to apply the urban modifier.

Hilly - used to describe the project topography and the modifier is applied to planning values for activities on projects or segments of projects that have an average cut and/or fill exceeding 10 feet on centerline.

Indiscriminate use of the planning value modifiers will result in large planning errors and consequently sound judgement must be applied to achieve accurate results.

Appendix A contains the Standard Planning Value Computations. The computations show the reasoning used to determine the manhours needed per planning unit for each of the Base Planning Values in the tables. An attempt was made by the Authors to incorporate the testing rates set forth in the "Schedule of Testing" and the testing procedures described in the various manuals into the Standard Planning Values. An attempt was also made to adapt the planning values to the field conditions found in Minnesota. The intent of the Technical Panel is to review the Standard Planning Values on a yearly basis and to revise those that seem to be yielding unrealistic results.

The next fifteen pages contain the table of Activity **Planning** Standards for each of the Contract Types.

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TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Construction

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban	Hil
EARTHWORK						
01	Roadway Layout Staking	Roadway Mile	127	32	32	
02	Cross Sectioning & Slope Staking	Roadway Mile	68	17	17	
03	Grade Control -- Subgrade	Roadway Mile	64	13	13	
04	Removal and Relocation Inspection	Roadway Mile	17	0	17	
05	Earthwork Inspection	10,000 c.y.	8	2	8	
06	Density -- Earthwork & Drainage	Roadway Mile	25	0	25	
07	Preparation for Const.-- Office	Roadway Mile	21	0	15	
08	Earthwork -- Office	Roadway Mile	44	0	0	
DRAINAGE						
11	Drainage Structure Staking	Roadway Mile	43	6	15	
12	Drainage Structure Inspection	Roadway Mile	28	7	28	
13	Drainage Structure -- Office	Roadway Mile	11	0	11	
14	Cast-in-Place Box Culvert Staking	Each	48	7	17	
15	Cast-in-Place Box Culvert Inspection	Each	105	26	26	
16	Cast-in-Place Box Culvert -- Office	Each	11	0	0	
AGGREGATE						
21	Line/Grade Control -- Aggreg. Const/Paving	Roadway Mile	53	8	13	
22	Aggregate Construction Inspection	Roadway Mile	44	13	22	
23	Density -- Aggreg. Construction	Roadway Mile	12	0	12	
24	Gradation -- Aggreg. Construction	1,000 Ton	1	0	1	
25	Weigh Aggregate Materials	1,000 Ton	5	2	2	
26	Check for Agg. Materials	1,000 Ton	5	2	2	
27	Aggregate Construction -- Office	Roadway Mile	2	0	0	
ASPHALT PAVING						
31	Asphalt Paving Inspection	1,000 Tons	6	2	3	
32(1)	Asphalt Plant Inspection	1,000 Tons	7	2	4	
33(1)	Weigh/Check Asphalt Mix.	1,000 Tons	10	3	5	
34	Asphalt Paving - Office	1,000 Tons	2	0	0	
PCC PAVING						
41	Portland Cement Concrete Paving Inspection	1,000 Sq. Yds.	4	1	2	
42(1)	PCC Plant - Paving	1,000 Sq. Yds.	3	1	2	
44	PCC Paving - Office	1,000 Sq. Yds.	1	0	0	
STRUCTURE						
51	Structure Staking	Bent	24	6	6	
52	Structure Inspection	Span-Lane	63	0	0	
53(1)	PCC Plant -- Structure	Span-Lane	12	0	0	
54	Structure -- Office	Span-Lane	18	0	0	
MISCELLANEOUS						
61	Staking Misc. Items	Roadway Mile	23	6	8	
62	Inspection for Misc. Items	Roadway Mile	30	8	15	
63	Office Work for Misc. Items	Roadway Mile	34	0	0	

* Manhours/Planning Unit

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Construction

Code	Description		Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban
GENERAL						
81(2)	General Office Work		Insp. MH	15%		
82	Project Super. and Management		MH Act. 01-81	10%		
83	Standby		MH Act. 01-81	02%		
84(3)	Travel	One Way				
		0 - 15 Min.	Staking & Insp. MH	0%		
		20 - 45 Min.	Staking & Insp. MH	15%		
		More Than 45	Staking & Insp. MH	25%		

* Manhours/Planning Unit

(1) Central inspection activities (District 5 and 9 only) omit activities 32, 42, 53, and 50% of 33.

(2) The Planning Unit for Activity Code 81 is the sum of the manhours required for Activity Codes 04, 05, 06, 12, 15, 22, 23, 24, 25, 26, 31, 32, 33, 41, 42, 52, 53, and 62.

(3) The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Codes 01, 02, 03, 11, 14, 21, 51, 61, plus the Planning Unit for Activity Code 81.

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Reconstruction

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban	Modifier Hil
EARTHWORK						
01	Roadway Layout Staking	Roadway Mile	94	24	24	1
02	Cross Sectioning & Slope Staking	Roadway Mile	61	15	15	1
03	Grade Control -- Subgrade	Roadway Mile	64	13	13	
04	Removal and Relocation Inspection	Roadway Mile	21	0	32	
05	Earthwork Inspection	Roadway Mile	80	20	80	1
06	Density -- Earthwork & Drainage	Roadway Mile	30	0	30	
07	Preparation for Const.-- Office	Roadway Mile	21	0	21	
08	Earthwork -- Office	Roadway Mile	44	0	0	
DRAINAGE						
11	Drainage Structure Staking	Roadway Mile	54	8	19	
12	Drainage Structure Inspection	Roadway Mile	25	6	50	
13	Drainage Structure -- Office	Roadway Mile	17	0	17	
14	Cast-in-Place Box Culvert Staking	Each	24	4	8	
15	Cast-in-Place Box Culvert Inspection	Each	54	14	14	
16	Cast-in-Place Box Culvert -- Office	Each	11	0	0	
AGGREGATE						
21	Line/Grade Control -- Aggreg. Const/Paving	Roadway Mile	53	8	13	
22	Aggregate Construction Inspection	Roadway Mile	44	13	22	
23	Density -- Aggreg. Construction	Roadway Mile	12	0	12	
24	Gradation -- Aggreg. Construction	1,000 Ton	1	0	1	
25	Weigh Aggregate Materials	1,000 Ton	5	2	2	
26	Check for Agg. Materials	1,000 Ton	5	2	2	
27	Aggregate Construction -- Office	Roadway Mile	2	0	0	
ASPHALT PAVNG						
31	Asphalt Paving Inspection	1,000 Tons	6	2	3	
32(1)	Asphalt Plant Inspection	1,000 Tons	7	2	4	
33(1)	Weigh/Check Asphalt Mix.	1,000 Tons	10	3	5	
34	Asphalt Paving - Office	1,000 Tons	2	0	0	
PCC PAVING						
41	Portland Cement Concrete Paving Inspection	1,000 Sq. Yds.	4	1	2	
42(1)	PCC Plant - Paving	1,000 Sq. Yds.	3	1	2	
43	Joint Repair Inspection	100 Sq. Yds.	22	0	11	
44	PCC Paving - Office	1,000 Sq. Yds.	1	0	0	
STRUCTURE						
51	Structure Staking	Bent	8	1	0	
52	Structure Inspection	Span-Lane	58	0	0	
53(1)	PCC Plant -- Structure	Span-Lane	11	0	0	
54	Structure -- Office	Span-Lane	16	0	0	
MISCELLANEOS						
61	Staking Misc. Items	Roadway Mile	23	6	8	
62	Inspection for Misc. Items	Roadway Mile	26	7	26	
63	Office Work for Misc. Items	Roadway Mile	34	0	0	

* Manhours/Planning Unit

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Reconstruction

Code	Description		Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban
GENERAL						
81(2)	General Office Work		Insp. MH	15%		
82	Project Super. and Management		MH Act. 01-81	10%		
83	Standby		MH Act. 01-81	02%		
84(3)	Travel	One Way				
		0 - 15 Min.	Staking & Insp. MH	0%		
		20 - 45 Min.	Staking & Insp. MH	15%		
		More Than 45	Staking & Insp. MH	25%		

* Manhours/Planning Unit

(1) Central inspection activities (District 5 and 9 only) omit activities 32, 42, 53, and 50% of 33.

(2) The Planning Unit for Activity Code 81 is the sum of the manhours required for Activity Codes 04, 05, 06, 12, 15, 22, 23, 24, 25, 26, 31, 32, 33, 41, 42, 43, 52, 53, and 62.

(3) The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Codes 01, 02, 03, 11, 14, 21, 51, 61, plus the Planning Unit for Activity Code 81.

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Bridge Replacement

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Urban	Hil
EARTHWORK						
01	Roadway Layout Staking	Roadway Mile	94	24	24	14
02	Cross Sectioning & Slope Staking	Roadway Mile	61	15	15	12
03	Grade Control -- Subgrade	Roadway Mile	64	13	13	(
04	Removal and Relocation Inspection	Roadway Mile	32	0	32	(
05	Earthwork Inspection	Roadway Mile	90	22	90	18
06	Density -- Earthwork & Drainage	Roadway Mile	33	0	33	(
07	Preparation for Const.-- Office	Roadway Mile	21	0	21	(
08	Earthwork -- Office	Roadway Mile	33	0	0	(
DRAINAGE						
11	Drainage Structure Staking	Roadway Mile	27	5	14	14
12	Drainage Structure Inspection	Roadway Mile	30	8	60	15
13	Drainage Structure -- Office	Roadway Mile	13	0	13	(
14	Cast-in-Place Box Culvert Staking	Each	24	4	8	1
15	Cast-in-Place Box Culvert Inspection	Each	54	14	14	5
16	Cast-in-Place Box Culvert -- Office	Each	11	0	0	(
AGGREGATE						
21	Line/Grade Control -- Aggreg. Const/Paving	Roadway Mile	53	8	13	5
22	Aggregate Construction Inspection	Roadway Mile	44	13	22	(
23	Density -- Aggreg. Construction	Roadway Mile	12	0	12	(
24	Gradation -- Aggreg. Construction	1,000 Ton	1	0	1	(
25	Weigh Aggregate Materials	1,000 Ton	5	2	2	(
26	Check for Agg. Materials	1,000 Ton	5	2	2	(
27	Aggregate Construction -- Office	Roadway Mile	2	0	0	(
ASPHALT PAVNG						
31	Asphalt Paving Inspection	1,000 Tons	6	2	3	
32(1)	Asphalt Plant Inspection	1,000 Tons	7	2	4	
33(1)	Weigh/Check Asphalt Mix.	1,000 Tons	10	3	5	
34	Asphalt Paving - Office	1,000 Tons	2	0	0	
PCC PAVING						
41	Portland Cement Concrete Paving Inspection	1,000 Sq. Yds.	4	1	2	
42(1)	PCC Plant - Paving	1,000 Sq. Yds.	3	1	2	
43	Joint Repair Inspection	100 Sq. Yds.	22	0	11	
44	PCC Paving - Office	1,000 Sq. Yds.	1	0	0	
STRUCTURE						
51	Structure Staking	Bent	24	6	6	
52	Structure Inspection	Span-Lane	63	0	0	
53(1)	PCC Plant -- Structure	Span-Lane	12	0	0	
54	Structure -- Office	Span-Lane	18	0	0	
MISCELLANEOUS						
61	Staking Misc. Items	Roadway Mile	23	6	8	
62	Inspection for Misc. Items	Roadway Mile	26	7	26	
63	Office Work for Misc. Items	Roadway Mile	34	0	0	

* Manhours/Planning Unit

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Bridge Replacement

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban
GENERAL					
81(2)	General Office Work	Insp. MH	15%		
82	Project Super. and Management	MH Act. 01-81	10%		
83	Standby	MH Act. 01-81	02%		
84(3)	Travel				
	One Way				
	0 - 15 Min.	Staking & Insp. MH	0%		
	20 - 45 Min.	Staking & Insp. MH	15%		
	More Than 45	Staking & Insp. MH	25%		

* Manhours/Planning Unit

(1) Central inspection activities (District 5 and 9 only) omit activities 32, 42, 53, and 50% of 33.

(2) The Planning Unit for Activity Code 81 is the sum of the manhours required for Activity Codes 04, 05, 06, 12, 15, 22, 23, 24, 25, 26, 31, 32, 33, 41, 42, 43, 52, 53, and 62.

(3) The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Codes 01, 02, 03, 11, 14, 21, 51, 61, plus the Planning Unit for Activity Code 81.

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Widening & Resurfacing

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban
EARTHWORK					
01	Roadway Layout Staking	Roadway Mile	61	15	15
02	Cross Sectioning & Slope Staking	Roadway Mile	38	10	10
03	Grade Control -- Subgrade	Roadway Mile	51	10	10
04	Removal and Relocation Inspection	Roadway Mile	6	0	9
05	Earthwork Inspection	Roadway Mile	18	5	18
06	Density -- Earthwork & Drainage	Roadway Mile	30	0	30
07	Preparation for Const.-- Office	Roadway Mile	20	0	20
08	Earthwork -- Office	Roadway Mile	40	0	0
DRAINAGE					
11	Drainage Structure Staking	Roadway Mile	27	4	9
12	Drainage Structure Inspection	Roadway Mile	22	6	44
13	Drainage Structure -- Office	Roadway Mile	17	0	4
14	Cast-in-Place Box Culvert Staking	Each	12	2	4
15	Cast-in-Place Box Culvert Inspection	Each	35	9	9
16	Cast-in-Place Box Culvert -- Office	Each	11	0	0
AGGREGATE					
21	Line/Grade Control -- Aggreg. Const/Paving	Roadway Mile	30	5	8
22	Aggregate Construction Inspection	1,000 Ton	6	0	2
23	Density -- Aggreg. Construction	Roadway Mile	12	0	12
24	Gradation -- Aggreg. Construction	1,000 Ton	1	0	1
25	Weigh Aggregate Materials	1,000 Ton	6	0	2
26	Check for Agg. Materials	1,000 Ton	6	0	2
27	Aggregate Construction -- Office	Roadway Mile	1	0	0
ASPHALT PAVING					
31	Asphalt Paving Inspection	1,000 Tons	9	2	2
32(1)	Asphalt Plant Inspection	1,000 Tons	9	2	2
33(1)	Weigh/Check Asphalt Mix.	1,000 Tons	13	3	3
34	Asphalt Paving - Office	1,000 Tons	2	0	0
PCC PAVING					
41	Portland Cement Concrete Paving Inspection	1,000 Sq. Yds.	6	2	2
42(1)	PCC Plant - Paving	1,000 Sq. Yds.	5	1	1
43	Joint Repair Inspection	100 Sq. Yds.	22	0	11
44	PCC Paving - Office	1,000 Sq. Yds.	1	0	0
STRUCTURE					
51	Structure Staking	Bent	5	1	0
52	Structure Inspection	Span-Lane	61	15	0
53(1)	PCC Plant -- Structure	Span-Lane	15	4	0
54	Structure -- Office	Span-Lane	20	0	0
MISCELLANEOUS					
61	Staking Misc. Items	Roadway Mile	23	6	8
62	Inspection for Misc. Items	Roadway Mile	26	7	13
63	Office Work for Misc. Items	Roadway Mile	6	0	0

* Manhours/Planning Unit

TABLE OF ACTIVITY PLANNING STANDARDS
Contract Type - Widening & Resurfacing

Code	Description	Planning Unit	* Base Planning Value	Modifier Under Traffic	Modifier Urban
GENERAL					
81(2)	General Office Work	Insp. MH	15%		
82	Project Super. and Management	MH Act. 01-81	10%		
83	Standby	MH Act. 01-81	02%		
84(3)	Travel				
	One Way				
	0 - 15 Min.	Staking & Insp. MH	0%		
	20 - 45 Min.	Staking & Insp. MH	15%		
	More Than 45	Staking & Insp. MH	25%		

* Manhours/Planning Unit

(1) Central inspection activities (District 5 and 9 only) omit activities 32, 42, 53, and 50% of 33.

(2) The Planning Unit for Activity Code 81 is the sum of the manhours required for Activity Codes 04, 05, 06, 12, 15, 22, 23, 24, 25, 26, 31, 32, 33, 41, 42, 43, 52, 53, and 62.

(3) The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Codes 01, 02, 03, 11, 14, 21, 51, 61, plus the Planning Unit for Activity Code 81.

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TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Resurfacing

PLANNING ACTIVITY		PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER	
CODE	DESCRIPTION			UNDER TRAFFIC	URBAN
AGGREGATE					
21	Line/Grade Control -- Agg. Const. Pvg.	Roadway Mile	16	2	4
22	Aggreg. Construction Insp.	1,000 Ton	9	0	2
23	Density -- Aggregate Construction	Roadway Mile	8	0	8
24	Gradation -- Aggregate Construction	1,000 Ton	2	0	2
25	Weigh Aggregate Materials	1,000 Ton	9	0	2
26	Checker for Agg. Materials	1,000 Ton	8	0	2
27	Aggregate Construction -- Office	Roadway Mile	1	0	0
ASPHALT PAVING					
31	Asphalt Paving Inspection	1,000 Tons	6	2	2
32(1)	Asphalt Plant Inspection	1,000 Tons	7	2	2
33(1)	Weigh/Check Asphalt Material	1,000 Tons	10	2	2
34	Asphalt Paving -- Office	1,000 Tons	2	0	0
PCC PAVING					
43	Joint Repair Inspection	100 Sq. Yds.	22	0	11
MISCELLANEOUS					
61	Staking for Miscellanous Items	Roadway Mile	8	0	4
62	Inspection for Miscellaneous Items	Roadway Mile	26	0	13
63	Office work for Miscellaneous Items	Roadway Mile	5	0	2
64	R/W Staking and Monumentation	Roadway Mile	60	0	60
65	Staking Turn Lanes	Turn Lane	8	0	8
66	Inspection for Turn Lanes	Turn Lane	7	0	7
67	Office Work for Turn Lanes	Turn Lane	3	0	0

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TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Resurfacing (Continued)

GENERAL				
81(2)	General Office Work		Inspection MH	10%
82	Project Supervision and Management		MH Act. 01-81	10%
83	Standby		MH Act. 01-81	02%
84(3)	Travel	One Way		
		0 - 15 Min.	Stkg. & Insp. MH	0%
		20 - 45 Min.	Stkg. & Insp. MH	15%
		More Than 45	Stkg. & Insp. MH	25%

* Manhours/Planning Unit

(1) Central inspection activities (Districts 5 and 9 only) omit activities 32, and 50% of 33.

(2) The Planning Unit for Activity Code 81 is the sum of the manhours required for Activity Codes 22, 23, 24, 25, 26, 31, 32, 33, 43, 62 and 66.

(3) The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Codes 21, 22, 23, 24, 25, 26, 31, 32, 33, 43, 61, 62, 64, 65 and 66.

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TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Bridge Repair

PLANNING ACTIVITY CODE	DESCRIPTION	PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER UNDER TRAFFIC	MODIFIER URBAN
STRUCTURE					
51	Structure Staking	Span	10	10	0
52	Structure Inspection	Working Day	10	2	0
GENERAL					
81	General Office Work	Working Day	3	0	0
82	Project Supervision and Management	MH Act. 01-81	15%		
83	Standby	MH Act. 01-81	02%		
**84	Travel One Way				
	0 - 15 Min.	Stkg. & Insp. MH	0%		
	20 - 45 Min.	Stkg. & Insp. MH	15%		
	More Than 45	Stkg. & Insp. MH	25%		

* Manhours/Planning Unit

** The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Code 51 and 52.

Revised 2/6/81

TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Intersection Improvements

PLANNING ACTIVITY		PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER	
CODE	DESCRIPTION			UNDER TRAFFIC	URBAN
MISCELLANEOUS					
61	Staking Miscellaneous Items	Working Day	8	3	0
62	Inspection of Miscellaneous Items	Working Day	15	0	4
GENERAL					
81	General Office Work	Working Day	2	0	0
82	Project Supervision and Management	MH Act. 01-81	15%		
83	Standby	MH Act. 01-81	02%		
**84	Travel One Way				
	0 - 15 Min.	Stkg. & Insp. MH	0%		
	20 - 45 Min.	Stkg. & Insp. MH	15%		
	More Than 45	Stkg. & Insp. MH	25%		

* Manhours/Planning Unit

** The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Code 61 and 62.

Revised 2/6/81

TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Safety and Traffic Control

PLANNING ACTIVITY		PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER	
CODE	DESCRIPTION			UNDER TRAFFIC	URBAN
MISCELLANEOUS					
61	Staking Miscellaneous Items	Working Day	1	0	0
62	Inspection of Miscellaneous Items	Working Day	6	0	3
GENERAL					
81	General Office Work	Working Day	2	0	0
82	Project Supervision and Management	MH Act. 01-81	15%		
83	Standby	MH Act. 01-81	02%		
**84	Travel One Way				
	0 - 15 Min.	Stkg. & Insp. MH	0%		
	20 - 45 Min.	Stkg. & Insp. MH	15%		
	More Than 45	Stkg. & Insp. MH	25%		

* Manhours/Planning Unit

** The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Code 61 and 62.

Revised 2/6/81

TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Miscellaneous

PLANNING ACTIVITY CODE	DESCRIPTION	PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER UNDER TRAFFIC	MODIFIER URBAN
MISCELLANEOUS					
61	Staking Miscellaneous Items	Working Day	1	0	0
62	Inspection of Miscellaneous Items	Working Day	9	0	0
GENERAL					
81	General Office Work	Working Day	2	0	0
82	Project Supervision and Management	MH Act. 01-81	15%		
83	Standby	MH Act. 01-81	02%		
**84	Travel One Way				
	0 - 15 Min.	Stkg. & Insp. MH	0%		
	20 - 45 Min.	Stkg. & Insp. MH	15%		
	More Than 45	Stkg. & Insp. MH	25%		

* Manhours/Planning Unit

** The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Code 61 and 62.

Revised 2/6/81

TABLE OF ACTIVITY PLANNING STANDARDS

Contract Type - Unique

PLANNING ACTIVITY		PLANNING UNIT	* BASE PLANNING VALUE	MODIFIER	
CODE	DESCRIPTION			UNDER TRAFFIC	URBAN
MISCELLANEOUS					
71	Special Feature Staking	Lump Sum (Estimate)			
72	Special Feature Inspection	Lump Sum (Estimate)			
73	Special Feature Office	Lump Sum (Estimate)			
GENERAL					
81	General Office Work	Lump Sum (Estimate)			
82	Project Supervision and Management	Lump Sum (Estimate)			
83	Standby	MH Act. 01-81	02%		
**84	Travel One Way				
	0 - 15 Min.	Stkg. & Insp. MH	0%		
	20 - 45 Min.	Stkg. & Insp. MH	15%		
	More Than 45	Stkg. & Insp. MH	25%		

* Manhours/Planning Unit

** The Planning Unit for Activity Code 84 is the sum of the manhours required for Activity Code 71 and 72.

Revised 2-6-81

PART THREE
Scheduling

The third element of the Construction Engineering Manpower Management System is scheduling.

Manpower scheduling is essential for proper project management and promotes efficient use of assigned personnel.

Benefits derived from manpower scheduling include:

- Personnel excesses or deficiencies become apparent early.
- Engineers and Project Supervisors become more familiar with the Contractor's sequence of operations.
- Project personnel can be given secondary assignments for those times when the Contractor's work schedule is interrupted.
- Minimizes standby time and maximizes use of available personnel.
- Improves communication which inturn improves the supervisor-employee relationship.
- Facilitates the monitoring function, since the activity codes are shown on the scheduling form.

The Project Engineer is responsible for planning the manpower schedule. The Construction Project Manpower Schedule should be completed on Thursday of each week for the coming week. Each Resident Office should inform the District Office of manpower excesses or deficiencies that become apparent when planning the schedule. The Construction Project Manpower Schedule is only used at the project management level. A sample schedule is shown on page 3-2.

The scheduling function is not essential to the operation of the system and if it is not used will have very little effect on the information generated by the monitoring function. However, scheduling is a good management practice and it is recommended that it be used as much as possible. The scheduling system discussed in this section of the manual can be used as a guide.

PART FOUR
Monitoring

The fourth element of the Construction Engineering Manpower Management System is monitoring.

Monitoring provides for evaluating work performance, staffing, construction progress, and for making staffing adjustments when necessary. It also provides data for upgrading the standard planning values.

Construction engineering performance on each contract should be monitored and controlled by the Project/Resident Engineer. The District will monitor manpower usage and work accomplishment through the Bi-Weekly Construction Project Manpower Report.

The first step in monitoring is the completion of the Bi-Weekly Construction Activity Report. This report is completed by each person working on a project. These reports should be kept current on a daily basis and turned in at the end of each pay roll period to the person in the Resident Office responsible for collecting this report. The field personnel using these reports should be given a copy of the Individual Planning Activity definitions (pages 1-8 to 1-16) and instructions for their use. A suggested handout is shown in Appendix C. A completed Bi-Weekly Construction Activity Report is shown on page 4-2. A list of the Activity Codes to be used on a project should be made available to all personnel working on that project so that only those Activities which were used on the Construction Project Manpower Planning Report are used for monitoring. A sample form to use for this purpose is shown on page C-3.

Revised 2-6-81

BI-WEEKLY CONSTRUCTION ACTIVITY REPORTS

Each employee involved in field or office work will complete this report each payroll period and submit it to the office with his time sheet. All time should be recorded to the nearest whole hour. As the Bi-Weekly Construction Activity Report is the first step in monitoring the manpower used on a project, it is important that it be filled out accurately and turned in on time. A sample of the completed report is shown below.

Note: A separate report should be filled out for each contract on which the employee has worked during the payroll period.

BI-WEEKLY CONSTRUCTION ACTIVITY REPORT

S.P. 5508-38

PAY PERIOD ENDING TUESDAY, May 22 , 19 79

NAME John Q. Inspector

CLASS TITLE Intermediate Highway Technician

ACTIVITY CODE	9 W	10 T	11 F	12 S	13 S	14 M	15 T	16 W	17 T	18 F	19 S	20 S	21 M	22 T	TOTAL
52	4	7	3	6		5	8		1	4					38
53	5	2						2	7		8		4	3	31
54	1		2			2		2		4					11
15			5	3		1		4	1				4	3	21
16				1		1		1						1	4

APPENDIX "C"

Examples of Computer Printouts

Reports printed by the Computer are 17 inches wide and are difficult to reproduce. Consequently, only examples of the computer printouts are shown in this appendix.

Revised 2-6-81

CONSTRUCTION PROJECT MANPOWER PLANNING REPORT

Contract Type Construction
Project Location & Description In Fillmore County, 3.8 miles S. of Spring Valley - Grading, Bit. Surface & Bridge

District 6
S.P. 2313-10 T.H. 53
Prop. Letting Date 2/24/78
Date Prepared 3/1/78

CODE	PLANNING ACTIVITY	PLANNING UNIT	NUMBER OF PLANNING UNITS	X STANDARD PLANNING VALUE (M-HRS/UNIT)	= MAN-HOURS REQUIRED	/ MAN-HOURS PER MAN-MONTH	= EQUIVALENT MAN-MONTHS
EARTHWORK							
01	Roadway Layout Staking	Roadway Mile	1.0	127	127	173	0.7
02	Cross Sectioning & Slope Staking	Roadway Mile	1.0	68	68	173	0.4
03	Grade Control -- Subgrade	Roadway Mile	1.0	64	64	173	0.4
04	Removal & Relocation Inspection	Roadway Mile	1.0	17	17	217	0.1
05	Earthwork Inspection	10,000 CY RM	4.6	8	37	217	0.2
06	Density -- Earthwork & Drainage	Roadway Mile	1.0	25	25	217	0.1
07	Preparation for Constr. - Office	Roadway Mile	1.0	21	21	173	0.1
08	Earthwork -- Office	Roadway Mile	1.0	44	44	173	0.3
	Total Earth Work Activities						2.3
DRAINAGE							
11	Drainage Structure Staking	Roadway Mile	1.0	43	43	173	0.2
12	Drainage Structure Inspection	Roadway Mile	1.0	18	18	217	0.1
13	Drainage Structure - Office	Roadway Mile	1.0	11	11	173	0.1
14	C.I.P. Box Culvert Staking	Each	0			173	
15	C.I.P. Box Culvert-Inspection	Each	0			217	
16	C.I.P. Box Culvert-Office	Each	0			173	
	Total Drainage Activities						0.4
AGGREGATE							
21	Line/Grade Control -- Aggregate Construction/Paving	Roadway Mile	1.0	53	53	173	0.3
22	Aggregate Construction Inspection	1,000 Tons	1.0	44	44	217	0.2
23	Density -- Aggreg. Construction	Roadway Mile	1.0	12	12	217	0.1
24	Gradation -- Aggreg. Construction	1,000 Tons	1.0	1	1	217	0.0
25	Weigh Aggregate Materials	1,000 Tons	0.0	5	0	217	0.0
26	Check for Aggregate Materials	1,000 Tons	0.0	5	0	217	0.0
27	Aggregate Construction -- Office	Roadway Mile	1.0	2	2	173	0
	Total Aggregate Activities						0.6
ASPHALT PAVING							
31	Asphalt Paving Inspection	1,000 Tons	3.4	6	20	217	0.1
32	Asphalt Plant Inspection	1,000 Tons	3.4	7	24	217	0.1
33	Weigh Asphalt Mixture	1,000 Tons	3.4	10	34	217	0.2
34	Asphalt Paving -- Office	1,000 Tons	3.4	2	7	173	0.0
	Total Asphalt Paving Activities						0.4

CODE	PLANNING ACTIVITY	PLANNING UNIT	NUMBER OF PLANNING UNITS	X	STANDARD PLANNING VALUE (M-HRS/UNIT)	= MAN-HOURS REQUIRED	/ MAN-HOURS PER MAN-MONTH	= EQUIVALENT MAN-MONTHS
PCC PAVING								
41	Portland Cement Concrete Paving Inspection	1,000 S.Y.	0				217	
42	PCC Plant -- Paving	1,000 S.Y.	0				217	
43	Joint Repair Inspection	100 S.Y.	0				217	
44	PCC Paving -- Office	1,000 S.Y.	0				173	
	Total PCC Paving Activities							
STRUCTURE								
51	Structure Staking	Bent or Span	2		22	44	173	0.3
52	Structure Inspection	Span Lane or WD	8		58	464	173	2.7
53	PCC Plant -- Structure	Span Lane	8		11	88	173	0.5
54	Structure -- Office	Span Lane	8		16	128	173	0.7
	Total Structure Activities							4.2
MISCELLANEOUS								
61	Staking for Miscellaneous Items	Rdwy Mi. or WD	1.0		23	23	173	0.1
62	Inspection for Misc. Items	Rdwy Mi. or WD	1.0		30	30	217	0.1
63	Office Work for Miscellaneous Items	Rdway Mi. or WD	1.0		34	34	173	0.2
64	R/W Staking and Monumentation	Roadway Mile					173	
65	Staking Turn Lanes	Turn Lanes					173	
66	Inspection for Turn Lanes	Turn Lanes					173	
67	Office Work for Turn Lanes	Turn Lanes					173	
	Total Miscellaneous Activities							0.4
SPECIAL FEATURES								
71	Special Feature Staking	Lump Sum	Est.				173	
72	Special Feature Inspection	Lump Sum	Est.				217	
73	Special Feature -- Office	Lump Sum	Est.				173	
	Total Spec. Features Activities							
GENERAL								
81	General Office Work	MH Insp. Act, WD L. Sum	814		15 %MH	122	173	0.7
82	Project Supervision & Management	MH Act.01-81	1605		10 %MH	161	173	0.9
83	Standby	MH Act.01-81	1605		2 %MH	32	173	0.2
84	Travel	MH Stkg.&Insp.	1236		15 %MH	185	173	1.1
	Total General Activities							2.9
	Total Project Activities							11.2

Prepared by _____

Revised 2-6-81

ANNUAL CONSTRUCTION PROJECT STAFFING PLAN

PROJECT LOCATION _____

DESCRIPTION _____

District _____
S.P. 2313-10 T.H. 63
Prop. Letting Date 2/24/78
Est.Comp.Date 10/30/78
Date Prepared 3/1/78
Planning Year 1978

Code	Planning Activity	Plan Equiv. Man-Mo	Man-Mo. Used To Date	Man-Months Remain	Man-Months Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Cur. Year Est.	Bal. to Compl.
01	Rdwy. Layout Staking	0.7	0	0.7					0.2	0.2	0.1	0.1	0.0	0.1			0.7	0
02	X-Sec. & Slope Staking	0.4	0	0.4					0.2	0.2							0.4	0
03	Grade Control-Subgrade	0.4	0	0.4						0.2			0.2				0.4	0
04	Removal & Rel.Insp.	0.1	0	0.1						0.1							0.1	0
05	Earthwork Inspection	0.2	0	0.2						0.1		0.1					0.2	0
06	Density-Earth.&Drainage	0.1	0	0.1						0.1							0.1	0
07	Prep.for Const.-Office	0.1	0	0.1					0.1								0.1	0
08	Earthwork-Office	0.3	0	0.3						0.1	0.1	0.1					0.3	0
11	Drainage Struct.Staking	0.2	0	0.2						0.2							0.2	0
12	Drainage Struct.Insp.	0.1	0	0.1							0.1						0.1	0
13	Drainage Struct. Office	0.1	0	0.1										0.1			0.1	0
14	Box Culvert-Staking																	
15	Box Culvert-Inspection																	
16	Box Culvert-Office																	
21	Line/Grade Control-Agg.	0.3	0	0.3								0.1	0.2				0.3	0
22	Aggregate Const. Insp.	0.2	0	0.2								0.1	0.1				0.2	0
23	Density-Aggreg.Const.	0.1	0	0.1									0.1				0.10	
24	Gradation-Aggreg.Const.																	
25	Weigh Aggregate Mat'l.																	
26	Check/Aggreg. Mat'l.																	
27	Aggregate Const.-Office																	

Code	Planning Activity	Plan Equiv. Man-Mo	Man-Mo. Used To Date	Man-Months Remain	Man-Months Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Cur. Year Est.	Bal. to Compl.
31	Asphalt Paving Insp.	0.1	0	0.1									0.1				0.1	0
32	Asphalt Plant Insp.	0.1	0	0.1									0.1				0.1	0
33	Weigh Asphalt Mixture	0.2	0	0.2									0.2				0.2	0
34	Asphalt Paving-Office																	
41	Portland Cem.Conc.Pav.																	
42	PCC Plant-Paving																	
43	Joint Repair Inspec.																	
44	PCC Paving-Office																	
51	Structure Staking	0.3	0	0.3						0.1	0.1	0.1					0.3	0
52	Structure Inspection	2.7	0	2.7						1.0	1.0	0.7					2.7	0
53	PCC Plant-Structure	0.5	0	0.5						0.2	0.2	0.1					0.5	0
54	Structure-Office	0.7	0	0.7						0.1	0.1	0.2	0.3				0.7	0
61	Staking for Misc.Items	0.1	0	0.1													0	0.1
62	Insp.for Misc. Items	0.1	0	0.1													0	0.1
63	Office Work for Misc.It	0.2	0	0.2													0	0.2
64	R/W Stak.& Monument.																	
65	Staking Turn Lanes																	
66	Inspection/Turn Lanes																	
67	Office Work/Turn Lanes																	
71	Special Feature Staking																	
72	Special Feature Insp.																	
73	Special Feature Office																	
81	General Office Work	0.7	0	0.7						0.1	0.1	0.1	0.1	0.2			0.6	0.1
82	Project Superv.&Manage.	0.9	0	0.9					0.1	0.1	0.2	0.1	0.1	0.1			0.7	0.2
83	Standby	0.2	0	0.2								0.1	0.1				0.2	0
84	Travel	1.1	0	1.1					0.1	0.2	0.2	0.2	0.2	0.1			1.0	0.1
85	Training & Equip.Maint.	0.1	0	0.1										0.1			0.1	
	Total Project Act.	11.0	0	11.0					0.7	3.0	2.2	2.1	1.8	0.7			10.5	0.8

Original - A.D.E.
Copy - Project File

ANNUAL DISTRICT CONSTRUCTION STAFFING SUMMARY

District	6
Year	1979
Date Prepared	1/3/79

S.P. NUMBER	MAN-MONTH DISTRIBUTION											
	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
2313-10					0.7	3.0	2.2	2.1	1.8	0.7		
5508-28	0.4	0.2	0.2	0.6	0.9	1.3	0.3	0.0	0.0	0.0	0.0	0.0
2001-10	0.2	0.3	0.2	5.1	4.2	4.0	3.2	3.4	4.5	2.9	1.2	0.7
2510-9103	0	0	0	0	0.5	1.3	2.4	2.4	1.1	1.2	0.6	0.3
5507-24	0.5	0.4	0.9	2.1	4.3	5.1	6.0	5.8	5.8	5.2	4.0	2.1
5507-25	0.3	0.0	0.0	0.2	0.5	0.9	0.9	0.3	0.2	0.1	0.0	0.0
5510-42	0.0	0.2	0.3	0.3	0.9	1.0	1.0	1.0	1.0	1.0	0.7	0.2
5507-10	2.1	2.1	2.1	3.2	4.0	6.1	5.5	7.2	7.9	7.8	5.1	1.6
TOTAL PROJECT ACTIVITIES	3.5	3.2	3.7	11.5	16.0	22.7	21.5	22.2	22.3	18.9	11.6	4.9
% LEAVE & HOLIDAY	20.9	21.0	17.9	21.6	12.4	13.7	14.5	13.0	14.7	18.7	19.5	39.0
LEAVE & HOLIDAY MAN-MOS.	0.7	0.7	0.6	2.5	2.5	3.1	3.1	3.0	3.3	3.4	2.1	1.9
TOTAL REQ'D.MAN-MOS.	4.2	3.9	4.3	14.0	18.5	25.8	24.6	25.2	25.6	22.3	13.7	6.8
AVAILABLE MAN-MOS.	20	20	20	20	20	20	20	20	20	20	20	20
EXCESS OR DEFICIENCY	+ 15.8	+ 16.1	+ 15.7	+6.0	+1.5	5.8	-4.6	-5.2	-5.6	-2.3	+6.3	+ 13.2

Original - C.O.
Copy - District File

Revised 2-6-81

CONSTRUCTION PROJECT MANPOWER SCHEDULE

S.P. 2313-10

For the Week Beginning May 14, 1979

PRIMARY ASSIGNMENT												SECONDARY ASSIGNMENT		
ACTIVITY		Remarks, Location	Name	HOURS								ACTIVITY		Remarks, Location
Code	Title	Spec.Inst.,Etc.	Starting Time	S	M	T	W	T	F	S		Code	Title	Spec.Equip.,Etc.
5	Earthwork Inspection	Entire Project	Randy H. 7:00		10	10	5	10	10	10		13	Final quantities RecomputeBedding	Culverts at 2+00 3+50,4+10,8+50
6	Density	Entire Project	Randy H. 7:00				5							
3	Subgrade B.T.s	SBL 1+00 to 28+00	Glenn P. 7:00		8			8				02	X-Section	
1	Grade - Paving	SBL 0+00 to 28+00	Glenn P. 7:00			8	8		8				Borrow Pit	
3	Subgrade B.T.s	SBL 1+00 to 28+00	Carl S. 7:00		8			8				02	Borrow Pit	
1	Grade - Paving	SBL 0+00 to 28+00	Carl S. 7:00			8	8		8					
3	Subgrade B.T.s	SBL 1+00 to 28+00	Steve S. 7:00		8			8				02	Borrow Pit	
1	Grade - Paving	SBL 0+00 to 28+00	Steve S. 7:00			8	8		8					
12	Drainage Insp.	Entire Project	Roger B. 7:00		5	5	5	5	5	5		13	Work with Randy	Above
15	C.I.P. Box Culv.	SBL 49+50	Roger B. 7:00		5	5	5	5	5	5				
53	Ready Mix Plant	Bridge 9069, 9033	Robert P. 7:00			4			4			52	Structure Insp.	Br. 9069,9033
52	Structure Insp.	Bridge 9069, 9033	Jim E. 7:00		10	10	10	10	10			54	Structure Office	Finals Br. 9069
52	Structure Insp.	Bridge 9069, 9033	Karl A. 7:00		10	10	10	10	10			54	Structure Office	Finals Br. 9069

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BI-WEEKLY CONSTRUCTION PROJECT MANPOWER REPORT

Report No.
S.P.
Period Ending

PROJECT LOCATION AND DESCRIPTION_____

CODE	PLANNING ACTIVITY	MANHOURS PLANNED	USED TO DATE	REMAINING	PERCENT USED	REMARKS*
EARTHWORK						
01	Roadway Layout Staking	127	138	-11	109	
02	Cross Sectioning & Slope Staking	68	52	16	76	
03	Grade Control -- Subgrade	64	70	- 6	109	
04	Removal & Relocation Inspection	17	15	2	88	
05	Earthwork Inspection	37	60	-23	162	Contr.moving borrow with 2TS14 Scrapers
06	Density -- Earthwork & Drainage	25	25	0	100	
07	Preparation for Construction-Office	21	20	1	95	
08	Earthwork -- Office	44	35	9	80	
DRAINAGE						
11	Drainage Structure Staking	43	25	18	58	
12	Drainage Structure Inspection	18	20	- 2	111	
13	Drainage Structure - Office	11	8	3	73	
14	C.I.P. Box Culvert Staking	0				
15	C.I.P. Box Culvert-Inspection	0				
16	C.I.P. Box Culvert-Office	0				
AGGREGATE						
21	Line/Grade Control -- Aggregate Construction/Paving	53	62	- 9	117	
22	Aggregate Construction Inspection	44	35	9	18	All aggregate placed in one day
23	Density- Aggreg. Construction	20	30	-10	150	Had gradation problems
24	Gradation-Aggreg. Construction					
25	Weigh Aggregate Materials					
26	Check for Aggregate Materials					
27	Aggregate Construction -- Office	2	6	- 4	300	
ASPHALT PAVING						
31	Asphalt Paving Inspection	20	36	-16	180	Contr. did not have enough trucks hauling mix to keep paver going steady
32	Asphalt Plant Inspection	24	29	- 5	121	
33	Weigh/Check Asphalt Mixture	34	44	-10	129	
34	Asphalt Paving -- Office	7	5	2	71	

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CODE	PLANNING ACTIVITY	MANHOURS PLANNED	USED TO DATE	REMAINING	PERCENT USED	REMARKS*
PCC PAVING						
41	Portland Cement Concrete Paving Insp.	0	0	0	0	
42	PCC Plant -- Paving	0	0	0	0	
43	Joint Repair Inspection	0	0	0	0	
44	PCC Paving -- Office	0	0	0	0	
STRUCTURE						
51	Structure Staking	44	50	- 6	114	
52	Structure Inspection	464	432	32	93	
53	PCC Plant -- Structure	88	98	-10	111	
54	Structure -- Office	128	125	3	98	
MISCELLANEOUS						
61	Staking for Miscellaneous Items	23	20	3	87	
62	Inspection for Misc. Items	30	35	5	117	
63	Office Work for Misc. Items	34	30	4	88	
64	R/W Staking and Monumentation					
65	Staking Turn Lanes					
66	Inspection for Turn Lanes					
67	Office Work for Turn Lanes					
SPECIAL FEATURES						
71	Special Feature Staking	0	0	0	0	
72	Special Feature Inspection	0	0	0	0	
73	Special Feature -- Office	0	0	0	0	
GENERAL						
81	General Office Work	123	112	11	91	
82	Project Supervision & Management	161	150	11	93	
83	Standby	32	50	-18	188	2 breakdowns at bit. plant.
84	Travel	186	220	-34	118	
85	Training & Equipment Maintenance	16	10	6	63	
	Total Project Activities	2008	2047	-39	102	

	Planned	Used to Date	Remaining	% Used
CONTRACT TIME (Working Days)	85	80.1	4.9	94%
CONTRACTOR PAYMENTS (Dollars) (Estimated)	885,400	372,860		97%

Project is complete except for sodding and seeding and misc. cleanup

*The "Remarks" column is used to explain significant overruns, underruns, and to note completed items.

Original - A.D.E.
Copy - Project Engineer - Project File

Prepared by_____
Project Engineer_____

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION
HIGHWAY STATEWIDE
MONTHLY CONSTRUCTION PAYMENTS AND ENGINEERING COSTS SAMPLE REPORT

DISTRICT LOCATION PERIOD ENDING DATE	FUNDS ENCUMBERED CERTIFIED % CERTIFIED	FUNDS USED THIS PERIOD	PERSONAL EXPENSE THIS PERIOD TO DATE	ENGINEERING COSTS THIS PERIOD TO DATE % *	WORKING DAYS PLANNED USED TO DATE % USED	MANHOURS PLANNED USED TO DATE % USED
DISTRICT 1	$3500000		$0	$50000	4000	9000
Duluth	$2000000	$200000	$0	$150000	2500	6000
Period Ending Date 10-09-81	57.1%			7.5%	62.5%	66.6%
DISTRICT 2	$4500000		$0	$20000	4500	8000
Bemidji	$3000000	$150000	$0	$250000	3000	7000
Period Ending Date 10-09-81	66.6%			8.3%	66.6%	87.%
DISTRICT 3	$2500000		$0	$10000	3000	7500
Brainard	$2000000	$50000	$0	$200000	2500	6000
Period Ending Date 09-25-81	80.0%			10.0%	83.3%	80.0%
DISTRICT 4	$5000000		$0	$50000	5000	10000
Detroit Lakes	$2500000	$300000	$0	$300000	2500	6000
Period Ending Date 09-25-81	50.0%			12.0%	50.0%	60.0%
District 5	$10000000		$3500	$150000	6000	15000
Golden Valley	$6000000	$1000000	$15000	$700000	4000	12000
Period Ending Date 10-9-81	60.0%			11.9%	66.6%	80.0%
District 6	$8000000		$0	$20000	750	1250
Rochester	$3500000	$50000	$0	$50000	450	900
Period Ending Date 10-09-81	43.7%			14.2%	60.0%	72.0%
TOTALS	$33500000	$1750000	$3500	$300000	23250	50750
	$19000000		$15000	$165000	14950	37900
AVERAGE OF ALL DISTRICTS	59.6%			10.7%	64.8%	74.3%

*Expressed as a % of funds certified

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION
HIGHWAY DISTRICT
MONTHLY CONSTRUCTION PAYMENTS AND ENGINEERING COSTS

RESIDENT ENGINEER: DAVE TROOIEN

SAMPLE REPORT

LOW S.P. T.H. LOCATION TYPE OF WORK: CONTRACTOR: STARTING DATE//PERIOD ENDING	FUNDS ENCUMBERED CERTIFIED % CERTIFIED	FUNDS USED THIS PERIOD	PERSONAL EXPENSE THIS PERIOD TO DATE	ENGINEERING COSTS THIS PERIOD TO DATE % *	WORKING DAYS PLANNED USED TO DATE % USED	MANHOURS PLANNED USED TO DATE % USED
S.P. 0702 T.H. 14 On T.H. 14 from Eagle Lake to Waseca Seal Coat Maintenance Project Miscellaneous Lindin Construction Co., Inc. 8/17/81 // 9/28/81	$97497 $97148 99.6%	$5000	$0 $171.24	$6800 7.0%	14 10 71.4%	199 205 103.0%
S.P. 0702-73 T.H. Completed District 7 Various Locations Safety & Traffic Control Dieseth Specialty Co. 5/19/81 // 10/6/81	$129467 $125075 96.6%	$7200	$0 $0	$824 $10036 8.0%	45 38 84.4%	553 581 105.1%
S.P. 0704-5959 T.H. 22 Over Cobb River 5.3 Mile No. Jct. TH 30 & Over LeSueur River 5.3 Mi. So. Jct. 60 Deck Repairs Reconstruction Glenwood Bridge, Inc. 6/15/81 // 10/6/81	$465070 $348078 74.8%	$10000	$117.40 $642.80	$1406.40 $18021 5.4%	85 74 87.0%	1675 1081 64.5%
TOTALS (PERIOD ENDING 10/6/81) AVERAGE % 3 PROJECTS	$692034 $570301 82.4%	$22200	$117.40 $814.04	$2230.40 $34857 6.8%	144 122 80.9%	2427 1867 90.9%

*Expressed as a % of funds certified.