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A METHODOLOGY FOR THE DETERMINATION OF CONTRACT MANPOWER EQUIVALENTS FOR THE UNITED STATES AIR FORCE

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THESIS

Submitted To The Graduate School
of
West Virginia University
In Partial Fulfillment Of The Requirements For
The Degree Of Master Of Science In Industrial Engineering

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by

Robert E. Corsi, Jr., B.M.E.

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CHAPTER I

DESCRIPTION OF THE PROBLEM

Introduction

The end of American combat involvement in the Vietnam War and the reduction of cold war tensions in recent years have contributed to a significant change in the composition of the Federal budget. Defense outlays remained virtually constant from 1968 to 1974, despite substantial cost increases and the pay raises which have accompanied the transition to an all-volunteer armed force. These added costs were offset by large savings resulting from reductions in men and materials. Defense costs have been a decreasing share of the national budget, falling from 44% of Federal spending in 1969 to an estimated 29% in 1975.

Conversely, Federal nondefense spending has increased from 56% of Federal spending in 1969 to 71% in the 1975 budget. In the process, the form that Federal spending takes has shifted dramatically away from support for direct Federal operations and toward benefit payments to individuals and grants to State and local governments (14,5). Figure 1.1 illustrates the "Budget Dollar" for Fiscal Year (FY) 1975 and how it is allocated.

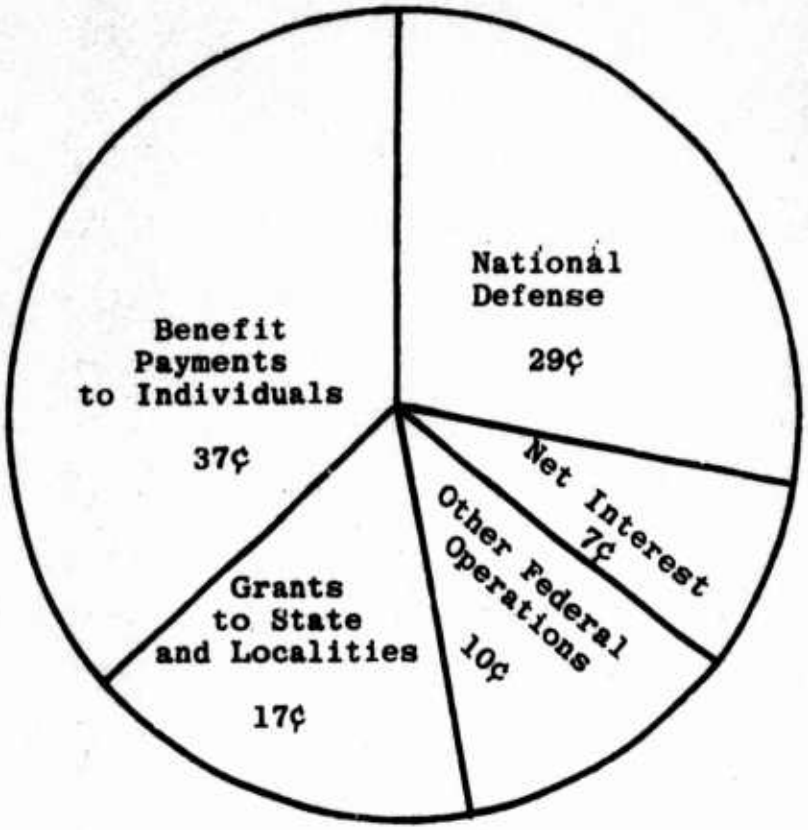

Figure 1.1. "Budget Dollar" for Fiscal Year 1975

The budget for FY 75 recommended total outlays of 304 billion dollars; of which, the military portion was approximately 87 billion dollars. Manpower costs for 1975 will require a larger share of the military budget than the total of operations, procurement, research and development, and construction, as indicated in Table 1.1 (14,62). As a result of the significant portion of the budget being allocated to manpower, this area tends to be the most affected when cuts are proposed by Congress. To offset manpower reductions, a greater portion of the defense budget must be used for contract services in order

TABLE 1.1

DEPARTMENT OF DEFENSE OUTLAYS - 1975

Item	Percent of Total Budget
1. Manpower	55
2. Operating Costs (other than payroll)	16
3. Procurement, Research and Development, and Construction	29
TOTAL	100

to continue maintaining acceptable standards at military facilities. The FY 75 budget designated approximately $235 million dollars to be used by the Air Force in maintenance of its real property facilities using contract services. This shift to contract services insures that the majority of the workload is accomplished by supplementing in-house personnel; however, significant manpower deficits are still being reported by some agencies of the Department of Defense, regardless of the impact of contract services on their operations.

As a result of the above situation, Congressional authorities are reluctant to accept the large manpower deficits reported until the contract effort has been fully accounted for when determining total resources.

This introduction provides a basis for an in-depth look into the background of the problem as it pertains to the United States Air Force.

Background

In the Air Force, the Base Civil Engineering Organization has the prime responsibility for maintaining all real property facilities and has both in-house and contract resources available to accomplish the identified workload. A newly created office of Manpower and Organization, known as the Civil Engineering Management Engineering Team (CE-MET), conducted an in-depth survey of all Base Civil Engineering organizations throughout the Air Force to determine the actual manpower posture, including the effort using contract services. As a result of the survey, the CE-MET identified the lack of standardization in quantifying the contractor effort in terms of in-house manpower resources and as a result established the requirement for an in-depth study into the area of contract manpower equivalents.

Contract manpower equivalents can best be described as the total in-house manyears that can be obtained with a given total contract dollar amount for work which can be accomplished using in-house forces. Contracts within in-house capabilities fall into the following four categories: Maintenance, Repair, Minor Construction, and Service. To best illustrate the impact of contract manpower equivalents the following example will be used:

Standard For A Base

Standard (based on Air Force Manual (AFM) 26-3(15)	-	600 manyears

Authorizations For A Base

1.	Authorized on the Unit Detail Listing (UDL)	-	400 manyears
2.	Youth Opportunity Corp (YOC)	-	10 manyears
3.	Contract Manpower Equivalents	-	100 manyears
	Total Authorizations		510 manyears

Manpower (Deficit/Surplus) = Standard-Total Authorizations
= 600 - 510

Manpower Deficit = 90 manyears

The standard in the above example indicated that the particular base could have a maximum total of 600 personnel assigned, based on the mission and other pertinent characteristics of that base. However, due to manpower limitations, the base is authorized only 400 spaces based on the UDL. In determining total manpower resources, the YOC contributed 10 manyears worth of effort while the contract effort, calculated using various procedures, accounted for equivalent in-house manpower spaces for 100 personnel. The actual manpower deficit is the difference between the standard and total authorizations. In this example, the total deficit was 90 manyears.

Using their best judgement in determining contract manpower equivalents, the Base Civil Engineering organizations

identified over 9900 manyears of contractor effort for 1975. Since contract resources are being used on an increasing basis, the CE-MET has determined that this resource must be carefully considered in analysis of total Base Civil Engineering resources and standardized procedures must be established to quantify this effort in terms of in-house manpower resources.

In consonance with the requirements of the CE-MET, this research will represent an initial effort in developing a methodology for the determination of contract manpower equivalents.

Existing Problems With the Present Procedures

This researcher conducted an in-depth review of the current procedures and directives concerning contract manpower equivalents and indicated the following:

1. No common interpretation of contract manpower equivalents exists. Some bases are attempting to calculate contractors manhours while others are attempting to estimate in-house manhours to accomplish the same work by contract.
2. The current methods of calculating contract manpower equivalents vary by command, as well as from base to base within a command. Thus, no accurate comparison can be made to assess the true manpower impact.

3. Existing procedures are highly subjective. The lack of standardization has resulted in the commands and bases using their initiative in establishing procedures to calculate contract manpower equivalents, thus biasing the results at the local level.
4. Existing procedures tend to be difficult and time consuming, thus imposing a substantial workload on both Management Engineering and Base Civil Engineering personnel.
5. The current methods only provide a means of estimating past actions. No forecasting is possible for work to be accomplished in the near future.

If one were to identify a single reason for the above problems, it would have to be the lack of available directives concerning the basic concepts of contract manpower equivalents. With the above problems as a basis, the problem can now be defined.

Problem Definition

Cognizant of the growing concern to quantify the impact of contract services on the manpower deficit, the CE-MET has directed that a study be accomplished in the area of contract manpower equivalents. Considering the

problems with the existing procedures, there are four major hypotheses which will be developed throughout this research:

1. A common interpretation of contract manpower equivalents can be provided.
2. A methodology exists that will standardize the calculations of contract manpower equivalents.
3. Manhour models exist which will allow comparisons between commands and bases.
4. Base groupings exist which can be used to reduce subjectivity at the base level.

The immediate problem is thus reduced to one of determining the Air Force impact, for the Base Civil Engineering organization, of contract services on the manpower deficit. Any methodology or models developed in ascertaining the impact should be suitable for eventual use by other Air Force organizations and by other Armed Services Departments.

Research Objectives

The foremost objective of this research effort is to develop the methodology that will permit the Department of the Air Force to accurately assess, in the most objective manner, the impact of contract services on the manpower deficit. Since this is an initial research effort in this area, all findings will be presented in order to prevent any duplication of effort in future research that may take place in this area.

CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this chapter is to present literature pertinent to the analysis of contract manpower equivalents by covering the following areas:

a. Literature relative to the impact of contract manpower equivalents

b. Base Civil Engineering Organization

c. Use of contract resources

d. Previous research efforts in the area of contract manpower equivalents

It is important to note that literature directly related to contract manpower equivalents is limited due to the lack of any in-depth analysis in the past. This chapter will, however, provide a sufficient background as to the present directives governing contract manpower equivalents in order to establish a basis for the actual research procedures and concepts.

Literature Relative to the Impact of Contract Manpower Equivalents

The Air Force workload may be accomplished by military, in-service civilian, or contract services manpower.

Various influences promote and restrain the use of each element of the manpower resource. The two predominant influences in determining which manpower resource to use are effectiveness and economy. Other influences include: optimum control of the work force performing combat and direct combat support functions; legal definitions of the type of work force to use; and the traditional policy of the Government to rely on private enterprise for the supply of products and services to the maximum extent consistent with effective and efficient accomplishment of Air Force programs. A decision to use any one of the three manpower resources must be based on a full consideration of the other two manning alternatives (11,1).

Considering the above, two major reports are presently attempting to quantify the contract effort in terms of in-house manpower resources in order to more clearly identify the manpower deficit for the United States Air Force (USAF) in the Civil Engineering area. The two reports are the PRICE-OUT, which entails a major effort to identify total manpower resources, and the Commercial or Industrial Activities, and Contract Services Data System (CICS) which calculates Required In-service Man-Years In Lieu Of Contract (RIMILOC) for all contracts within the in-house capability to accomplish. The PRICE-OUT attempts to determine how many in-house manhours could be obtained

with a given total contract dollar amount if the work was accomplished in-house. The CICS, on the other hand, is concerned with the productivity of both the contract and in-house resources in determining the RIMILOC value for its contract effort. The present guidance is very limited and purports for the organizations to use the most accurate and technically acceptable method to calculate the above manpower requirements (12). Due to minimal guidance, most commands had to formulate their own procedures to standardize the calculations between their respective bases.

The Base Civil Engineering Organization as Being Representative of the In-House Work Force

Base Civil Engineering (BCE) is essentially a service organization; the primary purpose of which is to provide needed facilities, utilities, and services in support of the base mission. To provide this support, BCE resource management is predicated, to the maximum extent feasible, on the concepts of preidentification, planning, and scheduling of facilities maintenance requirements. The BCE organization consists of six (6) main branches: Industrial Engineering, Family Housing Management, Programs, Operations and Maintenance, Engineering and Construction, and the Fire Department. Figure 2.1 illustrates the organizational chart for the BCE organization.

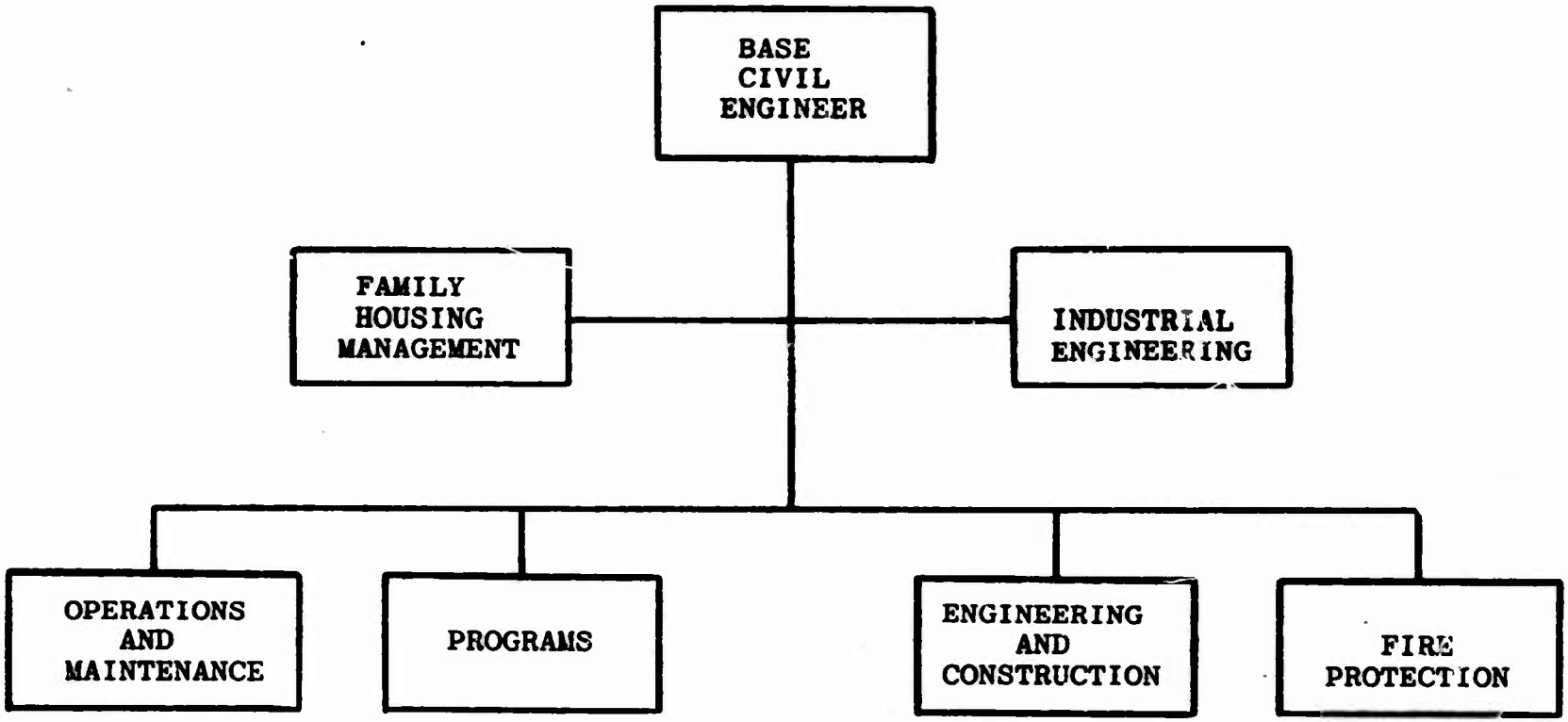

Figure 2.1. Organizational structure of the Base Civil Engineering Organization

To assist the reader in understanding the operation of the BCE organization, a brief explanation of the responsibilities for each major branch within Base Civil Engineering is as follows (1,7).

a. Industrial Engineering - advises the Base Civil Engineer, Chief of Programs, and Chief of Operations and Maintenance of accomplishments, problem areas, and recommended improvements. Directs the quality control evaluation of in-service and self-help work procedures, and accomplishments.

b. Family Housing Management - monitors family housing dwelling units from the standpoint of insuring optimal utilization of all dwelling units. Assists in the coordination of family housing maintenance requirements.

c. Programs - insures that the In-Service Work Plan (IWP) is properly prepared and maintained. Provides overall guidance and direction to the Material Control function with regard to supply support. Responsible for identifying work requirements and programming the necessary BCE resources.

d. Operations and Maintenance - conducts all maintenance of base facilities using in-house resources. Performs the overall planning, organization, and control of the Recurring Maintenance Program.

e. Engineering and Construction - provides technical expertise to the Base Civil Engineer. Conducts all design efforts for projects to be accomplished by contract. Performs surveillance on all facility projects by contract.

f. Fire Department - provides technical support to the BCE organization on fire protection matters. Conducts inspection on base facilities to identify fire hazards. Accomplishes fire control when required.

This research will only consider the Operations and Maintenance (O&M) branch because it contains the construction crafts that parallel those found in the civilian community. This branch is composed of various cost centers (i.e. Pavements, Grounds, Plumbing, Carpenter, Electrical), which specialize in those skills that are used by contractors in accomplishing work for the Government. Each cost center has its own hourly rate to allocate its expenses which is known as the shop rate. Since this research is concerned with estimating in-house equivalent

manhours for work accomplished by contract, the O&M branch with its respective cost centers will be of significant importance in the development of the methodology for this research effort.

Governing Directives Pertaining to the Use of In-House and Contract Resources

Two main directives emphasize the decision criteria to be applied when determining whether to use contract resources and they are as follows:

a. Air Force Regulation (AFR) 26-12(11) - Manpower Directive

b. Air Force Manual (AFM) 86-1(13) - Civil Engineering Directive

In order to provide a concise summary of the major criteria of each of these directives, the following breakdown is provided.

AFR 26-12

AFR 26-12 stipulates when in-service and contractor resources should be used. In-service personnel will be used in the following cases:

a. When procurement from private commercial sources would disrupt or materially delay an Air Force program.

b. When in-service personnel are required for one of the following reasons: direct combat support functions, training or retraining of military

personnel or units, including training or retraining to achieve self-sufficient military capability for the operation and direct maintenance support of their mission-essential equipment, and accomplishing workload when performance by contract manpower would not conform with applicable laws and regulations, including Civil Service regulations or other appropriate authority, or would be a means of avoiding Government manpower or salary limitations.

c. When a satisfactory commerical source is not available and can not be developed in time to provide the service or product when it is needed, nor can it be provided by another Federal Agency.

If in-service accomplishment of a service or manufacture of a product is required, but cannot be accomplished because in-service skills will not be available to perform the necessary work, use of private commercial sources may be used only until the necessary in-service skills are made available.

AFM 86-1

AFM 86-1 emphasizes that it is important for all resources to work together in order to satisfy total

long-range requirements and base objectives. In this respect, all resource programs are used to achieve the same goals, namely to:

a. Optimize mission accomplishment

b. Provide adequate facilities

c. Expend resources wisely to minimize future costs

d. Minimize the impact of future mission changes by providing facilities that can be used for several purposes.

The Base Civil Engineer has the overall responsibility for reviewing work requirements, determining the resources to be used, and the best program avenue to accomplish the work (in-house or contract).

As can be seen, the Manpower Regulation, AFR 26-12, is more restrictive in the criteria concerning which resource is to be used in accomplishing work. The Civil Engineering Manual AFM 86-1, on the other hand, deals in general terms; however, it must be emphasized that it is the local engineers in the BCE organization that are highly cognizant of in-house capabilities, and advise the Base Civil Engineer which resource avenue should be pursued for a given work requirement.

This research effort will concentrate on those contracts that are capable of being accomplished with in-house resources; however, but due to the lack of available manhours and priority of the work, the contract method was used.

Previous Research Efforts in the Area of Contract Manpower Equivalents

No previous research efforts were accomplished in the area of contract manpower equivalents. Some commands have taken the initiative in an effort to standardize a procedure that can be used by all the bases within their command; however, no effort was made to standardize the procedures between commands.

The information presented in this chapter provided the reader with the degree of understanding required to grasp the research concepts and procedures that will be presented in the next chapter.

CHAPTER III

RESEARCH CONCEPTS AND PROCEDURES

Introduction

The purpose of this chapter is to introduce some of the concepts that will be required in the development of a "Methodology for Determining Contract Manpower Equivalents." As was previously mentioned, significant problems exist in both the interpretation and application of present directives, and as a result, most of the commands have instituted their own procedures for calculating contract manpower equivalents.

Before any problem can be solved, an in-depth analysis of the existing procedures and techniques must be undertaken to assess the existing problem areas and a plan of attack formulated for remedying the situation. In Chapter I, the problems with the existing methods were presented; this chapter will concentrate on the concepts and research procedures that will be used in the problem solving process. The presentation of the concepts and procedures will include dynamics of resource allocation, discussion of contract categories and in-house hourly rates (shop rate), skilled hourly rates for contract personnel and discussions on the survey design and sample size.

Dynamics of Resource Allocations

The Base Civil Engineering organization represents the in-house group that will be the prime reference when considering in-house resources and workload. Each year, the Base Civil Engineer (BCE) identifies the total work to be accomplished at his particular installation through a detailed analysis of all the work requirements submitted by the various organizations at that base. Once the total work requirement is identified, the BCE must determine the optimal method for accomplishing his projected work requirements. As depicted in Figure 3.1, the BCE has three main resources at his disposal to accomplish his workload as illustrated below.

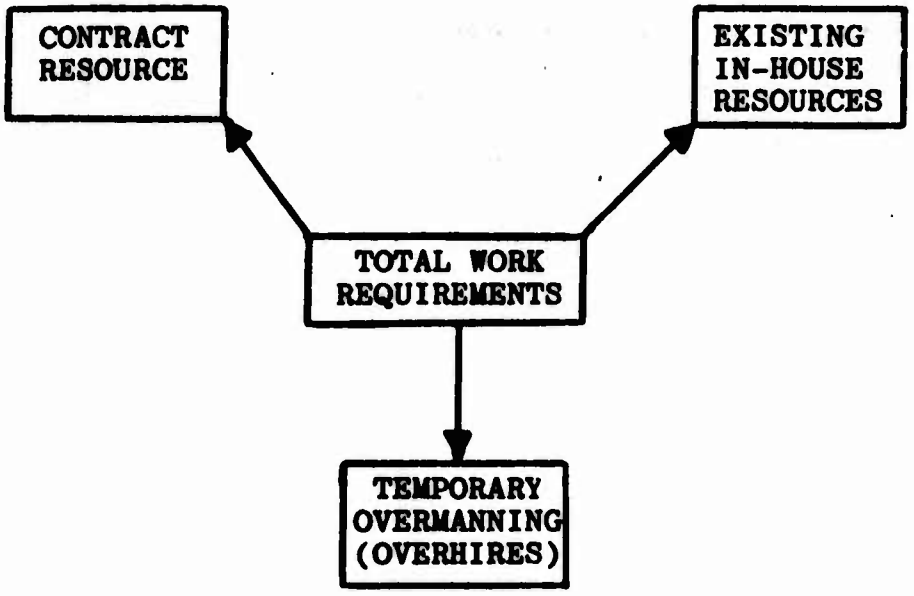

Figure 3.1. Resources available to the Base Civil Engineer

In his selection process, the BCE must categorize his workload into the following main areas: maintenance, repair, minor construction, services, and operations (1,3-5). He must be highly cognizant of the restrictions placed on him by present Air Force directives as to what can and can not be accomplished using in-house resources and the limitations that are inherent within his own shops. An example of restrictions placed on the BCE can best be indicated when studying the minor construction category where Air Force Regulation (AFR) 85-1 (1,3-5b) states the following:

> "The Facilities Board is prohibited from approving minor construction work more than 5% of the total of all Operations and Maintenance ATA Cost Centers programmed available direct manhours. This percentage may vary over the course of a year; however, it will not be exceeded in any one fiscal year."

NOTE: The Facilities Board is a group of installation representatives, chaired by the Base Commander, that is responsible for validating all work requirements and insuring the Base Civil Engineering work force is productively employed.

In most cases, once the workload has been categorized, priorities established for work accomplishment, and all the restrictions and limitations have been considered, the determination of which resource avenue to pursue is a rather straightforward process.

Discussion of Contract Categories

As was previously mentioned, the use of contract forces represents one of the main resources available to the BCE for the accomplishment of his required workload. For the purposes of this research, only those contract categories that parallel the types of work that can be accomplished with in-house forces will be considered and they are as follows: Maintenance, Repair, Minor Construction, and Service Contract categories. A brief description of each contract category and examples of each are as follows:

a. Maintenance Contract Category - recurring day-to-day, periodic, or scheduled maintenance work, including minor repairs incidental to maintenance. Examples include painting, fog-sealing runways, refinishing hardwood floors, and maintaining air conditioning equipment.

b. Repair Contract Category - represents work to restore a failing system to a condition that it may be effectively used for a designated purpose by overhaul, or replacement of parts or materials that have deteriorated by action of the elements or wear and tear in use and which cannot be corrected through maintenance. Examples include replacing roofing, waterproof and repair brick walls, and replace cooling coils.

c. Minor Construction Category - represents work to construct, erect, install, alter, extend, convert, or rearrange portions of facilities. Minor construction connotes constructing a new facility or altering a present one. Examples include constructing partitions, installing new utility systems, and construct storage facility.

d. Service Contract Category - "non-project" oriented contracts where the major service purchased is labor. Examples include custodial services, grass cutting, refuse collection, and tree trimming.

In House Hourly Rate (Shop Rate)

The shop rate developed for each Actual Time Accounting (ATA) Cost Center is a dollar per hour value used to allocate all "Fixed Cost Center Expenses" which are incurred in the day-to-day operations of the cost center (1, 13-13). It is a method that provides equitable distribution of "Fixed Cost Center Expenses" within a "Job Oriented" cost accounting system. The two factors used in development of the shop rate are: (1) anticipated "Fixed Cost Center Expenses" by element of expense for the period for which the rate will be used and (2) the anticipated direct labor hours to be utilized during the same period.

The total anticipated "Fixed Cost Center Expenses" divided by the total anticipated labor hours is the shop rate (1, 13-13).

Fixed Cost Center Expense (FCCE) can be directly related to the Element of Expense Investment Codes (EEIC). The EEIC's, mainly used in arriving at the total FCCE for a cost center, are shown in Figure 3.2.

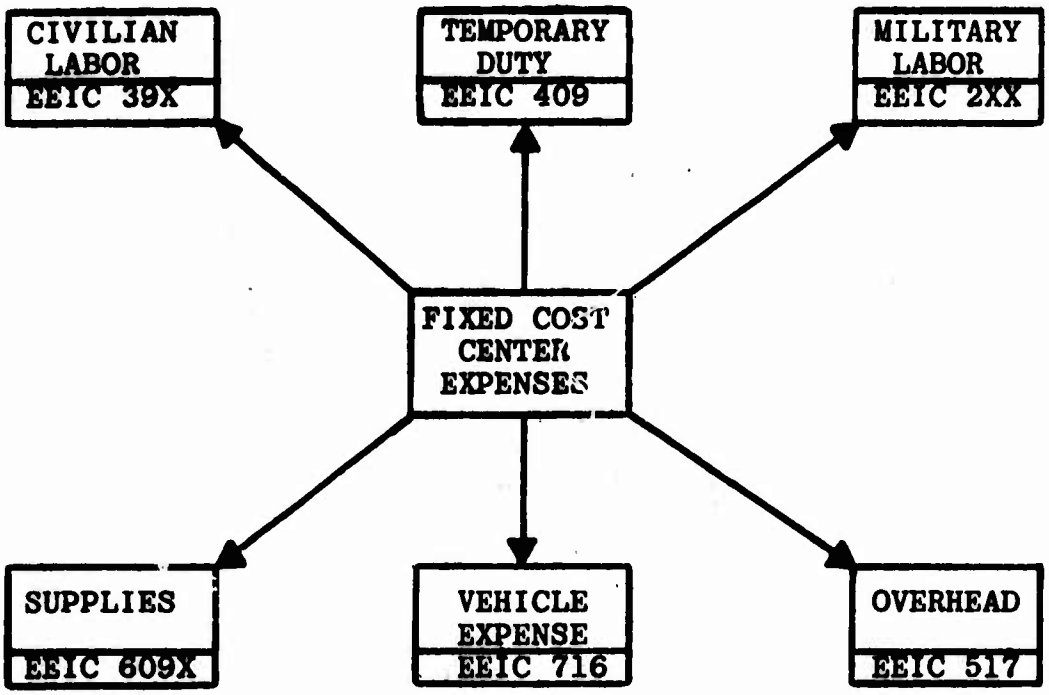

Figure 3.2. Fixed cost center expenses

The estimated direct hours are based on the number of estimated assigned personnel within a cost center for a year, multiplied by 2080 hours (40 hours a week for 52 weeks), less all federal holidays and foreign holidays where applicable. If the standard work day differs, the corresponding yearly hours less holidays will be used. This total must be adjusted for estimated loaned and borrowed hours and then multiplied by the availability rate of the cost center. The result will provide the estimated direct manhours. The availability rate is the number of direct hours expended by a cost center during a set time period divided by the total hours (direct plus indirect) expended by the cost center during the same period (2,4-25).

To best illustrate the above concepts, a sample computation is provided below:

COST CENTER 441 - EQUIPMENT OPERATIONS

(1) Fixed Cost Center Expense (FCCE):

EEIC	DESCRIPTION	FY XX EST. FCCE
2XXX	Military Personnel Costs	$25,000
3XXX	Civilian Pay	18,000
4XXX	Travel and Per Diem	700
5XXX	Civilian Overhead	3,000
6XXX	Supplies	1,500
7XXX	Vehicle Charges	1,200
	TOTAL ESTIMATED FCCE	$49,400

(2) Estimated Direct Manhours:

6 employees X 2080 available hours/year = 12,480 total hours

Availability Rate = 67%

Estimated Direct Manhours = Total hours X Availability Rate

= 12,480 X 0.67

Estimated Direct Manhours = 8,361.6 hours

(3) Formula:

$$\text{Shop Rate} = \frac{\text{Total Estimated FCCE}}{\text{Total Estimated Direct Manhours}}$$

$$= \frac{\$49,400}{8316.6 \text{ hours}}$$

Shop Rate = $5.91/hour

Skilled Hourly Rates for Contract Personnel

On March 3, 1931, the U.S. Congress passed the Davis-Bacon Act. The Act is now part of the United States Code, Title 40, "Public Buildings, Property and Works" and in non-legal terms requires that contracts in excess of $2,000 for construction, alteration and/or repair, including painting and decorating of public buildings or public works, which requires mechanics and/or laborers must include the minimum wages to be paid various classes of workers (3, 4). The minimum wages or "wage rates" are established by the Secretary of Labor and are in effect for a specified time period after which time they are

subject to revaluation. Federal wage rates are established for all sectors of the nation and can best be explained using Figure 3.3.

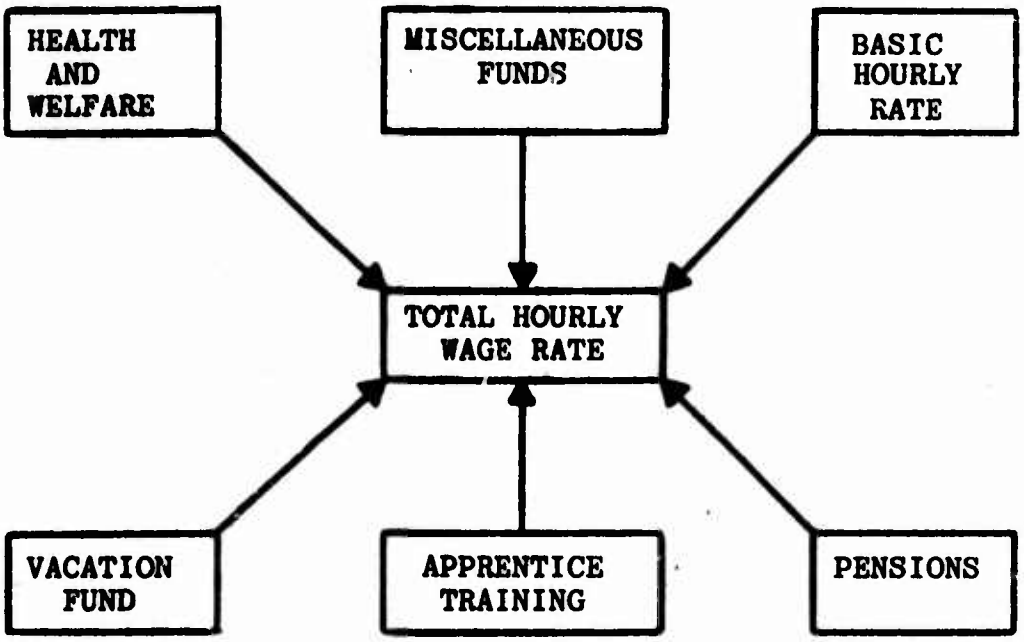

Figure 3.3. Total hourly wage rate

As can be seen in Figure 3.3, the Federal Wage Rate determination for a particular skill includes the Fringe Benefit Package, which encompasses all negotiated fringe benefits paid into special trust funds by the employer in addition to the basic hourly wage. One shortcoming of the Federal Wage Rate is that it represents the minimum wage to be paid for a particular construction skill. Generally, the contractor will have to pay more than the stipulated minimum, either because individuals are not willing to

work for the minimum or the prevailing union wage rate in the area is higher. For all practical purposes, the contractor will be required to pay the higher rate or be subject to union or Federal reprisals.

Since most installations are located within reasonable distances of highly populated areas, which represents the hub of union influence, the union wage rate will be used in all future hourly rate applications in the estimation of contract manhours. This departure from using the Federal Wage Rates as a basis is strictly a value judgement on the part of this researcher in an effort to obtain the most representative results.

Survey Design

The information required to effect analysis in the area of contract manpower equivalents is not centrally available and must be obtained through the local bases. Furthermore, the volume of data required and the widespread geographical distribution of the input bases precludes any type of direct contact with all sample bases. It was therefore necessary to develop a detailed questionnaire as the main avenue for obtaining the required data.

As a first step in the development process, three days (January 1 to January 3, 1975) were spent at the Civil Engineering-Management Engineering Team (CE-MET), Dover AFB, Delaware, discussing the area of contract

manpower equivalents and limits of this research effort. Initial findings of the CE-MET were as follows:

a. The contract manhour equivalents are not determined on a cumulative or monthly basis; therefore, the BCE has no indication of how many contract manhour equivalents he is using on a day-to-day or month-to-month basis.

b. The estimated contract manhour equivalents are not accurately determined prior to letting a contract; therefore, no realistic comparison is made of in-service versus contract manhours prior to negotiating a contract.

c. The method of determining the inclusion/exclusion of contracts for computing contract manhour equivalents varies from command-to-command and from base-to-base within a command. Much of this variation is due to the lack of definitive instructions concerning how to determine if a contract should be included or excluded when computing contract manhour equivalents.

After an in-depth analysis was conducted of the problem area and special considerations given to the initial findings of the CE-MET, this researcher determined that extensive data must be obtained in the areas of contracts, in-house manhours, contract manhours, present procedures

for calculating contract manpower equivalents, and a determination as to how contract personnel compare to in-house personnel.

A detailed questionnaire was prepared, a copy of which is included as Appendix C to this report, with five main categories of data required of the local bases. Detailed instructions were provided for each section of the survey to insure uniformity in the method of obtaining the data; however, a survey of this type has its definite limitations. Four main limitations are as follows:

a. The topic of contract estimating is a highly subjective area, especially when Project Engineers are asked to estimate the breakout of a contractor's costs on a given construction project.

b. In order to obtain data on contracts that parallel the type of work capable of being accomplished in-house at each particular installation, this researcher had no alternative but to ask each Base Civil Engineer to select five (5) contracts in each of the four contract categories, this tended to influence the contracts reported.

c. Equating contract and in-house resources on a general basis is, again, a highly subjective area; yet, this researcher is of the opinion that the experience of the BCE and his various division

chiefs represents the best means for quantifying any differences that may exist between these two resources.

d. Due to Air Force Institute of Technology (AFIT) regulations, all surveys required in research work must stipulate that response is voluntary.

In order to emphasize the high level interest in this research effort, a coordinated Manpower and Civil Engineering letter was sent from Headquarters USAF to the eleven (11) commands participating in the survey. The letter was sent prior to the distribution of the questionnaires and was signed by Brigadier General Jack I. Posner, Director of Manpower and Organization. The letter emphasized the need for complete support to insure the success of this endeavor, but the response was still on a voluntary basis. A copy of General Posner's letter is also included as part of Appendix C to this report.

Sample Size

Due to the amount of data required from each base and the time required to obtain the data, restrictions were levied by Headquarters USAF on the number of bases that could be sampled. Since this represents the first attempt at an in-depth study in this area, the possibility of failure existed and tended to reduce the sample to the minimum allowable to give representative results.

Based on the above facts, the sample size was limited to 23 bases (see Table 3.1 for list of bases). In order to give adequate representation to each portion of the country, the bases were selected using two main criteria:

a. The 23 bases had to represent every geographical sector of the United States and a representative sample from Alaska. Since contract costs are being considered, there is a noticeable difference from east to west and north to south in almost all of the contract categories.

b. Of the eleven (11) commands being sampled, no one command would be overburdened with the number of bases to participate in the survey.

According to Air Force criteria (5, 4-17), proper selection of locations for measurement must satisfy two basis conditions: (a) a sufficient percentage of the work center locations (bases) must be included in the measurement, and, (b) the locations selected must be representative in terms of workload volume--that is, a proportionate number of locations from low, intermediate, and high volume locations must be included in the measurement. Based on the installations surveyed, it is the opinion of this researcher that the above criteria have been satisfied. In addition, if a study is to impact Air Force wide, a minimum number of bases must be sampled. According to Air Force policy, Table 3.2 depicts the minimum number of locations to be measured (5, 4-17).

TABLE 3.1

SAMPLED AIR FORCE BASES (AFB)

Bolling AFB(HQCMD), DC	Malmstrom AFB(SAC), MO
Charleston AFB(MAC), SC	Maxwell AFB(AU), ALA
Edwards AFB(AFSC), CA	Moody AFB(ATC), GA
Elmendorf AFB(AAC), AK	Nellis AFB(TAC), NEV
Grand Forks AFB(SAC), ND	Offutt AFB(SAC), NEBR
Hanscom AFB(AFSC), MASS	Richards-Gebaur AFB(AFCS), MO
Hill AFB(AFLC), UT	Scott AFB(MAC), IL
Kelly AFB(AFLC), TX	Seymour-Johnson AFB(TAC), NC
Kirtland AFB(AFSC), NM	Tinker AFB(AFLC), OKLA
K.I. Sawyer AFB(SAC), MI (See Note 1)	Tyndall AFB(ADC), FL
Lowry AFB(ATC), CO	Williams AFB(ATC), ARIZ
Wright-Patterson AFB(AFLC), OH	

Note 1. The data for K.I. Sawyer AFB was received too late to be included in the analysis.

Note 2. The abbreviations for the commands are shown next to each of the installations in the sample. See Appendix A for explanation of abbreviations and terminology.

TABLE 3.2

MINIMUM NUMBER OF LOCATIONS TO BE MEASURED
FOR AN AIR FORCE STANDARD

If TOTAL NO. OF WORK CENTER LOCATIONS IS	THEN MINIMUM NO. OF LOCATIONS TO BE SURVEYED IS
1-3	ALL
4-7	4
8-13	5
14-20	6
21-30	7
31-44	8
45-65	9
66-100	10
101 or MORE	10% of TOTAL

It is planned that the results of this survey be applied to the finite number of bases in the U.S. and Alaska which numbers approximately 140; thus 10% of this total would yield 14 bases as the minimum allowable for the results to impact on the above geographic sectors. Since 22

bases responded, this researcher can only conclude that, the sample survey results will be representative of the total Air Force population being considered. Cognizant of the concepts presented in this chapter, the remainder of this research will be devoted to data analysis and development of functional relationships between contract and in-house resources.

CHAPTER IV

DATA ANALYSIS AND SURVEY RESULTS

Introduction

This chapter will encompass the analysis of the data obtained in the survey. The data will be analyzed in three segments; namely, contract data, hourly rate data, and a summary of the responses to the subjective question concerning equating contract and in-house resources. Contract data analysis will consist of tests for significant differences between contract categories and bases, determination of "fit" of data and a contract profile consisting of the percentage breakdown of contractors costs by contract category. The hourly rate analysis will encompass the determination of skilled hourly rates for contracts and weighted hourly shop rates for the Base Civil Engineering organization and the rate categorization of bases.

Due to the extensive data obtained in this research and since this is the first time a detailed effort is being made to attack this problem area, all the base data obtained in the survey will be included in Appendix B to this report. To assist in future research efforts in this area, all findings will be addressed in this write-up.

Contract Data Analysis

a. Test for Significant Difference Between Contract Categories and Bases

As was emphasized in Chapter III, four contract categories will be considered: Maintenance, Repair, Minor Construction, and Service Contracts. Having reviewed previous research in this area and analyzed their findings, it was noted that the Service Contract category was disregarded, and no qualifications were placed on the contracts obtained (6). In the previous efforts, contracts were selected by a random process with no emphasis placed on whether or not the scope of the contract was within the base's capability to accomplish. The results of their findings were twofold:

1. There was no significant difference between contract categories; hence, all contract data for the three contract categories was combined, and,
2. There was no significant difference between the weighted means at each of the respective bases sampled.

The research appears to show that if a base has the capability to accomplish work in a given contract category and is within the governing Air Force directives, then that category must be considered.

To test for significant difference, a non-parametric Rank-Sum test will be used for testing the null hypothesis that the base weighted average contract labor percentages do not differ significantly between contract categories and bases, versus the alternate hypothesis that they are indeed significantly different. The Kruskal-Wallis H test, at a confidence level of 95%, will be used in this analysis where:

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{K} \frac{R_i^2}{n_i} - 3(N+1)$$

R_i = the sum of the ranks occupied by the n_i observations of the i_{th} sample

$N = n_1 + n_2 + \ldots\ldots n_k$ (for K observations)

NOTE: When $n_i > 5$ for all i, the distribution of the H statistic is well approximated by the chi-square distribution with K-1 degrees of freedom (7,214).

The detailed contract data, including number of projects, labor dollars, contract amounts, and weighted labor percentages by base and contract category is included in Appendix D. Tables 4.1 and 4.2 represents a summarization of the contract data in Appendix D and will be used in the tests for significant differences.

Test 1

Test For Significant Difference Between Bases

H_o: A difference does not exist between bases

H_1: A difference does exist between bases

TABLE 4.1

BASE WEIGHTED AVERAGE LABOR PERCENTAGES

(Ranks From Lowest to Highest Shown in Parenthesis)

Base	Maintenance Category	Repair Category	Minor Construction Category	Service Contract Category
Bolling	50.4 (51)	45.3 (43.5)	25.3 (3)	55.4 (64)
Charleston	43.3 (37)	29.8 (7.5)	31.3 (10)	-
Edwards	61.2 (70)	39.5 (28)	41.2 (32)	62.5 (72)
Elmendorf	62.1 (71)	54.2 (58)	65.0 (73)	93.1 (85)
Grand Forks	44.3 (39)	25.2 (2)	47.8 (48)	60.3 (68)
Hanscom	42.1 (34)	36.0 (17.5)	29.0 (4)	-
Hill	60.0 (67)	38.7 (25.5)	42.7 (36)	-
Kelly	36.2 (19)	29.8 (7.5)	29.5 (6)	54.6 (59)
Kirtland	54.0 (57)	51.6 (55)	37.5 (22)	51.5 (54)
Lowry	39.3 (27)	41.1 (31)	36.9 (20)	71.9 (79)
Malmstrom	48.0 (49)	43.5 (38)	37.4 (21)	61.1 (69)
Maxwell	51.2 (53)	30.0 (9)	33.9 (14)	56.9 (65)
Moody	38.7 (25.5)	34.9 (15)	36.0 (17.5)	57.8 (66)
Nellis	52.0 (56)	45.7 (45)	45.3 (43.5)	81.6 (83)
Offutt	50.8 (52)	20.5 (1)	33.6 (13)	66.5 (74)
Richards-Gebaur	55.0 (62)	54.9 (60)	55.0 (62)	55.0 (62)
Scott	45.1 (42)	38.6 (24)	42.5 (35)	68.0 (75)
Seymour-Johnson	49.2 (50)	29.1 (5)	32.6 (12)	76.4 (81)
Tinker	44.6 (40)	40.3 (29)	35.0 (16)	75.0 (80)
Tyndall	70.1 (70)	69.9 (77)	68.4 (76)	85.9 (84)
Williams	44.9 (41)	40.7 (30)	38.4 (23)	46.3 (46)
Wright-Patterson	46.4 (47)	41.9 (33)	31.8 (11)	79.4 (82)

Note: No Service Contracts were submitted by Charleston, Hanscom, and Hill

TABLE 4.2

SUMMATION OF BASE RANKS

Base	Maintenance Ranks	Repair Ranks	Minor Construction Ranks	Service Ranks	ΣR_i Base Rank Sum
Bolling	51	43.5	3	64	161.5
Charleston	37	7.5	10	-	54.5
Edwards	70	28	32	72	202
Elmendorf	71	58	73	85	287
Grand Forks	39	2	48	68	157
Hanscom	34	17.5	4	-	55.5
Hill	67	25.5	36	-	128.5
Kelly	19	7.5	6	59	91.5
Kirtland	57	55	22	54	188
Lowry	27	31	20	79	157
Malmstrom	49	38	21	69	177
Maxwell	53	9	14	65	141
Moody	25.5	15	17.5	66	124
Nellis	56	45	43.5	83	227.5
Offutt	52	1	13	74	140
Richards-Gebaur	62	60	62	62	246
Scott	42	24	35	75	176
Seymour-Johnson	50	5	12	81	148
Tinker	40	29	16	80	165
Tyndall	78	77	76	84	315
Williams	41	30	23	46	140
Wright-Patterson	47	33	11	82	173
Category = Rank Totals ΣR_i	1067.5	641.5	598.0	1348	

$N = 85$

$n = 4$ (except for Charleston, Hanscom, and Hill where n=3)

$$H = \frac{12}{85(86)}\left[\frac{669586}{4} + \frac{22562}{3}\right] - 3(86)$$

$$= 287.1 - 258$$

$$= 29.1$$

Chi-square for 21 degrees of freedom and 95% confidence level = 32.67.

Results: Since H calculated is less than chi-square (.05,21), one cannot reject the null hypothesis, at a confidence level of 95%, that the base weighted average labor percentages do not differ significantly between bases. Simply stated, the labor percentages for each contract, estimated by the Project Engineers at the local bases, are not significantly different when compared base by base. Note that since $n_i < 5$, the accuracy of the Kruskal-Wallis H test in this case is questionable and that very little weight can be placed on the results.

Test 2

Test For Significant Difference Between Contract Categories

H_o: A difference does not exist between contract categories

H_1: A difference does exist between contract categories

$N = 85$

$n = 22$ (except for the Service Contract category where n=19)

$$H = \frac{12}{85(86)}\left[\frac{(1067.5)^2}{22} + \frac{(641.5)^2}{22} + \frac{(598)^2}{22} + \frac{(1348)^2}{19}\right] - 3(86)$$

$$= 299-258$$

$$= 41$$

Chi-square for 3 degrees of freedom and 95% confidence level = 7.81.

Results: Since H calculated is greater than chi-square (.05,3), one must reject the null hypothesis and state with a confidence level of 95% that the base weighted means are significantly different between the various contract categories.

Based on the previous tests, one must conclude the following: (1) Each contract category Maintenance, Repair, Minor Construction, and Service must be considered as a separate entity in all future applications, and (2) statistically, no definite conclusion can be stated as to whether a significant difference exists between the weighted labor means at each of the 22 bases.

b. Determination of Fit of Data

In order to provide the capability to compare existing and future data to assess any significant changes that may have occurred, an attempt will be made to determine the "fit" of the data received. Since this is not indigenous to the outcome of this research effort, the reader will

appreciate the fact that the data will only be tested against the normal distribution. The normal distribution was chosen based on the fact that previous research work indicated that the labor percentages, reported by the Project Engineers, may be normally distributed.

Since it has statistically been shown that there is a significant difference between contract categories, each contract category will be considered separately when determining the distribution of the reported data. Recall that in the questionnaire on contract data, each Project Engineer was asked to estimate, as accurately as possible, the percent breakout for Supervision, Overhead, and Profit; Labor, and Material for each contract reported. Each contract category will be tested against a normal distribution using the following statistical tests: Kolmogorov-Smirnov (K-S) goodness of fit, Skewness, and Kurtosis. All percentages tested represent the unweighted values as reported in the questionnaire.

The data will be tested at a confidence level of 95% with the null hypothesis that the data comes from a normal population, versus the alternate hypothesis that the data does not come from a normal population. The main item of interest is the percent labor which will be used in future applications; however, in the interest of presenting all the findings, all results will be summarized in tabular form, by contract category, and will be included as Appendix F to this report.

Based on the findings, one can not state any definite conclusions as to the f't of the data obtained; however, one can state, at a confidence level of 95%, that the variables tested are not normally distributed in all contracts. Since no definite conclusions can be made as to the "fit" of the data, this researcher is of the opinion that either a detailed effort should be made to determine the distribution of the data in a future study or that distribution-free tests be used for any comparisons that be required in the future.

c. Contract Profile

In order to develop profiles on the various contract categories, weighted percentages (based on total contract dollar amount) were calculated for Supervision, Overhead, and Profit; Labor; and Materials, and frequency distributions were made on the contract dollar amounts. In Table 4.3, one can observe the noticeable differences in the weighted percentages between contract categories; the most notable of which occur in the labor and material areas. The two contract categories which show extreme differences in these two areas are the Maintenance and Service Contract categories. Both contract categories are labor oriented with Service contracts almost all labor. Recall from Chapter III that when the contract categories were explained, it was emphasized that Service contracts are labor oriented and that

TABLE 4.3

SUMMARY OF WEIGHTED PERCENTAGES FOR ALL CONTRACT CATEGORIES

Contract Category	Supervision Overhead Profit	Labor	Material
Maintenance	21.6	49.9	28.5
Repair	23.1	38.5	38.4
Minor Construction	23.4	37.7	38.9
Service	20.7	70.6	8.7

in the Maintenance area, normal maintenance is performed on items prior to failure, thus requiring less material expenditures. Repair and Minor Construction contracts, on the other hand, entail replacing, erecting and installation which accounts for more balanced labor and material percentages.

Tables 4.4-4.7 contain the frequency distributions, by contract category, for the contract amounts of those contracts sampled. By reviewing the distribution of the contract amounts, it should be noted that approximately 85% of the contracts sampled are less than $100,000 with the exception of the Minor Construction which has 81% less than $40,000. These results are indicative of the fact that the Base Civil Engineer analyzed his in-house capabilities prior to reporting the contracts in this survey.

TABLE 4.4

FREQUENCY DISTRIBUTION

CONTRACT DOLLAR AMOUNTS - MAINTENANCE CONTRACTS

Interval ($)	Frequency	% Occurrence	Cumulative % Occurrence
0- 29,999	35	34.3	34.3
30,000- 59,999	42	41.2	75.5
60,000- 89,999	10	9.8	85.3
90,000-119,999	6	5.9	91.2
120,000-149,999	3	2.9	94.1
150,000-179,999	1	1.0	95.1
180,000-209,999	1	1.0	96.1
210,000-239,999	3	2.9	99.0
240,000-269,999	0	0	99.0
270,000-299,999	1	1.0	100.0
	102		

TABLE 4.5

FREQUENCY DISTRIBUTION

CONTRACT DOLLAR AMOUNT - REPAIR CONTRACTS

Interval ($)	Frequency	% Occurrence	Cumulative % Occurrence
0- 69,999	76	72.1	72.1
70,000-139,999	12	11.5	83.6
140,000-209,999	9	8.6	92.2
210,000-279,999	5	5.8	98.0
280,000-349,999	1	1.0	99.0
350,000-419,999	0	0	99.0
420,000-489,999	0	0	99.0
490,000-559,999	0	0	99.0
460,000-629,999	0	0	99.0
630,000-699,000	1	1.0	100.0
	104		

TABLE 4.6

FREQUENCY DISTRIBUTION

CONTRACT DOLLAR AMOUNT - MINOR CONSTRUCTION CONTRACTS

Interval ($)	Frequency	% Occurrence	Cumulative % Occurrence
0- 19,999	48	46.6	46.6
20,000- 39,999	36	34.9	81.5
40,000- 59,999	13	12.5	94.0
60,000- 79,999	1	1.0	95.0
80,000- 99,999	1	1.0	96.0
100,000-119,999	1	1.0	97.0
120,000-139,999	0	0	97.0
140,000-159,999	1	1.0	98.0
160,000,179,999	1	1.0	99.0
180,000-199,999	1	1.0	100.0
	103		

TABLE 4.7

FREQUENCY DISTRIBUTION

CONTRACT DOLLAR AMOUNT - SERVICE CONTRACTS

Interval ($)	Frequency	% Occurrence	Cumulative % Occurrence
0- 59,999	79	86.8	86.8
60,000-119,999	3	3.3	90.1
120,000-179,999	1	1.1	91.2
180,000-239,999	0	0	91.2
240,000-299,999	3	3.3	94.5
300,000-359,999	2	2.2	96.7
360,000-419,999	1	1.1	97.8
420,000-479,999	1	1.1	98.9
480,000-539,999	0	0	98.9
540,000-599,999	1	1.1	100.0
	91		

Hourly Rate Analysis

a. Determination of Skilled Hourly Rates for Contracts

Of the 400 contracts that were sampled, 56 contracts were classified as requiring predominantly unskilled labor, 26 of which were in the Service Contract area. Due to limitations on the labor rates available, it would be extremely difficult to determine an unskilled average hourly rate for a particular geographical sector of the country without being highly subjective. Since this is an initial research effort in this subject area, this researcher is not of the opinion that subjective judgments should be introduced in such a highly controversial area as labor rates. For the remainder of this research, skilled average hourly construction rates are available and will be applied against all contracts; however, recommendations will be made for further research into the area of unskilled labor for future applications. This decision is strictly a value judgment on the part of this researcher.

The skilled wage rates were obtained from the "1975 Labor Rates for the Construction Industry," compiled by R. S. Means (4). The wage rates in this text are for the Building Construction Industry and not for Residential, Heavy or Highway Construction. The rates are the latest available as of 1 Jan. 1975 and were obtained from labor

unions and Employer's Associations in the various cities. The city average skilled hourly rate was determined by taking the average of hourly rates for 30 various construction trades in that particular area. Since some of the bases sampled were not located in or near a city where the construction rates were available, the rate for the city closest to the base was used. Table 4.8 indicates the average skilled hourly rate and the city where the rate prevails; these rates will be used in future computations.

b. Determination of Weighted Hourly Shop Rates for the Base Civil Engineering Organization

As was pointed out in Chapter III, the Base Civil Engineering (BCE) organization represents the in-house group that has the skills which parallel those available in the construction trades. Chapter II emphasized that the BCE organization consisted of six (6) main divisions: Industrial Engineering, Programs, Operations and Maintenance, Engineering and Construction, Fire Department, and Family Housing Management. Each division is further subdivided into cost centers with their own respective shop rates.

During the initial formulation of the questionnaire, this researcher was of the opinion that it would be best to use simply a weighted aggregate shop rate, which is the average hourly shop rate, weighted based on the estimated direct manhours, for all cost centers authorized under the

TABLE 4.8

SKILLED HOURLY AVERAGE CONSTRUCTION RATES PER BASE

Base	City Where Rate Prevails	Average Hourly Rate ($/Hour)
Bolling	Washington, DC	9.88
Charleston	Charleston, SC	5.71
Edwards	Riverside, CA	11.34
Elmendorf	Anchorage, AK	13.64
Grand Forks	Fargo, ND	8.40
Hanscom	Boston, MASS	10.71
Hill	Ogden, UT	8.80
Kelly	San Antonio, TX	8.02
Kirtland	Alburqueque, NM	7.97
Lowry	Denver, CO	9.57
Malmstrom	Great Falls, MO	8.60
Maxwell	Montgomery, AL	8.32
Moody	Savannah, GA	7.44
Nellis	Reno, NEV	10.15
Offutt	Omaha, NEB	8.90
Richards-Gebaur	Kansas City, MO	10.45
Scott	Joliet, IL	10.71
Seymour-Johnson	Raleigh, NC	7.48
Tinker	Oklahoma City, OK	8.66
Tyndall	Pensacola, FL	8.64
Williams	Phoenix, AZ	10.27
Wright-Patterson	Dayton, OH	10.14

Unit Detail Listing (UDL). As a result of the above policy, all bases submitted the weighted aggregate shop rate using all cost centers authorized. After a more detailed look at the above procedure, the research dictated that in order to be more realistic in the comparison with the construction industry, only those in-house cost centers that are related to the construction trades should be used and the overhead cost centers should be disregarded. Considering the above policy, this researcher has selected sixteen (16) cost centers, all of which are in the Operations and Maintenance division, are common to most bases and parallel the construction industry trades. The cost centers selected are listed in Table 4.9.

In addition to reconciling the problem of matching the in-house and construction skills, another area of difference occurs in the manner the hourly rates for each group are calculated. The construction industry's hourly rate consists of the basic hourly rate plus fringe benefits; the Base Civil Engineer, on the other hand, includes all his Fixed Cost Center Expenses (FCCE) and availability rate in the determination of the hourly rate for each of his cost centers. To reconcile these differences, this researcher has proposed the concept of an adjusted weighted aggregate shop rate, based only on military and civilian labor costs and overhead costs in order that like quantities

TABLE 4.9

COST CENTERS USED IN CALCULATING AGGREGATE SHOP RATE

Cost Center	Description
441	Equipment Operations
442	Pavements
443	Grounds
451	Structural
452	Protective Coating
453	Plumbing
454	Metal
455	Mason
457	Structural, Maintenance and Repair Team (SMART)
461	Refrigeration
463	Heating
471	Interior Electric
472	Exterior Electric
480	Power Production
491	Water and Waste
493	Entomology

NOTE: Due to contract services, the following cost centers were deleted from their respective bases.

Base	Cost Centers Under Contract
Moody	441, 442, 443, 491, 493
Williams	441, 442, 443, 455, 457, 491, 493
Maxwell	441, 455

compose the hourly rates for both the construction industry and the BCE organization. The availability rate will still be used to account for productive time since the government has training and other miscellaneous duties that must be accounted for. To illustrate the above procedure, recall the example in Chapter III where the shop rate was calculated and consider that result as being the indicated shop rate. To calculate the adjusted shop rate for that particular example, the following procedure will be used:

COST CENTER 441 - Equipment Operations

1. Fixed Cost Center Expense (FCCE):

EEIC	DESCRIPTION	EST. FCCE
2XXX	Military Pay	$25,000
3XXX	Civilian Pay	18,000
5XXX	Overhead	3,000
Total Estimated FCCE		$46,000

2. Estimated Direct Manhours are calculated in the same manner as in Chapter III and equal 8,361.6 hours for this example.

3. Adjusted Shop Rate = $\frac{\text{Total Estimated FCCE}}{\text{Estimated Direct Manhours}}$

$= \frac{\$46,000}{8361.6}$

= $5.50/hour

The adjusted shop rate of $5.50/hour is less than the indicated shop rate of $5.91/hour; yet, the adjusted

hourly shop rate is more representative of the in-house hourly rate from a strictly labor cost standpoint, since material, TDY, and vehicle expenses were omitted from the FCCE. The above procedure was applied to each of the cost centers at the 22 bases and the values were weighted based on the Estimated Direct Manhours to yield a weighted aggregate adjusted shop rate for each installation. A weighted aggregate indicated shop rate, which includes all FCCE, was also calculated strictly for comparison purposes. The detailed calculations and weighting process yielded the results in the Hourly Rate Analysis portion of Appendix B. A summary of the hourly rates that will be used for each base is shown in Table 4.10.

It is important to note that, even though the work sheets for the shop rates were obtained in the survey, isolating the FCCE for each cost center is a very tedious task. The work sheets that were submitted consisted of manual work sheets, which are considered highly accurate, and the Base Engineer's Automated Management Systems (BEAMS) product, PCN: 200474, which is considered unreliable unless the report is continually monitored and adjusted at base level. Fourteen (14) bases submitted manual work sheets and the other eight (8) submitted the BEAMS product. Table 4.10 also indicates the method used to adjust the shop rates. All shop rates were as of 30 April 75, except for Malmstrom which reflects the rates as of 31 May 75.

TABLE 4.10

WEIGHTED AGGREGATE ADJUSTED AND INDICATED SHOP RATES

Base	Weighted Aggregate Indicate Shop Rate ($/hr)	Weighted Aggregate Adjusted Shop Rate ($/hr)	Method of Adjustment
Bolling	7.45	6.92	M
Charleston	8.49	8.49	See Note 1
Edwards	8.26	7.55	M
Elmendorf	9.75	8.03	M
Grand Forks	7.90	6.75	B
Hanscom	9.56	9.00	M
Hill	10.14	7.87	M
Kelly	9.47	8.61	M
Kirtland	8.78	7.71	M
Lowry	8.10	7.70	B
Malmstrom	9.11	7.64	B
Maxwell	9.31	8.00	B
Moody	8.87	8.25	M
Nellis	8.45	7.50	M
Offutt	8.72	7.57	B
Richards-Gebaur	7.80	6.97	M
Scott	8.99	8.06	B
Seymour-Johnson	10.39	8.66	B
Tinker	9.18	8.01	M
Tyndall	7.16	6.48	M
Williams	9.31	8.39	M
Wright-Patterson	9.52	8.45	M

M-Manual Work Sheets B-BEAMS Product

Note 1. Charleston AFB could not be adjusted due to incomplete BEAMS product

c. Rate Categorization of Bases

During the early stages of developing the methodology for this research effort, it was initially postulated that the bases could be placed into geographical regions. It was hoped that by geographically combining bases, approximately the same dollar/hour labor construction rate could be assigned for the work performed. However, when the average skilled hourly rates were assigned to all the bases in the U.S., no geographical patterns could be established and an alternate procedure had to be formulated.

The above problem resulted in the concept of "Rate Groupings" whereby all bases, regardless of geographical location, would be classified based on the prevailing average skilled hourly rate in their respective area. In addition to the 22 bases in the sample, 72 other bases were categorized using the "1975 Labor Rates for the Construction Industry" (4). The average skilled hourly rates varied from $5.71 at Charleston AFB to $13.64 at Elmendorf AFB. Initially, rate groupings were based on a $\pm$ $0.25 deviation which resulted in 13 rate groupings. Since hourly rates tend to fluctuate because of union negotiations, it was determined that the $\pm$ $0.25 deviation was to restrictive and as a result, a deviation of $\pm$ $0.50 was determined to be more workable with eight (8) rate groupings. It is the opinion of this researcher that once

the rate groupings are established at ± $0.50 deviation, increases will occur uniformly throughout the various rate groupings with minimal impact on the composition of each rate grouping. Table 4.11 represents the rate groupings of the 94 bases that were categorized.

Discussion on Equating Contract and In-House Resources

In an effort to quantify any differences that may exist between the in-house and contract work force, this researcher presented the following question to the Base Civil Engineers:

> "At the present time, the Civil Engineering shops contain individuals that are highly skilled in most of the disciplines that compose a contractor's work force; yet, it is often postulated that the in-house forces could not keep pace with a contractor's disciplined work force. Do you agree with the above statement? Why? If you feel that there is a difference, can you quantify it?"

Of the 22 Base Civil Engineers that were queried, 20 responded with some definite opinions on the area in question. On the responses, 17 disagreed and 3 agreed with the postulated statement. To emphasize the major reasons for the two viewpoints, the following summary is presented:

a. Reasons for Agreement:

1. The in-house work force, particularly on the military side, usually includes a significant

TABLE 4.11

RATE GROUPING OF BASES

Rate Grouping 1 (5.25 - 6.24)	Rate Grouping 2 (6.75 - 7.74)	Rate Grouping 3 (7.75 - 8.74)		Rate Grouping 4 (8.75 - 9.74)
*Charleston (MAC)	Cannon (TAC)	Altus (MAC)	Laughlin (ATC)	Chanute (ATC)
	Columbus (ATC)	Barksdale (SAC)	Loring (SAC)	Duluth IAP (ADC)
	Eglin (AFSC)	Bergstrom (TAC)	Mac Dill (SAC)	Ellsworth (SAC)
	England (TAC)	Blytheville (SAC)	*Malmstrom (SAC)	Ent (ADC)
	Fort Lee (ADC)	Brooks (AFLC)	*Maxwell (AU)	Francis E. Warren (SAC)
	Keesler (ATC)	Carswell (SAC)	Minot (SAC)	Griffis (SAC)
	Langley (TAC)	Craig (ATC)	Mt. Home (TAC)	Grissom (SAC)
	Little Rock (TAC)	Dyess (SAC)	Pease (SAC)	Hancock Field (ADC)
	*Moody (ATC)	Goodfellow (USAFSS)	Pope (TAC)	*Hill (AFLC)
	Myrtle Beach (TAC)	*Grand Forks (SAC)	Randolph (ATC)	*Lowry (ATC)
	Patrick (AFSC)	Gunter (AU)	Robins (AFLC)	McConnell (TAC)
	Reese (ATC)	Holloman (AFSC)	*Tinker (AFLC)	McCord (MAC)
	*Seymour-Johnson (TAC)	*Kelly (AFLC)	*Tyndall (ADC)	Niagara Falls IAP (ADC)
	Shaw (TAC)	*Kirtland (AFSC)	Vance (ATC)	*Offutt (SAC)
	Sheppard (ATC)	Lackland (ATC)	Webb (ATC)	Petersen Field (ADC)
				Plattsburg (SAC)

Rate Grouping 5 (9.75 - 10.74)	Rate Grouping 6 (10.75 - 11.74)	Rate Grouping 7 (11.75 - 12.74)	Rate Grouping 8 (12.75 - 13.74)
Andrews (AFSC)	Castle (SAC)	Beale (SAC)	*Elmendorf (AAC)
*Bolling (HQCMD)	*Edwards (AFSC)	Mather (ATC)	
David-Monthan (SAC)	George (TAC)	Mc Clellan (AFLC)	
Dover (MAC)	Kincheloe (ADC)		
Fairchield (SAC)	*K.I. Sawyer (SAC)		
*HANSCOM (AFSC)	Los Angeles AFS (AFSC)		
Homestead (TAC)	March (SAC)		
Luke (TAC)	Mc Guire (MAC)		
*Nellis (TAC)	Norton (MAC)		
*Richards-Gebaur (AFCS)	Travis (MAC)		
Rickenbacker (TAC)	Vandenberg (SAC)		
*Scott (MAC)	Wurtsmith (SAC)		
Selfridge (ADC)			
Whiteman (SAC)			
*Williams (ATC)			
*Wright-Patterson (AFLC)			

Asterisk (*) - Indicates bases in survey

number of trainee/apprentice craftsmen. The contractor, on the other hand, can normally maintain a work force of fully qualified craftsmen.

2. The Air Force supply system is cumbersome, inefficient, and unreliable. The contractor's ability to determine and directly buy the equipment and materials he feels are necessary to accomplish the job gives him a significant advantage in the areas of material lead time, avoidance of job stoppage conditions, and smaller overhead expenditures.
3. A contractor must survive in a competitive environment. His survival depends on making enough money to meet his operating expenses, to cover re-investments and to realize an acceptable profit. Contrarily, the in-house work force is not competing as a corporate entity; thus, their survival is not contingent on the profit margin.
4. Contracts are geared to specialization. The in-house work force must be capable of responding to any number of maintenance tasks. Types of skills required vary from day-to-day, job-to-job. The contractor is able to realize a higher efficiency factor because of this specialization.

b. Reasons for Disagreement

1. Government and industry select personnel from the same labor reservoir. Government pay scales are now comparable to industry and both forces have training programs. There is no sound basis in these facts to assume a difference in skill. The advantage is on the side of the Civil Engineering in-house forces, due to longevity and familiarity with the facilities maintained.
2. Specialized equipment for construction type projects is not always available/authorized in a Civil Engineering organization because their prime mission is maintenance, repair, and operations of facilities and utilities. As a result of this situation, people are of the opinion that the in-house forces are not capable (skill wise) and therefore accomplish projects by contract.
3. The BCE work force, like any other industry, is geared to productivity, with the key being management's ability, at all levels, to motivate the work force. A well organized and motivated BCE work force is far and above contractor efforts.

The opinions of the individuals presented represent an average of between 15-20 years experience in the United States Air Force in senior management positions. Even though the majority of the respondents disagreed with the statement, no one could quantify any difference that may exist. Most did, however, agree that the statement can not be considered accurate unless more definitive qualifications are placed on the environment in which the two resources would be compared.

Summary of Findings

In an attempt to summarize some of the significant findings in this chapter, this researcher presents the following recapitulation:

a. Statistically, there is a significant difference between the contract categories of Maintenance, Repair, Minor Construction, and Service.

b. Other than determining that the data was not normal, no other conclusion could be made as to the "Fit" of the data received. The unweighted percentages assigned to supervision, overhead, and profit; labor; and material were tested against the normal distribution using the K-S, Skewness, and Kurtosis tests. The results of the tests are in Appendix F.

c. Weighted percentages, based on the Total Contract Dollar Amount, were determined for supervision overhead, and profit; labor; and material by contract category. The most notable differences occurred in the labor and material areas for the maintenance and service contract categories.

d. Skilled average hourly construction rates were determined for each base in the sample. Further research must be accomplished in determining average unskilled hourly rates to be applied against contracts where unskilled labor is the predominant work force. Fifty-six (56) of the 400 contracts sampled were classified as requiring unskilled labor; however, no adjustment could be made in the average skilled hourly rate to account for the above situation.

e. There was no correlation between geographical location and average skilled hourly rates that prevailed in an area. The concept of Rate Grouping was introduced whereby all bases were placed in eight (8) Rate Groupings based on the prevailing average skilled hourly construction rate in their respective area. Table 4.11 contains the Rate Groupings for 94 bases that were categorized.

f. The concept of a weighted aggregate adjusted shop rate was introduced, which accounts for only the

Fixed Cost Center Expenses that parallel the costs incurred by a contractor, namely, labor and overhead expenses.

g. No definitive conclusions can be drawn from the Base Civil Engineer's comments on equating contract and in-house resources. The main area of agreement was that adequate evaluation can only be made if a specific situation is analyzed; any attempt to evaluate the two resources in a general context is highly subjective.

CHAPTER V

FUNCTIONAL RELATIONSHIPS AND MODEL DEVELOPMENT

Introduction

In consonance with this researcher's policy of presenting all findings, this chapter will present an in-depth analysis of the functional relationships between the variables obtained in the survey coupled with the development of the manhour models. An attempt will be made to determine if there is correlation between the total contract dollar amount and the percent labor, material, and that of supervision, overhead, and profit submitted by the project engineers. Also, a check will be performed to determine if correlation exists between the average skilled hourly rate and the in-house rates identified as the weighted aggregate adjusted shop rate and the weighted aggregate indicated shop rate. The development of the manhour models will entail calculation of the estimated contractor hours per contract, estimated adjusted equivalent in-house hours per contract and estimated indicated equivalent in-house hours per contract. Regression analysis will then be used to determine the predicted manhours based on a given contract dollar amount. The manhour models will be developed, by contract category, for

both the national data, which includes all 22 bases, and on a rate grouping basis; any differences between the models will be analyzed and strong points of each model emphasized. The detailed analysis for each of these processes will be explained as the need arises. The explanations provided in this chapter will provide the background and degree of understanding necessary for future applications of the proposed methodology.

Functional Relationships

Since it was statistically proven in Chapter IV that each contract category must be considered separately, a correlation procedure was used, by contract category, to determine if correlation existed between the total contract dollar amount (AMOUNT) and the variables percent supervision, overhead, and profit (SOP_PER); percent labor (LAB_PER); and percent materials (MAT_PER). The results of the correlation procedure for the four contract categories are in matrix form and shown in Table 5.1. To assist in interpreting the results, please note the first set of results titled, "National Data-Maintenance Contract Category." If the reader should be interested in checking whether correlation existed between contract dollar amount (AMOUNT) and percent labor (LAB_PER); the reader would go to the values located where the row marked "AMOUNT" intersects the column marked "LAB_PER." The values at this location are the following:

TABLE 5.1

CORRELATION COEFFICIENTS--BY CONTRACT CATEGORY

NATIONAL DATA - MAINTENANCE CONTRACT CATEGORY

N = 107 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	AMOUNT	SOP_PER	LAB_PER	MAT_PER
AMOUNT	1.000000 0.0000	-0.130846 0.1868	-0.147888 0.1341	0.232609 0.0176
SOP_PER	-0.130846 0.1868	1.000000 0.0000	-0.431191 0.0001	-0.059604 0.5589
LAB_PER	-0.147888 0.1341	-0.431191 0.0001	1.000000 0.0000	-0.874925 0.0001
MAT_PER	0.232609 0.0176	-0.059604 0.5589	-0.874925 0.0001	1.000000 0.0000

NATIONAL DATA - REPAIR CONTRACT CATEGORY

N = 104 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	AMOUNT	SOP_PER	LAB_PER	MAT_PER
AMOUNT	1.000000 0.0000	0.048975 0.6274	-0.156032 0.1097	0.156904 0.1077
SOP_PER	0.048975 0.6274	1.000000 0.0000	-0.495773 0.0001	0.134042 0.1715
LAB_PER	-0.156032 0.1097	-0.495773 0.0001	1.000000 0.0000	-0.927069 0.0001
MAT_PER	0.156904 0.1077	0.134042 0.1715	-0.927069 0.0001	1.000000 0.0000

NATIONAL DATA - MINOR CONSTRUCTION CONTRACT CATEGORY

N = 103 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	AMOUNT	SOP_PER	LAB_PER	MAT_PER
AMOUNT	1.000000 0.0000	0.071041 0.5172	-0.127847 0.1952	0.112728 0.2557
SOP_PER	0.071041 0.5172	1.000000 0.0000	-0.465538 0.0001	0.084841 0.6014
LAB_PER	-0.127847 0.1952	-0.465538 0.0001	1.000000 0.0000	-0.921333 0.0001
MAT_PER	0.112728 0.2557	0.084841 0.6014	-0.921333 0.0001	1.000000 0.0000

NATIONAL DATA - SERVICE CONTRACT CATEGORY

N = 91 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	AMOUNT	SOP_PER	LAB_PER	MAT_PER
AMOUNT	1.000000 0.0000	-0.082395 0.5564	0.173459 0.0962	-0.152464 0.1453
SOP_PER	-0.082395 0.5564	1.000000 0.0000	-0.328466 0.0019	-0.029872 0.7755
LAB_PER	0.173459 0.0962	-0.328466 0.0019	1.000000 0.0000	-0.934283 0.0001
MAT_PER	-0.152464 0.1453	-0.029872 0.7755	-0.934283 0.0001	1.000000 0.0000

Results at Intersection of AMOUNT and LAB_PER

- 0.147888

0.1341

The first portion of the results indicates a correlation coefficient of - 0.14788 exists between the variables AMOUNT and LAB_PER. The second value is the significance probability of the correlation coefficient which is the probability that a correlation coefficient that large or larger in absolute value would arise by chance were the random variables truly independent (i.e., were the corresponding population rho=0). That probability is based on the assumption that the values are realizations of random variables having a bivariate normal distribution (8, 208). Therefore, since it is giving the PROB > |R| under H_o: RHO = 0, at a level of significance of .05, it must be concluded that since the probability of .1341 > .05, one can not reject the null hypothesis that RHO, the population correlation coefficient is not statistically significant at the .05 level of significance.

As can be seen by scanning the results in column one of Table 5.1, the absolute values of the correlation coefficients are small, and one must conclude that no correlation exists between AMOUNT and the variables SOP_PER, LAB_PER, and MAT_PER.

The same correlation procedure was used to detect correlation between the average hourly skilled rate (CITY-AVG) that prevails in an area, versus the weighted aggregate indicated and adjusted shop rates (WISHOP and WASHOP) at the base in that respective area. It was initially postulated that since the civilian pay scales for military workers are contingent on the prevailing hourly rates in the area that a correlation would exist. The hourly rates used in the procedure are shown, by base, in Table 5.2. The results of the correlation procedure were contrary to what was initially postulated and are shown in Table 5.3.

The results were conclusive that there was no correlation between CITY-AVG and the variables WISHOP and WASHOP. However, it should be noted that correlation does exist between WISHOP and WASHOP. This fact was completely predictable if one recalls that WASHOP was derived from WISHOP by deleting the Fixed Cost Center Expenses (FCCE) of TDY, Vehicle, and Supplies. The next section will detail the procedures that will be used in developing the manhour models.

TABLE 5.2

HOURLY RATES USED IN ANALYSIS

Base	Average City Rate ($/hr) (CITY-AVG)	Weighted Indicated Shop Rate ($/hr) (WISHOP)	Weighted Adjusted Shop Rate ($/hr) (WASHOP)
Bolling	9.88	7.45	6.92
Charleston	5.71	8.49	8.49
Edwards	11.34	8.27	7.55
Elmendorf	13.64	9.75	8.03
Grand Forks	8.40	7.90	6.75
Hanscom	10.71	9.57	9.00
Hill	8.80	10.14	7.87
Kelly	8.02	9.47	8.61
Kirtland	7.97	8.79	7.71
Lowry	9.57	8.10	7.70
Malmstrom	8.60	9.11	7.63
Maxwell	8.32	9.32	8.01
Moody	7.44	8.87	8.25
Nellis	10.15	8.46	7.50
Offutt	8.90	8.72	7.57
Richards-Gebaur	10.45	7.80	6.97
Scott	10.71	8.99	8.07
Seymour-Johnson	7.48	10.40	8.66
Tinker	8.66	9.18	8.02
Tyndall	8.64	7.17	6.49
Williams	10.27	9.32	8.40
Wright-Patterson	10.14	9.53	8.45

TABLE 5.3

HOURLY RATE CORRELATION RESULTS - 22 BASES

	CITY-AVG	WASHOP	WISHOP
CITY-AVG	1.0000 0.0000	-0.107039 0.6401	0.013008 0.9530
WASHOP	- .107039 0.6401	1.0000 0.0000	0.805147 0.0001
WISHOP	0.013008 .9530	0.805147 .0001	1.0000 0.0000

Model Development

A. Theory and System Logic

The procedure for developing the manhour models is a straightforward process once the reader is familiar with the terminology and concepts used to this point. Figure 5.1 illustrates the steps that will be followed in development of the models both on a National and Rate Grouping basis for the four contract categories. One of the most important steps in the analysis is the determination of the labor dollars for each individual contract. Recall that in the questionnaire, the project engineer most familiar with each contract was tasked with identifying the percentage breakout for supervision, overhead, and profit; labor; and material. In order to determine labor dollars for each contract, the percent labor (LAB-PER) was multiplied by the contract dollar amount (AMOUNT) to yield labor dollars. Once the labor dollars are determined, the estimated contractor hours (ECON_HRS), estimated indicated equivalent hours (EINHSE_I), and the estimated adjusted equivalent hours (EINHSE_A) can be calculated for each contract. It is important to note that the item of most concern is the estimated adjusted equivalent hours, EINHSE_A, which is the equivalent in-house hours based on this researcher's approach. ECON-HRS and EINHSE_I will be shown strictly for comparison purposes.

To aid in the computations and understanding of the procedure, the following formulas are provided:

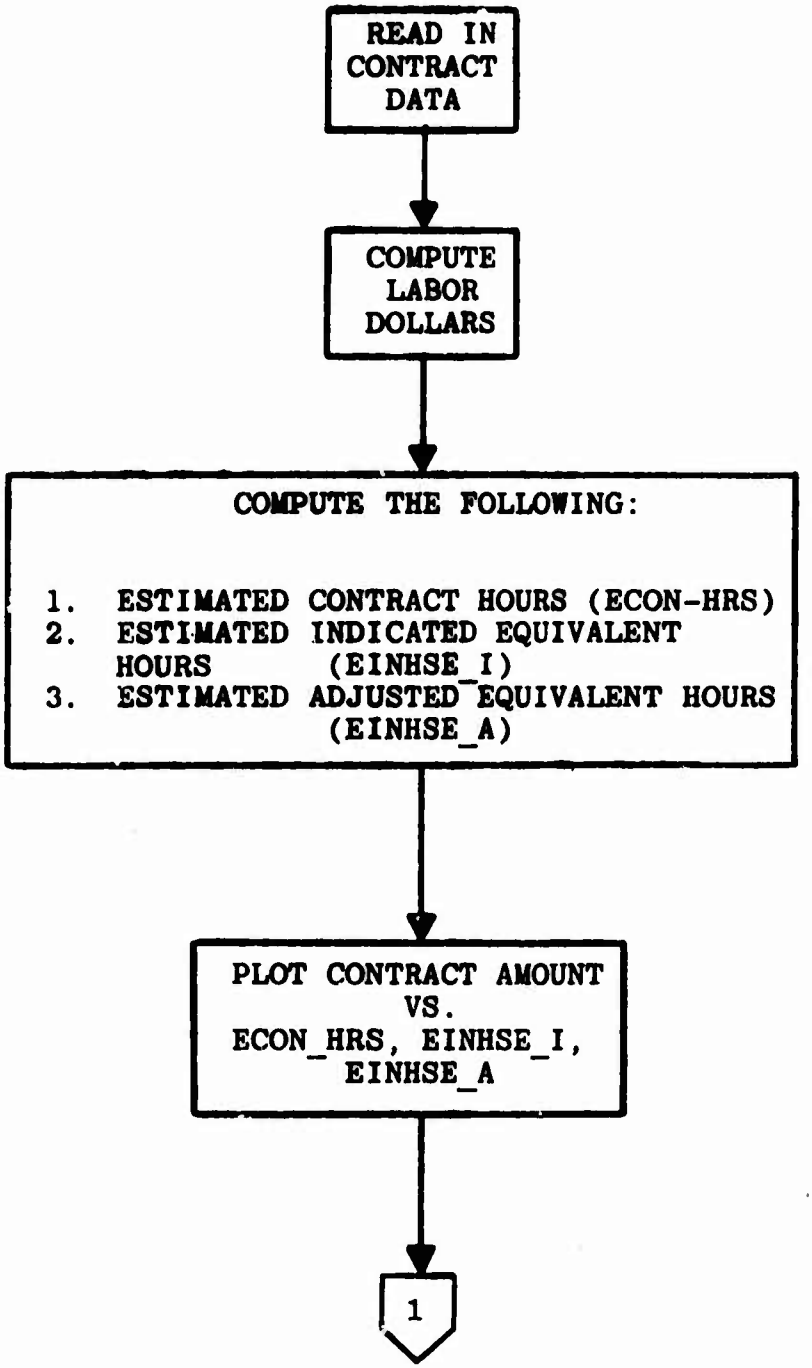

Figure 5.1. Macro flow chart--development of manhour models

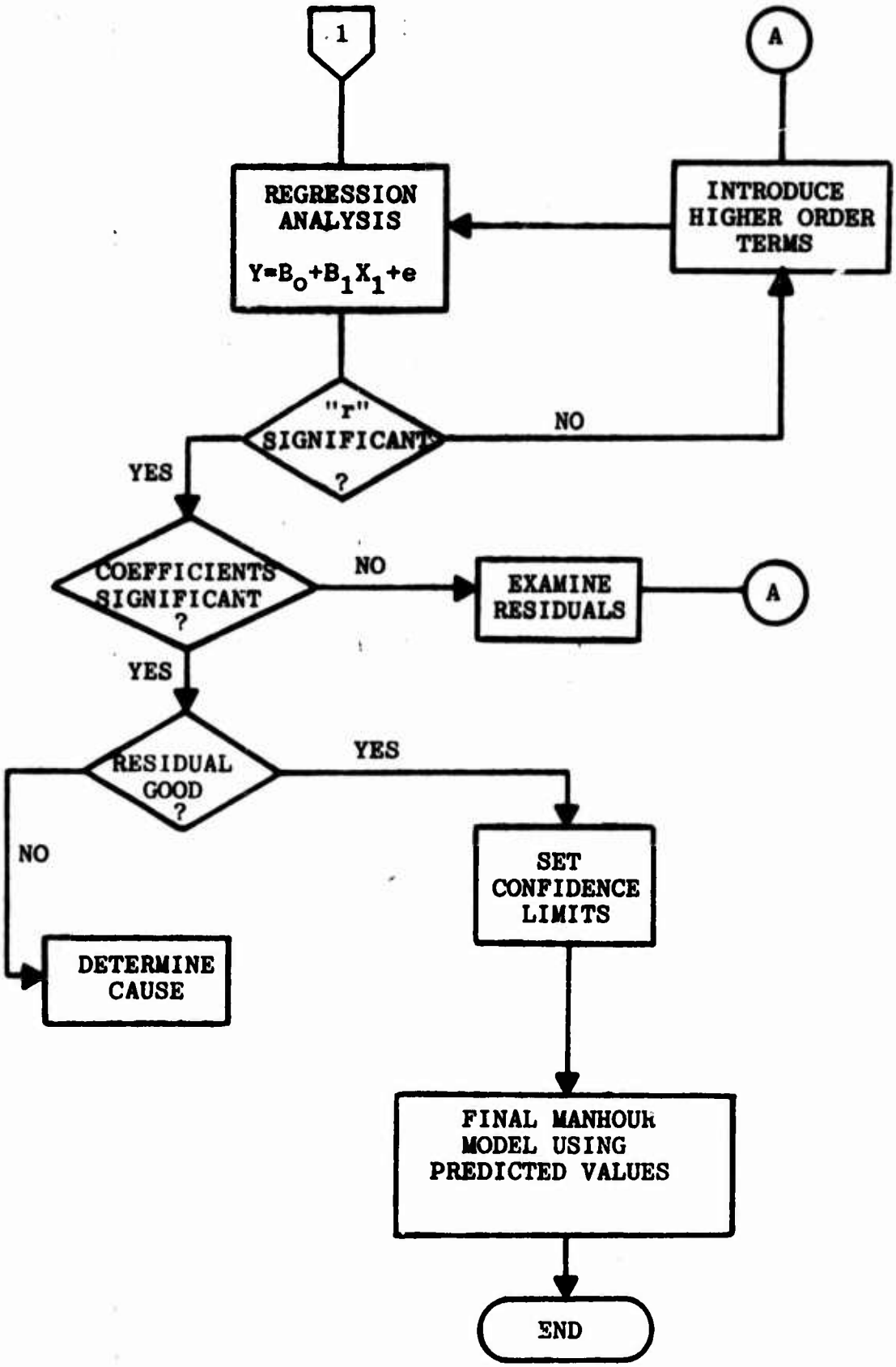

Figure 5.1 (Continued). Macro flow chart--development of manhour models

1. ECON-HRS = $\frac{\text{Labor Dollars per Contract (MNLAB,RPLAB,MCLAB,SVLAB)}}{\text{Skilled Hourly Construction Rate (CITY-AVG)}}$

where:

CITY-AVG = skilled hourly rate prevailing in the area where the contract was performed.

MNLAB = labor dollars on Maintenance Contracts

RPLAB = labor dollars on Repair Contracts

MCLAB = labor dollars on Minor Construction Contracts

SVLAB = labor dollars on Service Contracts

2. EINHSE-I = $\frac{\text{Labor Dollars per Contract}}{\text{Weighted Aggregate Indicated Shop Rate (WISHOP)}}$

where:

WISHOP = the weighted aggregate indicated shop rate which includes all Fixed Cost Center Expenses (FCCE) at the particular base where the contract was performed.

3. EINHSE-A = $\frac{\text{Labor Dollars per Contract}}{\text{Weighted Aggregate Adjusted Shop Rate (WASHOP)}}$

where:

WASHOP = the weighted aggregate adjusted shop rate which includes only those FCCE's that parallel the expenses incurred by a civilian contractor at the particular base where the contract was executed.

NOTE: Table 5.2 identifies the hourly rates assigned to CITY-AVG, WISHOP, and WASHOP, respectively.

The above computations will be accomplished for each project, by contract category. Each of the manhour variables will then be plotted against its respective contract dollar amount in order to determine if the data fits a pattern

that is identifiable. Regression analysis, which employs the method of least squares, will then be used to examine the data in an effort to identify dependency relationships between independent and response (dependent) variables, in order that the manhour forecast models be determined. Based on the approach of this researcher, only two variables were considered in the regression analysis, namely; manhours, which is the response variable, and the contract dollar amount, which is the independent variable. Once the model is tested using the above two variables, the Statistical Analysis System (SAS) indicates the coefficient of determination, r^2, from which the correlation coefficient, r, can be determined by taking the square root. The correlation coefficient is a measure of the degree of closeness of the linear relationship between two variables. If the correlation coefficient, r, is not statistically significant (9, 174), the only alternative is to introduce a higher order variable since there are only two variables under consideration. If this fails, a different research approach must be taken to yield equivalent in-house hours.

Since the correlation coefficient is only one indicator of fit, the residual values must then be analyzed for insight into how the model can be improved or as a further check on the accuracy of the model. Once it is shown that the residuals fall randomly within a horizontal band and

exhibit no discernible pattern, and the coefficients are checked for significance, the final phase of model development requires that confidence intervals be placed around the predicted response values.

B. Model Results

The data was analyzed using the procedure in Figure 5.1; the manhour data was calculated, by contract category, for each contract obtained in the survey and is shown in Appendix E. In the development of both the National and Rate Grouping manhour models, all models were determined to be linear and represented by the general form: $Y = B_o + B_1X + e$. Since there was very little flexibility in the development of the models, it would have been necessary to revise the complete approach to model development if a simple bivariate model could not be fitted to the data. In all cases, the correlation coefficients were proven to be statistically significant at 95% confidence (9, 557). The sum of squared residuals was very high in all cases; however, this was attributed mainly to approximately 10% of the values that showed large residual values in contracts over $100,000. Since this is an initial research effort and very little data was obtained on contracts over $100,000, this researcher determined that it would be more representative to retain the extreme values in order not to bias the research

results. The residual values were, however, checked for random dispersion and in the opinion of this researcher no pattern was exhibited.

As was pointed out in Chapter IV, the "Rate Grouping" technique was used solely for the purpose of grouping the bases to obtain approximately the same dollar per hour labor rate. Due to the limited sample size, manhour models could only be developed for rate groupings which contained sufficient bases as per Table 3.2. As a result of the above constraint, coupled with the rate groupings in Table 4.11, only two (2) rate groupings could be analyzed. The equivalent manhour models were developed, by contract category, for three (3) special groupings. The groupings were as follows:

1. National - included all 22 bases regardless of prevailing hourly skilled rates.

2. Rate Grouping 3 - included bases with prevailing average hourly skilled rates in the range (7.75 - 8.74), which included the following bases: Tinker, Tyndall, Maxwell, Malmstrom, Kirtland, Kelly, and Grand Forks.

3. Rate Grouping 5 - included bases with prevailing average hourly skilled rates in the range (9.75 - 10.74), which included the following bases: Nellis, Williams, Wright-Patterson, Richards-Gebaur, Hanscom, Bolling, and Scott.

Tables 5.4 thru 5.6 illustrate the results obtained using the regression procedure, by contract category, for the above three groupings. It is important to note the

TABLE 5.4

NATIONAL DATA-EQUIVALENT IN-HOUSE MANHOUR MODELS (BY CONTRACT CATEGORY)

	Contract Category	Model	No. of Contracts	"r" For Model	"r" To Be Statistically Significant @ .95
1.	Maintenance	EINHSE_A = .0597 X AMOUNT	102	.880	.194
2.	Repair	EINHSE_A = 736.5 + .0383 X AMOUNT	104	.861	.193
3.	Minor Construction	EINHSE_A = .0466 X AMOUNT	103	.962	.193
4.	Service	EINHSE_A = .0901 X AMOUNT	91	.974	.205

TABLE 5.5

RATE GROUPING 3--EQUIVALENT IN-HOUSE MANHOUR MODELS (BY CONTRACT CATEGORY)

Contract Category	Model	No. of Contracts	"r" For Model	"r" To Be Statistically Significant @ .95
. Maintenance	EINHSE_A = .0587 X AMOUNT	33	.849	.335
. Repair	EINHSE_A = 1466 + .033 X AMOUNT	34	.871	.330
. Minor Construction	EINHSE_A = .0450 X AMOUNT	34	.975	.330
. Service	EINHSE_A = 111.6 + .065 X AMOUNT	35	.999	.325

TABLE 5.6

RATE GROUPING 5--EQUIVALENT IN-HOUSE MANHOUR MODELS (BY CONTRACT CATEGORY)

	Contract Category	Model	No. of Contracts	"r" For Model	"r" To Be Statistically Significant @ .95
1.	Maintenance	EINHSE_A = .0607 X AMOUNT	30	.928	.349
2.	Repair	EINHSE_A = -491.4 + .0703 X AMOUNT	31	.977	.344
3.	Minor Construction	EINHSE_A = .045 X AMOUNT	35	.890	.325
4.	Service	EINHSE_A = .0998 X AMOUNT	26	.992	.374

increase in the correlation coefficients in the Rate Groupings as compared to the National Data.

The detailed regression analysis results, 95% confidence intervals around the predicted line, and plots of the predicted versus observed equivalent in-house hours, EINHSE-A, are shown for the National and Rate Grouping data in Appendices G and H, respectively.

C. Constraints

Both the National and Rate Grouping equivalent in-house manhour models require clarification as to when each should be used. This researcher will list those items which can be considered of major importance in using the models.

1. NATIONAL MODELS

   A. The models in this category reduce the impact of the subjectivity that can be introduced at the local level when estimated inputs are determined concerning percentage breakout of a contractor's costs.

   B. The models are not accurate at the local level, for it can not compensate for the significant variability in the prevailing skilled hourly rates (i.e. Charleston - $5.71, and Edwards - $11.34). They are accurate, however, if a command is dispersed throughout the CONUS and consolidates the calculation of equivalent in-house hours for contracts at the headquarters level.

2. RATE GROUPING MODELS

A. Due to the limited sample size for each Rate Grouping, the subjectivity, introduced by estimating at the base level, is more pronounced in the development of the manhour models.

B. The manhour models determined for the two Rate Groupings are highly accurate at the local level and compensate for the local labor situation.

3. GENERAL CONSTRAINT OF THE MODELS

Due to the lack of contracts under $2,000 and over $100,000, the models can only be considered accurate within the range where the contracts were available. Accuracy below $2,000 or over $100,000 is questionable due to the residuals obtained especially for the larger contracts.

Summary of Findings

To present the findings in this chapter, the following summary is provided:

a. No correlation existed between the Contract Dollar Amount and the percentages attributed to supervision, overhead, and profit; labor; and material.

b. No correlation existed, on a National basis, between the prevailing average skilled hourly rates and the weighted aggregate adjusted and indicated shop rates at the bases.

c. Correlation exists between the weighted aggregate adjusted and indicated shop rates (WASHOP and WISHOP) which was predictable since WASHOP was derived from WISHOP, less the Fixed Cost Center Expenses of Vehicle, TDY, and Supplies.

d. Equivalent manhour models were successfully developed using bivariate models, by contract category, for the National data and two (2) Rate Groupings. All models were highly correlated and coefficients were tested for significance. Tables 5.4 thru 5.6 illustrate the models developed.

CHAPTER VI

APPLICATIONS AND PROCEDURES

Introduction

The purpose of this chapter is to present the procedures necessary to use the equivalent in-house manhour models at both the command and base levels. A logic flow chart will be presented to guide the user in a step by step process to determine whether or not a particular contract should be considered for calculation of manhour equivalents. Sample problems will be presented for both the National and Rate Grouping categories and also the limitations of the models developed.

Logic Flow Chart

Figure 6.1 details the procedures required to ascertain whether or not a contract should be considered for inclusion and how to calculate equivalent in-house manhours. Recall from Chapter I that only the contract categories of Maintenance, Repair, Minor Construction, and Service Contracts are under consideration; all other contract categories (i.e. MCP and P 341) are considered out of the realm of in-house accomplishment. Even though the contract categories have been carefully screened, further restrictions exist

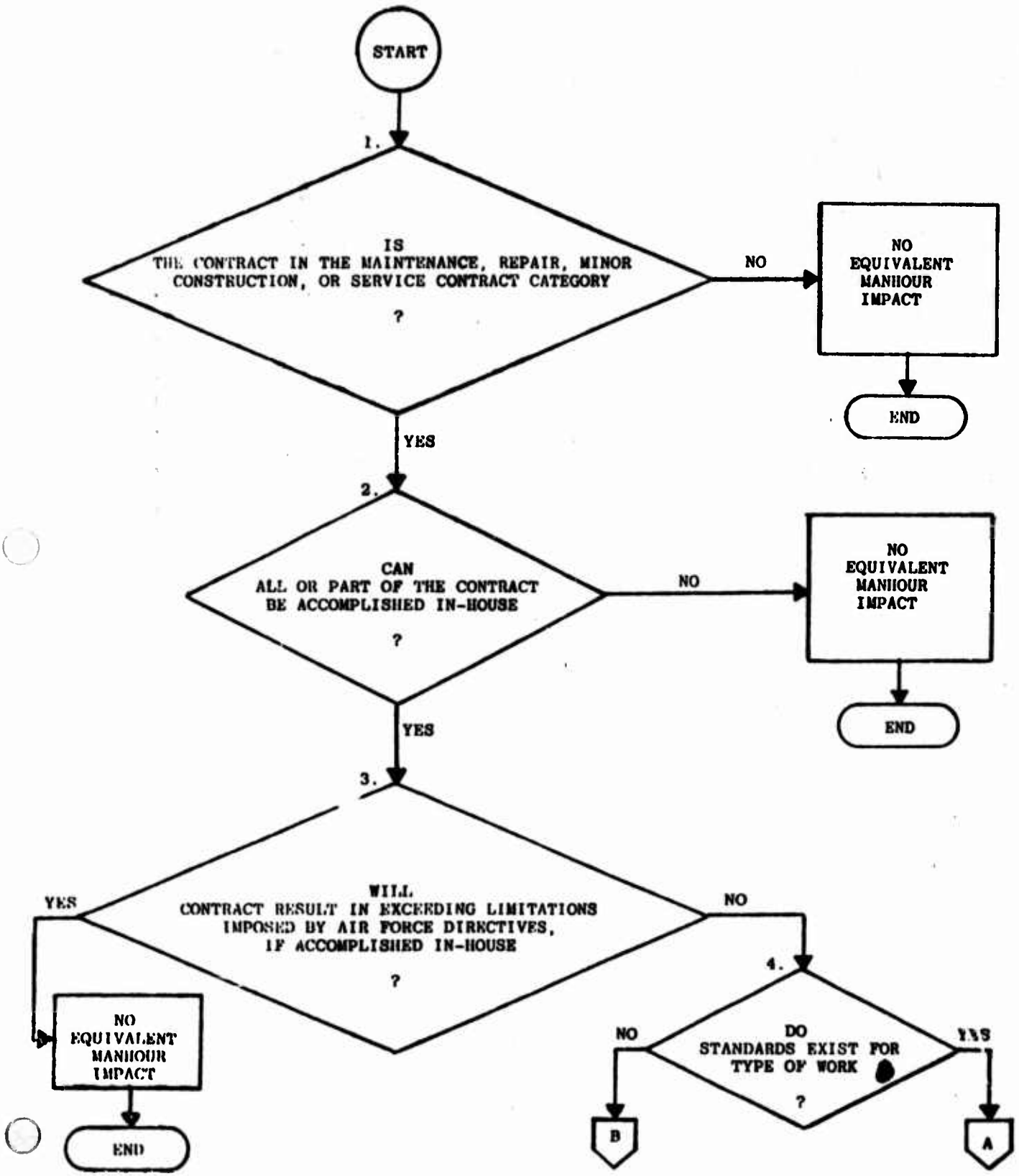

Figure 6.1. Logic flow chart--equivalent manhour procedure

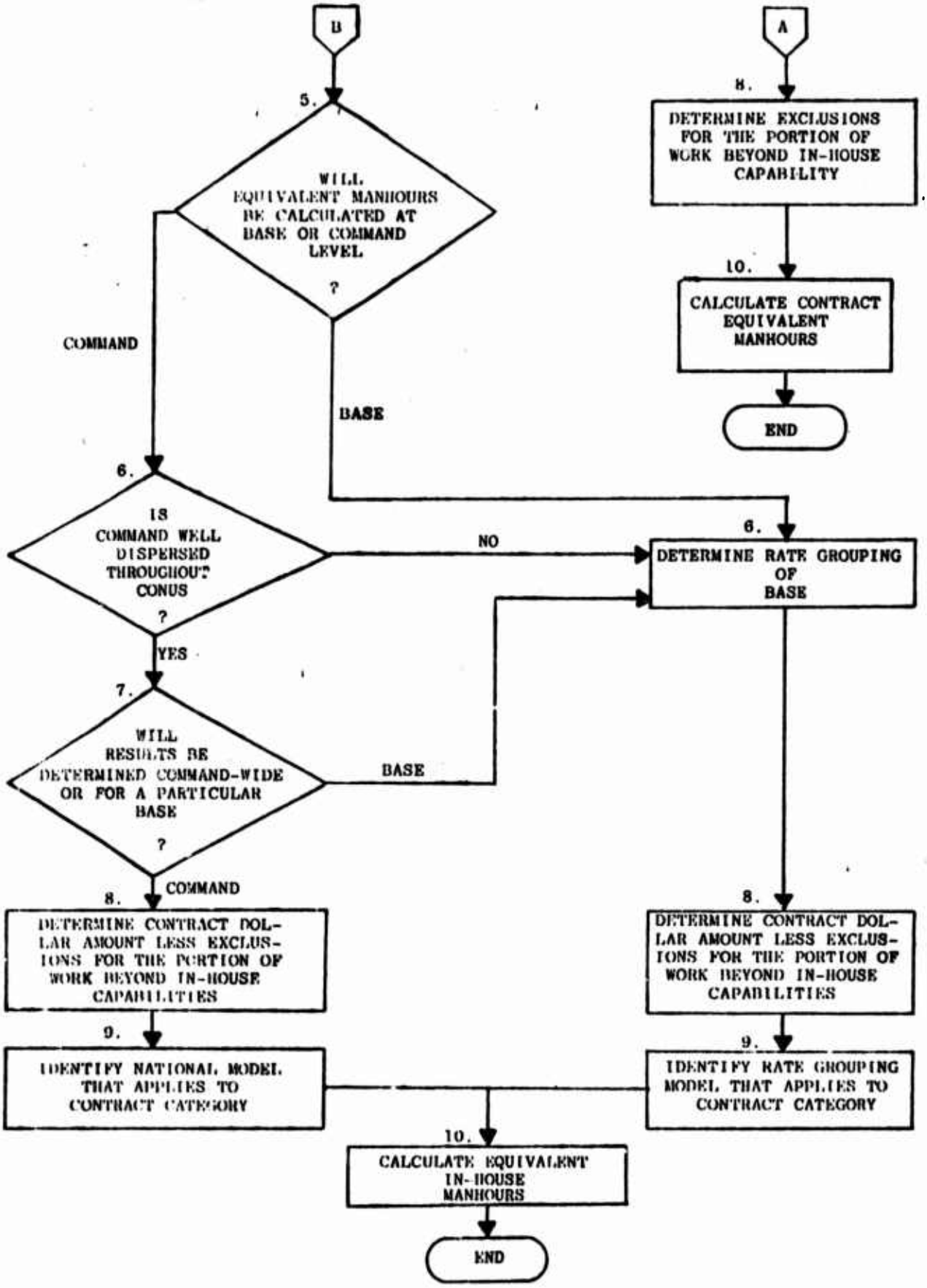

Figure 6.1 (Continued). Logic flow chart--equivalent manhour procedure

within each contract category that may nullify applying the procedure to a given contract. The following steps parallel the logic in Figure 6.1 and will aid in the application of the procedure:

1. Identify the contract category of the facility contract under consideration. If the contract is not in either the Maintenance, Repair, Minor Construction, or Service Contract category, the contract should be removed from consideration. If the contract is in one of the above categories, proceed to the next step.
2. The Base Civil Engineer (BCE) must determine whether all or part of the contract is within the capability of the in-house forces to accomplish. If all or part of the contract requires skills or equipment that are not available in-house, that portion of the contract should be removed from consideration for there is no equivalent manhour impact. If, on the other hand, the expertise exists in-house and the equipment is available, proceed to the next step. (NOTE: If the capability exists in-house, however, but due to the lack of in-house manhours or funds the contract approach was used, this contract must be considered for further evaluation and the user is to proceed to the next step.)

3. If the scope of the contract is within in-house capability, the BCE must ascertain if the contract would result in exceeding limitations imposed by Air Force directives if accomplished in-house (i.e., if a contract is in the Minor Construction category and the estimated in-house manhours to accomplish the work would put the base over the 5% limitation on total manhours, this contract should be removed from consideration). If no limitations will be exceeded, all or part of the contract will be used in calculating equivalent manhours.
4. Once it has been determined that contract equivalent manhours will be calculated for a particular contract, the local Management Engineering Personnel (MEP) must check Air Force Manual 26-3 to see if standards have already been developed for the work centers involved in that type of contract. If they are available, contract equivalent manhours should be calculated at this point. If the standards are not available, the methodology in this research effort will be used.
5. In order to determine which equivalent manhour model to use, the user must decide at what level the computations would be made, either command or base.

6. If at the base level, the user must determine in what rate grouping the base is located, in order that the proper equivalent manhour model be applied. If the user is applying the procedure at the command level, a decision must be made as to whether or not the particular command is well dispersed throughout the CONUS. If the bases within that particular command are well dispersed, the National manhour models may be used; if not, the calculations must be made by base after their respective rate grouping is determined.
7. If a command is well dispersed throughout the CONUS and intends to compile the results command-wide, the National models can be used with a high degree of accuracy. If a command compiles the results to assess the impact at each base, the rate grouping for the base must be determined before proceeding any further.
8. The BCE must determine the total contract dollar amount, less any exclusions for the portion of work beyond in-house capability, to be used in the equivalent manhour model.
9. MEP must then select the proper equivalent manhour models, either National or on a Rate Grouping basis, that should be applied to the respective contract category.

10. Finally, the MEP have now reached the point where contract equivalent manhours can be calculated.

Sample Problems

The purpose of the following problems is to assist in the application of the methodology developed in this research. The procedures in both problems parallel the steps illustrated in Figure 6.1.

A. Use of the National Manhour Models

Headquarters Air Training Command, which is well dispersed throughout the CONUS, has decided that contract equivalent manhours will be calculated at the headquarters to assess the manhour impact, command-wide, of their facility contracts. The data received from the bases is as follows:

Project Number	Base	Contract Category	Total Contract Dollar Amount (Less Exclusions)
LO 5-1	Lowry	Mtce	$35,000
MO 5-2	Moody	Mtce	$43,200
MO 5-3	Moody	Repair	$27,000
WM 5-4	Williams	MC	$26,200

The methodology used in analyzing the problem is as follows:

1. Verify the contract categories to insure that the categories are included as one of the four types that have been stipulated.

2. Since the contracts were submitted by the base, insure that they can be accomplished in-house.
3. Insure that the contracts submitted by the bases are not in violation of existing Air Force directives if they were to be accomplished in-house.
4. Perform a check of existing standards to identify that none were available for the type of work being considered.
5. As the problem states, the equivalent manhour calculations will be accomplished at the command level.
6. Check to determine if the bases in that command are well dispersed throughout the CONUS.
7. If the results are to be calculated for the entire command, the National manhour models can be used.
8. Portions of the contract which can not be accomplished in-house have been removed from the total contract dollar amount at base level before submission to the command.
9. Since the National manhour models apply, the models required for these calculations are in the Maintenance, Repair, and Minor Construction categories. Recall from Table 5.4 that the respective equivalent manhour models are as follows:

Contract Category	Manhour Models
Maintenance	EINHSE-A = .0597 X AMOUNT
Repair	EINHSE-A = 736.5 + .0383 X AMOUNT
Minor Construction	EINHSE_A = .0466 X AMOUNT

10. The calculations, by contract, are as follows:

Maintenance

a. EINHSE_A = .0597 X (35,000) = 2119.4 manhours

b. EINHSE_A = .0597 X (43,200) = 2579.0 manhours

Repair

EINHSE_A = 736.5 + .0383 X (27,000) = 1770.6 manhours

Minor Construction

EINHSE_A = .0466 X (26,200) = 1220.9 manhours

Summary of Results

Total Impact = 2119.4 + 2579.0 + 1770.6 + 1220.9

= 7689.9 manhours

TOTAL IMPACT (MANYEARS) = $\frac{7689.6}{1728}$ = 4.5 manyears

NOTE: The Air Force factor to convert manhours to manyears is 1728 manhours/manyear.

B. Use of Rate Grouping Manhour Models

Wright-Patterson AFB is in the process of determining total contract equivalent manhours for its contract effort

during FY 75. After a review of the contracts was accomplished by Base Civil Engineering, the following contracts were submitted for evaluation:

Project Number	Contract Category	Contract Amount (Less Exclusions)
WP 4-5	Mtce	$86,300
WP 4-12	Repair	$51,600
WP 4-8	MC	$46,200
WP 4-23	Service	$81,000

The methodology used in analyzing the problem is as follows:

1. Verify the contract categories to insure that the categories are included as one of the four types that have been stipulated.
2. Insure that the contracts can be accomplished in-house.
3. Insure that the contracts are not in violation of existing Air Force directives if they were to be accomplished in-house.
4. Perform a check of existing standards to identify that none were available for the type of work being considered.
5. Since the calculations are being performed at the base level, determine the Rate Grouping of the base.
6. Recall from Table 4.11 that Wright-Patterson AFB is located in Rate Grouping 5.

7. Does not apply for calculations at the base level.

8. Portions of the Total Contract Dollar Amount which can not be accomplished in-house have been removed.

9. Recall from Table 5.6, the equivalent manhour models for Rate Grouping 5 are as follows:

Contract Category	Manhour Models
Maintenance	EINHSE_A = .0607 X AMOUNT
Repair	EINHSE_A = -491.4 + .0703 X AMOUNT
Minor Construction	EINHSE_A = .045 X AMOUNT
Service	EINHSE_A = .0998 X AMOUNT

10. The calculations, by contract, are as follows:

Maintenance

EINHSE_A = .0607 X (86,300) = 5238.4 manhours

Repair

EINHSE_A = -491.4 + .0703 X (51,600) = 3136.1 manhours

Minor Construction

EINHSE_A = .045 X (46,200) = 2079.0 manhours

Service

EINHSE_A = .0998 X (81,000) = 8083.8 manhours

Summary of Results

Total Impact (manhours) = 5238.4 + 3136.1 + 2079.0 + 8083.8

= 18537.3 manhours

Total Impact (Manyears) = $\frac{18537.3}{1728}$ = 10.73 manyear

Model Limitations

1. Since over 85% of the contracts were under $100,000, potential users should restrict their applications to the above dollar amount until additional contract data may be obtained to assess the impact on the manhour models over $100,000.
2. Due to the lack of contract data for contracts under $2,000, some National and Rate Grouping manhour models show significant intercepts which essentially point out that if there are zero contract dollars, the equivalent in-house manhours will be equal to the intercept. This is not a desirable result. The user must be cognizant of this fact and not use the manhour models for contracts under $2,000 when an intercept exists in the manhour models. Additional contract data must be gathered to evaluate the impact on the manhour models under $2,000.
3. The National manhour models are not valid at the local bases and should only be used to assess the manpower impact, command-wide, throughout the CONUS.
4. Due to the limited sample size, the equivalent manhour models for bases in only two rate groupings could be determined. Additional contract data must be obtained in order to complete the models for the other six rate groupings.

CHAPTER VII

FINAL ANALYSIS AND RECOMMENDATIONS

Introduction

To this point efforts have been concentrated on developing a methodology to calculate contract manpower equivalents. In the opinion of this researcher, the study was successful in that an objective technique was developed to calculate contract manpower equivalents, coupled with simplified procedures for use of the manhour models developed. In all cases, the detailed findings were presented at the end of each chapter when appropriate. The remainder of this report will concentrate on the researcher's overall conclusions on the study and possible recommendations for future research efforts in this area.

Conclusions on the Methodology Developed

Since no previous research efforts were concentrated in this area, no direct comparisons can be made between existing procedures and the procedures developed in this research. However, this researcher will present what he feels are the most important conclusions that can be made, based on the methodology and procedures developed. The conclusions are as follows:

1. No comparison could be made to any existing reports due to the format in which the data was received on these reports. In all cases contracts were combined, regardless of contract category, which precluded any valid comparisons. This researcher does acknowledge the fact that the methodology developed does not have the precision of an AFR 26-12 review. The AFR 26-12 review is a detailed effort to determine whether or not a service should go in-house or contract; it itemizes all costs associated with both methods to determine which method of accomplishment is most economical. The methodology developed in this research effort does not consider productivity and is geared to providing equivalent in-house manhours that could be obtained with a given contract dollar amount.
2. This research provides a common interpretation of contract manpower equivalents which rules out the possibility of misinterpretation at all levels of command.
3. It was statistically proven that a significant difference exists between the contract categories of Maintenance, Repair, Minor Construction, and Service which precludes combining all contract categories as was accomplished in the past.

4. It was statistically proven that equivalent in-house manhour models could be developed, by contract category, and that simplified procedures could be formulated for application of the manhour models. The models developed are standardized and allow for direct comparison between commands and bases.
5. The "Rate Grouping" technique is a viable means for combining bases and reducing subjectivity at the local level. The manhour models developed can be used at the national level, when the results are desired for a group of bases dispersed throughout the CONUS, or on the local level using the models developed within a rate grouping.
6. All that is required to use the manhour models is the total contract dollar amount, less exclusions for work that is not within in-house capability. It is important to note that unless the procedures developed in this research for using the models are strictly adhered to, subjectivity may be introduced at the local level which may bias the inputs. USAF/PRM/PRE must be highly cognizant of the above when developing the implementation plan, if the procedure is approved.
7. The manhour models must be used only for contracts in the range of $2,000-$100,000; any extrapolation

beyond these points is highly discouraged and would represents misuse of the manhour models. A manual procedure must be used for contracts under $2,000; however, it is highly unlikely that contracts beyond $100,000 are within in-house capability.

8. It is imperative that USAF/PRM/PRE recognize that a significant difference can exist between rate groupings for a given contract dollar amount, regardless of the prevailing average skilled hourly rates. Recall from Chapter IV, the average skilled hourly rates were used only for grouping the bases; the manhour models, on the other hand, were developed using the labor portion of a given contract and the weighted aggregate adjusted shop rates at the given bases. Since there is no correlation between shop rates and skilled hourly rates; it is very possible to have a base in a high rate grouping obtain more equivalent in-house manhours per contract than a lower rate grouping. This will result from either a larger labor portion of the contracts or lower weighted aggregate adjusted shop rates. The models are highly accurate at the base level due to the correlation between the predicted values, using the manhour models, and the observed values at each of the bases.

9. Approximately 12% of the contracts were classified as requiring unskilled labor, over 50% of which were in the Service Contract category. This researcher could determine no way of objectively ascertaining unskilled hourly in-house rates and hence, could not develop unskilled equivalent in-house manhour models. The user must be cognizant of this fact and expect to obtain lower equivalent in-house manhours for the unskilled contracts, since the weighted aggregate adjusted shop rates, which represents the skilled in-house shop rates, were used in the development of the manhour models.

Recommendations for Future Efforts

The recommendations for future research efforts can best be summarized as follows:

1. If the procedure is approved, it is highly recommended that additional bases be sampled in order to complete the manhour models for the other six (6) rate groupings.
2. The procedure developed can be used, utilizing the "Rate Grouping" technique, to calculate the RIMILOC values provided that objective measures of productivity for both the in-house and contract forces can be determined. The procedure developed

will yield estimated total contractor hours for a given contract dollar amount which is calculated regardless of productivity. If the productivity of the contractor is known, the contractor hours determined can be adjusted downward to obtain the hours if the contractor was 100% productive. The adjusted hours at 100% productivity can then be divided by the in-house rate to yield the RIMILOC value.

3. Once the rate grouping manhour models have been completed and the procedure implemented, this researcher recommends that a similiar study be performed after approximately two years to assess any differences that may have occurred, and if needed, modify the manhour models.

Summary

It is hoped that this research effort be recognized as one solution to the problem of contract manpower equivalents. Considering the results obtained, this researcher strongly recommends approval of the procedure developed in this research and completion of the study.

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APPENDIX A

GLOSSARY OF ABBREVIATIONS AND TERMS

ABBREVIATIONS

AAC - Alaskan Air Command

ADC - Air Defense Command

AFCS - Air Force Communications Service

AFLC - Air Force Logistics Command

AFSC - Air Force Systems Command

ATA - Actual Time Accounting

ATC - Air Training Command

AU - Air University

CONUS - Continental United States

HQCMD - Headquarters Command

MAC - Military Airlift Command

SAC - Strategic Air Command

TAC - Tactical Air Command

TERMS

Adjusted Aggregate Shop Rate - Aggregate Shop Rate less the Fixed Cost Center Expenses (FCCE) of material, TDY, and vehicle expenses.

Aggregate Shop Rate - the weighted average shop rate, weighted on the basis of anticipated direct manhours, for all cost centers authorized under the UDL.

Average Skilled Wage Rate - the average of 30 skilled wage rates for construction trades that exist in an area.

Contract Equivalent In-house Hours - the estimated in-house Civil Engineering manhours that can be obtained from a given total contract dollar amount.

Federal Wage Rate - the minimum hourly rate, per construction trade, to be paid for contracts under the Davis-Bacon Act.

Rate Grouping - the technique of grouping bases based on their prevailing Average Skilled Wage Rates.

Skilled Wage Rates - the prevailing hourly union rate for a construction trade in a given area.

Weighted Aggregate Adjusted Shop Rate - the Adjusted Aggregate Shop Rate for 16 cost centers in the Operations and Maintenance branch of Civil Engineering, weighted on the basis of anticipated direct manhours.

Weighted Aggregate Indicated Shop Rate - the Aggregate Shop Rate for 16 cost centers in the Operations and Maintenance branch of Civil Engineering, weighted on the basis of anticipated direct manhours.

APPENDIX B

BASE CONTRACT AND HOURLY RATE DATA

This appendix includes all the data used in the development of the methodology for this research effort. The data encompasses two main areas: Contract and Hourly Rate data. The contract data is for each of the categories of Maintenance, Repair, Minor Construction, and Service Contracts. The Hourly Rate data is presented by base and includes all pertinent information concerning the hourly rates prevailing at a particular base. To assist in interpreting the data, the following explanation is provided for each term in the data sets.

Base Contract Data

VARIABLE NAME	EXPLANATION
AMOUNT	Total Contract Dollar Amount
BASE	Installation which submitted the data
CATEGORY	Classification as to whether the job required skilled or unskilled labor
LAB-PER	The percent of the contract dollar amount attributed to labor
MAT-PER	The percent of the contract dollar amount attributed to material
PROJ-NUM	Base project number assigned to each facility contract
SOP-PER	The percent of the contract dollar amount attributed to supervision, overhead, and profit
TYPE	The contract category under consideration (i.e. MTCE-maintenance, etc)

Hourly Rate Data

VARIABLE NAME	EXPLANATION
ASHOP	The weighted hourly portion, based on direct manhours, assigned to the adjusted shop rate for each cost center
ASHOP-RT	Adjusted Shop Rate for each cost center
CATEGORY	Name of a cost center
CITY-AVG	Skilled average hourly construction rate prevailing in the area around a base
COST-CTR	Numerical designation for the work center
DIR-MHRS	Direct manhours available for each cost center after adjusting for productivity
ISHOP	The weighted hourly portion, based on direct manhours, assigned to the indicated shop rate for each cost center
ISHOP-RT	Indicated Shop Rate for each cost center
TMHRS	Total direct manhours for all cost centers being considered in analysis
UNION-RT	Union rate for each skill prevailing in the area around a particular base
WAGE-RTE	Current Federal Wage Rate for journeyman in the respective skills
WASHOP	Weighted Aggregate Adjusted Shop Rate (NOTE: The last value in the column represents the weighted aggregate adjusted shop rate for all the cost centers)

BASE CONTRACT DATA

BASE DATA - MAINTENANCE CONTRACTS

JOB	BASE	TYPE	PROJ_NUM	AMOUNT	SOP_PER	LAB_PER	PAT_PER	CATEGORY
1	NELLIS	MTCE	14-CCC4	84600	.170	.500	.330	SKILLED
2	NELLIS	MTCE	14-CCC3	22000	.170	.500	.330	SKILLED
3	NELLIS	MTCE	14-CCC65	8400	.170	.500	.330	SKILLED
4	NELLIS	MTCE	14-CCC3	22300	.170	.600	.230	SKILLED
5	NELLIS	MTCE	14-CCC2	55000	.170	.530	.300	SKILLED
6	MCDONNELL-PATTERSON	MTCE	22517	26603	.250	.380	.370	SKILLED
7	MCDONNELL-PATTERSON	MTCE	14-4	38223	.250	.500	.250	SKILLED
8	MCDONNELL-PATTERSON	MTCE	14-4	67962	.250	.330	.420	SKILLED
9	MCDONNELL-PATTERSON	MTCE	14-3	36975	.250	.490	.260	SKILLED
10	MCDONNELL-PATTERSON	MTCE	14-2	104790	.250	.550	.200	SKILLED
11	WILLIAMS	MTCE	14-CC461	55000	.210	.488	.302	SKILLED
12	WILLIAMS	MTCE	55-CC24	43000	.200	.400	.400	SKILLED
13	EDWARDS	MTCE	66-CC104	43000	.210	.490	.300	SKILLED
14	EDWARDS	MTCE	14-CC111	57000	.210	.590	.200	SKILLED
15	EDWARDS	MTCE	14-CC252	65000	.210	.670	.120	SKILLED
16	EDWARDS	MTCE	14-CC114	40000	.200	.630	.170	SKILLED
17	EDWARDS	MTCE	14-CC113	123000	.200	.630	.170	SKILLED
18	RICHARDS-GEBAUR	MTCE	14-CC55	73500	.250	.550	.200	SKILLED
19	RICHARDS-GEBAUR	MTCE	14-CC57	56600	.250	.550	.200	SKILLED
20	RICHARDS-GEBAUR	MTCE	14-CC58	30900	.250	.550	.200	SKILLED
21	RICHARDS-GEBAUR	MTCE	14-CC65	23700	.250	.550	.200	SKILLED
22	RICHARDS-GEBAUR	MTCE	14-CC2	36500	.250	.550	.200	SKILLED
23	HANSCOM	MTCE	14-CCC1	39500	.275	.570	.155	SEMI
24	HANSCOM	MTCE	14-CCC2	123000	.275	.570	.155	SEMI
25	HANSCOM	MTCE	14-CCC3	14900	.275	.475	.250	SKILLED
26	HANSCOM	MTCE	14-CCC8	52200	.275	.250	.475	SKILLED
27	HANSCOM	MTCE	14-CC4	400	.275	.725	.000	SEMI
28	KIRTLAND	MTCE	4C-14	57409	.200	.560	.240	SEMI
29	KIRTLAND	MTCE	22-14	43699	.270	.500	.230	SEMI
30	KIRTLAND	MTCE	14	14582	.200	.480	.320	SEMI
31	KELLY	MTCE	14	273000	.250	.250	.500	SEMI
32	KELLY	MTCE	14-4	16000	.250	.520	.230	SEMI
33	KELLY	MTCE	14	68000	.250	.750	.000	SEMI
34	KELLY	MTCE	18-14	25000	.250	.400	.350	SEMI
35	KELLY	MTCE	14-4	28000	.250	.380	.370	SEMI
36	MCCOY	MTCE	14	20000	.300	.590	.110	SKILLED
37	MCCOY	MTCE	14	30000	.100	.310	.590	SKILLED
38	MCCOY	MTCE	14	21700	.350	.180	.470	SEMI
39	MCCOY	MTCE	2C1-5	42153	.210	.310	.480	SEMI
40	MCCOY	MTCE	2C1-5	28251	.150	.600	.250	SKILLED
41	TINKER	MTCE	14-4	49800	.200	.400	.400	SEMI
42	TINKER	MTCE	142-3	50000	.200	.500	.300	SKILLED
43	TINKER	MTCE	66-2	29000	.200	.400	.400	SKILLED
44	TINKER	MTCE	14-3	60000	.200	.450	.350	SKILLED
45	TINKER	MTCE	7-3	216700	.200	.450	.350	SKILLED
46	MAXWELL	MTCE	24-CCC05-2	25400	.250	.590	.160	SKILLED
47	MAXWELL	MTCE	14-CCC17-2	27900	.250	.480	.270	SKILLED
48	MAXWELL	MTCE	24-CC28-2	18000	.250	.480	.270	SKILLED
49	MAXWELL	MTCE	14-CC1C	30100	.250	.500	.250	SKILLED
50	MAXWELL	MTCE	14-CC22	7300	.250	.500	.250	SKILLED
51	MALMSTROM	MTCE	14-CC12	84000	.250	.500	.250	SKILLED
52	MALMSTROM	MTCE	14-CC03	114900	.250	.500	.250	SKILLED
53	MALMSTROM	MTCE	14-CC59	32000	.250	.500	.250	SKILLED
54	MALMSTROM	MTCE	14-CC02	220700	.250	.450	.300	SKILLED
55	MALMSTROM	MTCE	14-CC16	104000	.250	.500	.250	SKILLED

BASE DATA - MAINTENANCE CONTRACTS

OBS	BASE	TYPE	PROJ_NUM	AMOUNT	SOP_PER	LAB_PER	MAT_PER	CATEGORY
56	GRAND FORKS	MTCE	[illegible]-CC01	8600	.265	.535C	.2CCC	SKILLED
57	GRAND FORKS	MTCE	[illegible]-CC65	31500	.265	.4350	.3000	SKILLED
58	GRAND FORKS	MTCE	[illegible]-CC08	3100	.265	.535C	.2CCC	SKILLED
59	GRAND FORKS	MTCE	[illegible]-CC11	38900	.265	.2350	.2CCC	SEMISKILLED
60	GRAND FORKS	MTCE	[illegible]-CCC3	79600	.265	.535C	.2CCC	SKILLED
61	SEYMOUR-JOHNSON	MTCE	[illegible]-CC67	17949	.230	.650C	.1200	SKILLED
62	SEYMOUR-JOHNSON	MTCE	[illegible]-CC64	4809	.230	.630C	.1400	SKILLED
63	SEYMOUR-JOHNSON	MTCE	[illegible]-C133	38388	.230	.5000	.7CCC	SKILLED
64	SEYMOUR-JOHNSON	MTCE	[illegible]-CC138	47000	.230	.420C	.1CCC	SKILLED
65	SEYMOUR-JOHNSON	MTCE	[illegible]-0141	23800	.220	.4800	.1CCC	SKILLED
66	SCOTT	MTCE	[illegible]-2	59000	.200	.350C	.4500	SKILLED
67	SCOTT	MTCE	[illegible]-4	105430	.250	.4200	.3000	SKILLED
68	SCOTT	MTCE	[illegible]-3	43667	.200	.640C	.1600	SKILLED
69	OFFUTT	MTCE	[illegible]-CC78	57600	.300	.410C	.2500	SKILLED
70	OFFUTT	MTCE	[illegible]-CC73	23900	.260	.520C	.2200	SKILLED
71	OFFUTT	MTCE	[illegible]-CC12	1900	.280	.6000	.1200	SEMISKILLED
72	OFFUTT	MTCE	[illegible]-CC6C	1800	.320	.6300	.0500	UNSKILLED
73	OFFUTT	MTCE	[illegible]-C1C3	37400	.260	.640C	.1CCC	SKILLED
74	LOWRY	MTCE	[illegible]-4	42000	.265	.5512	.1888	SKILLED
75	LOWRY	MTCE	[illegible]-3	133378	.265	.3475	.2677	SKILLED
76	LOWRY	MTCE	[illegible]-0002	12000	.265	.5191	.1555	SKILLED
77	LOWRY	MTCE	[illegible]-3	98351	.265	.3725	.2255	SKILLED
78	HILL	MTCE	[illegible]-2	24000	.240	.540C	.2200	SKILLED
79	HILL	MTCE	[illegible]-2	43600	.230	.580C	.1900	SKILLED
80	HILL	MTCE	[illegible]-3	58400	.210	.6100	.1800	SKILLED
81	HILL	MTCE	[illegible]-3	49000	.180	.640C	.1800	SKILLED
82	HILL	MTCE	[illegible]-4	39500	.200	.6000	.2000	SKILLED
83	ELMENDORF	MTCE	[illegible]-CC02	24400	.060	.9400	.0000	SEMISKILLED
84	ELMENDORF	MTCE	[illegible]-CC47A	43100	.050	.650C	.3000	SKILLED
85	ELMENDORF	MTCE	[illegible]-CC48	161300	.100	.6000	.3000	SKILLED
86	ELMENDORF	MTCE	[illegible]-CC58	31300	.100	.6000	.3000	SKILLED
87	ELMENDORF	MTCE	[illegible]-CC19A	70200	.100	.5500	.3500	SKILLED
88	CHARLESTON	MTCE	[illegible]-4	191600	.250	.4500	.3000	SKILLED
89	CHARLESTON	MTCE	[illegible]-4	20600	.360	.3000	.3400	SKILLED
90	CHARLESTON	MTCE	1C2-4	59500	.320	.430C	.2500	SKILLED
91	CHARLESTON	MTCE	EC-4	52800	.320	.4300	.2500	SKILLED
92	CHARLESTON	MTCE	[illegible]-3	89800	.320	.430C	.2500	SKILLED
93	BOLLING	MTCE	[illegible]-CC53	32900	.210	.4470	.3430	SKILLED
94	BOLLING	MTCE	[illegible]-CC61	19200	.198	.3750	.4270	SKILLED
95	BOLLING	MTCE	[illegible]-CC07	36800	.215	.7000	.0850	SKILLED
96	BOLLING	MTCE	[illegible]-CCC5	31000	.200	.6130	.1870	SKILLED
97	BOLLING	MTCE	[illegible]-CC57	132000	.200	.4570	.3430	SKILLED
98	TYNDALL	MTCE	[illegible]-3	2401	.172	.747C	.0810	SKILLED
99	TYNDALL	MTCE	[illegible]-2	34738	.070	.684C	.2460	SKILLED
100	TYNDALL	MTCE	[illegible]	102267	.120	.750C	.1300	SKILLED
101	TYNDALL	MTCE	[illegible]	215600	.070	.684C	.2460	SKILLED
102	TYNDALL	MTCE	[illegible]-3	50000	.070	.6840	.2460	SKILLED

BASE DATA - REPAIR CONTRACTS

OBS	BASE	TYPE	PROJ_NUM	AMOUNT	SUP_PER	LAB_PER	MAT_PER	CATEGORY
1	WRIGHT-PATTERSON	REPAIR	320-4	8418	.250	.4900	.2600	SKILLED
2	WRIGHT-PATTERSON	REPAIR	6-2	27665	.200	.3500	.4500	SKILLED
3	WRIGHT-PATTERSON	REPAIR	371-3	47010	.250	.3900	.3600	SKILLED
4	WRIGHT-PATTERSON	REPAIR	323-4	26947	.250	.4700	.2800	SKILLED
5	WRIGHT-PATTERSON	REPAIR	319-4	20269	.250	.4800	.2700	SKILLED
6	WILLIAMS	REPAIR	74-0525	49000	.210	.4860	.3020	SKILLED
7	WILLIAMS	REPAIR	69-0065	22000	.209	.3330	.4580	SKILLED
8	WILLIAMS	REPAIR	74-0457	70000	.209	.3730	.4180	SKILLED
9	TYNDALL	REPAIR	23-3	135000	.095	.7000	.2050	SKILLED
10	TYNDALL	REPAIR	4-4	50000	.095	.7000	.2050	SKILLED
11	TYNDALL	REPAIR	40-5	39973	.095	.7000	.2050	SKILLED
12	TYNDALL	REPAIR	72-3	50000	.070	.6840	.2460	SKILLED
13	TYNDALL	REPAIR	104-2	9179	.120	.7500	.1300	SKILLED
14	TINKER	REPAIR	161-2	14100	.220	.4000	.3800	SKILLED
15	TINKER	REPAIR	195-2	121000	.220	.4300	.3500	SKILLED
16	TINKER	REPAIR	3-3	178800	.220	.3800	.4000	SKILLED
17	TINKER	REPAIR	53-4	49600	.220	.4300	.3500	SKILLED
18	TINKER	REPAIR	26-3	137500	.220	.4000	.3800	SKILLED
19	SEYMOUR-JOHNSON	REPAIR	75-0027	24954	.230	.3600	.4100	SKILLED
20	SEYMOUR-JOHNSON	REPAIR	72-0040	219099	.230	.1400	.6300	SKILLED
21	SEYMOUR-JOHNSON	REPAIR	75-0032	40060	.230	.6900	.0800	SKILLED
22	SEYMOUR-JOHNSON	REPAIR	71-0228	2999936	.230	.3200	.4500	SKILLED
23	SEYMOUR-JOHNSON	REPAIR	71-0074	23837	.230	.5700	.2000	SKILLED
24	SCOTT	REPAIR	62-1	12410	.200	.4000	.4000	SKILLED
25	SCOTT	REPAIR	13-1	18580	.250	.5300	.2200	SKILLED
26	SCOTT	REPAIR	59-2	77465	.250	.3500	.4000	SKILLED
27	RICHARDS-GEBAUR	REPAIR	74-0094	5900	.250	.5500	.2000	SKILLED
28	RICHARDS-GEBAUR	REPAIR	74-0104	22500	.250	.5500	.2000	SKILLED
29	RICHARDS-GEBAUR	REPAIR	74-0118	2400	.250	.5500	.2000	SKILLED
30	RICHARDS-GEBAUR	REPAIR	74-0129	13800	.250	.5500	.2000	SKILLED
31	RICHARDS-GEBAUR	REPAIR	74-5125	2000	.250	.5500	.2000	SKILLED
32	OFFUTT	REPAIR	74-0058	274800	.300	.4500	.2500	SKILLED
33	OFFUTT	REPAIR	73-0165	30500	.260	.1800	.5600	SKILLED
34	OFFUTT	REPAIR	73-0138	16500	.260	.6000	.1400	SKILLED
35	OFFUTT	REPAIR	74-0042	17200	.300	.4500	.2500	SKILLED
36	OFFUTT	REPAIR	69-0003	17200	.300	.5000	.2000	SKILLED
37	MAXWELL	REPAIR	74-0041	26500	.250	.4000	.3500	SKILLED
38	MAXWELL	REPAIR	75-0022	11800	.310	.3100	.3800	SKILLED
39	MAXWELL	REPAIR	74-0236	50900	.200	.2900	.5100	SKILLED
40	MAXWELL	REPAIR	75-CC49-2	44300	.270	.1700	.5600	SKILLED
41	MAXWELL	REPAIR	75-0105	10600	.300	.4900	.2100	SKILLED
42	MALMSTROM	REPAIR	73-0479	42200	.250	.3750	.3750	SKILLED
43	MALMSTROM	REPAIR	75-0103	15800	.250	.5650	.1850	SKILLED
44	MALMSTROM	REPAIR	75-6128	26300	.250	.4875	.2625	SKILLED
45	MALMSTROM	REPAIR	75-6124	6800	.250	.3000	.4500	SKILLED
46	LOWRY	REPAIR	XX-CC24AB	34753	.265	.5199	.2151	SKILLED
47	LOWRY	REPAIR	8-1	77593	.265	.4000	.3350	SKILLED
48	LOWRY	REPAIR	63-3	23906	.265	.4275	.3075	SKILLED
49	LOWRY	REPAIR	73-0059	196955	.265	.3936	.3414	SKILLED
50	KIRTLAND	REPAIR	110-4	29640	.200	.6400	.1600	SKILLED
51	KIRTLAND	REPAIR	21-4	70000	.200	.4800	.3200	SKILLED
52	KIRTLAND	REPAIR	269-4	19381	.200	.4800	.3200	SKILLED
53	KIRTLAND	REPAIR	78-3	134075	.200	.5600	.2400	UNSKILLED
54	KIRTLAND	REPAIR	238-4	171492	.200	.4800	.3200	SKILLED
55	KELLY	REPAIR	60-2	160000	.250	.3800	.3700	UNSKILLED

BASE DATA - REPAIR CONTRACTS

JOB	BASE	TYPE	PROJ_NUM	AMOUNT	SOP_PER	LAB_PER	MAT_PER	CATEGORY
5[illegible]	KELLY	REPAIR	201-4	46000	.250	.270	.480	SKILLED
37	KELLY	REPAIR	82-4	680000	.300	.260	.440	UNSKILLED
50	KELLY	REPAIR	87-4	11000	.250	.200	.550	SKILLED
59	KELLY	REPAIR	76-4	151000	.300	.400	.300	UNSKILLED
60	KELLY	REPAIR	15-4	35000	.250	.530	.220	UNSKILLED
61	KELLY	REPAIR	67-3	201300	.180	.430	.390	SKILLED
62	KELLY	REPAIR	41-4	40700	.220	.050	.730	SKILLED
63	KELLY	REPAIR	69-5	29400	.210	.410	.380	SKILLED
64	KELLY	REPAIR	160-5	17100	.240	.350	.410	UNSKILLED
65	GRAND FORKS	REPAIR	73-C0050	69100	.265	.435	.300	UNSKILLED
66	GRAND FORKS	REPAIR	73-0051	5600	.265	.485	.250	SKILLED
67	GRAND FORKS	REPAIR	73-0263	4000	.265	.135	.600	SKILLED
68	GRAND FORKS	REPAIR	73-0094	162800	.265	.235	.500	UNSKILLED
69	GRAND FORKS	REPAIR	74-0058	92400	.265	.135	.600	SKILLED
70	ELMENDORF	REPAIR	73-0099	242000	.200	.400	.400	SKILLED
71	ELMENDORF	REPAIR	74-0056	61300	.200	.500	.300	SKILLED
72	ELMENDORF	REPAIR	75-0047	188300	.050	.650	.300	SKILLED
73	ELMENDORF	REPAIR	75-0024	41100	.050	.750	.200	SKILLED
74	ELMENDORF	REPAIR	75-0050	39400	.050	.750	.200	SKILLED
75	EDWARDS	REPAIR	72-0222	45000	.240	.560	.200	SKILLED
76	EDWARDS	REPAIR	74-0218	45000	.220	.550	.230	SKILLED
77	EDWARDS	REPAIR	72-0306	49000	.200	.120	.680	SKILLED
78	[illegible]	REPAIR	74-0228	87000	.200	.220	.580	SKILLED
79	[illegible]	REPAIR	75-0216	193000	.250	.470	.280	SKILLED
80	[illegible]STON	REPAIR	36-4	224300	.300	.300	.400	SKILLED
82	[illegible]STON	REPAIR	43-4	96300	.250	.300	.450	SKILLED
83	[illegible]STON	REPAIR	66-4	49900	.250	.350	.400	SKILLED
84	[illegible]STON	REPAIR	52-4	19600	.300	.300	.400	SKILLED
85	BOLLING	REPAIR	57-5	31100	.320	.190	.490	SKILLED
86	BOLLING	REPAIR	72-0052	261600	.210	.516	.274	SKILLED
87	BOLLING	REPAIR	73-0069	29500	.337	.228	.435	SKILLED
88	BOLLING	REPAIR	74-0083	12700	.106	.0913	.8033	SKILLED
89	BOLLING	REPAIR	74-0107	44800	.200	.345	.455	SKILLED
90	BOLLING	REPAIR	75-0001	6100	.249	.400	.351	SKILLED
91	[illegible]	REPAIR	74-0011A	47000	.275	.375	.350	SKILLED
92	[illegible]	REPAIR	74-0011B	81300	.275	.375	.350	SKILLED
93	[illegible]	REPAIR	74-0030	24000	.275	.325	.400	SKILLED
94	[illegible]	REPAIR	74-0067	13000	.275	.200	.525	SKILLED
95	[illegible]	REPAIR	74-0119	30000	.275	.395	.330	SKILLED
96	MOODY	REPAIR	2-5	41263	.180	.410	.410	SKILLED
97	MOODY	REPAIR	27-2	14130	.200	.490	.310	UNSKILLED
98	MOODY	REPAIR	403-9	28547	.250	.280	.470	SKILLED
99	MOODY	REPAIR	14-3	16465	.350	.340	.310	SKILLED
100	MOODY	REPAIR	404-9	26364	.200	.260	.540	UNSKILLED
101	NELLIS	REPAIR	74-010822	700	.170	.430	.400	SKILLED
102	NELLIS	REPAIR	75-010043	500	.170	.430	.400	SKILLED
103	NELLIS	REPAIR	70-0125	38000	.170	.660	.170	SKILLED
104	NELLIS	REPAIR	75-0072	21000	.170	.430	.400	SKILLED
105	NELLIS	REPAIR	74-0011	11400	.170	.650	.180	SKILLED

BASE DATA - MINOR CONSTRUCTION CONTRACTS

JOB	BASE	TYPE	PROJ_NUM	AMOUNT	SUP_PER	LAB_PER	MAT_PER	CATEGORY
1	[illegible]	MC	434-3	4620	.250	.4700	.2800	SKILLED
2	[illegible]	MC	486-2	16600	.250	.2700	.4800	SKILLED
3	[illegible]	MC	230-2	8836	.270	.4300	.3300	SKILLED
4	[illegible]	MC	251-4	46241	.250	.4300	.3500	SKILLED
5	[illegible]	MC	210-4	24961	.250	.1400	.6100	SKILLED
6	[illegible]	MC	14-0452	31000	.210	.4530	.3370	SKILLED
7	[illegible]	MC	14-0445	43000	.250	.5000	.3500	SKILLED
8	[illegible]	MC	14-0465	13000	.210	.0970	.6930	SKILLED
9	[illegible]	MC	12-0007	39000	.210	.2740	.5160	SKILLED
10	[illegible]	MC	73-0213	9000	.210	.4980	.3020	SKILLED
11	TYNDALL	MC	88-4	19946	.070	.6840	.2460	SKILLED
12	TYNDALL	MC	22-3	3600	.070	.6840	.2460	SKILLED
13	TYNDALL	MC	47-3	12200	.070	.6840	.2460	SKILLED
14	TYNDALL	MC	62-4	8265	.070	.6840	.2460	SKILLED
15	TINKER	MC	258-2	43300	.250	.3500	.4000	SKILLED
16	TINKER	MC	201-4	21100	.250	.3500	.4000	SKILLED
17	TINKER	MC	151-2	34800	.250	.3500	.4000	SKILLED
18	TINKER	MC	149-2	39700	.250	.3500	.4000	SKILLED
19	TINKER	MC	72-4	10200	.250	.3500	.4000	SKILLED
20	SEYMOUR-JOHNSON	MC	72-0146	37946	.230	.4200	.3500	SKILLED
21	SEYMOUR-JOHNSON	MC	73-0141	22546	.230	.3300	.4400	SKILLED
22	SEYMOUR-JOHNSON	MC	74-0092	36774	.230	.1900	.5800	SKILLED
23	SEYMOUR-JOHNSON	MC	71-0190	7301	.230	.5100	.2600	SKILLED
24	SCOTT	MC	50-1	34897	.250	.4800	.2700	SKILLED
25	SCOTT	MC	63-3	25000	.200	.5000	.3000	SKILLED
26	SCOTT	MC	68-5	11421	.200	.5800	.2200	SKILLED
27	SCOTT	MC	54-8	36418	.200	.3000	.5000	SKILLED
28	SCOTT	MC	65-4	9523	.200	.3200	.4800	SKILLED
29	RICHARDS-GEBAUR	MC	74-0033	8600	.250	.5500	.2000	SKILLED
30	RICHARDS-GEBAUR	MC	74-0105	2000	.250	.5500	.2000	SKILLED
31	RICHARDS-GEBAUR	MC	74-0123	6900	.250	.5500	.2000	SKILLED
32	RICHARDS-GEBAUR	MC	74-0128	2200	.250	.5500	.2000	SKILLED
33	RICHARDS-GEBAUR	MC	74-3103	5100	.250	.5500	.2000	SKILLED
34	OFFUTT	MC	73-0040	50000	.300	.2500	.4500	SKILLED
35	OFFUTT	MC	67-0028	9800	.280	.4400	.2800	SKILLED
36	OFFUTT	MC	72-0030	6700	.280	.4800	.2400	SKILLED
37	OFFUTT	MC	72-0065	9000	.280	.4000	.3200	SKILLED
38	OFFUTT	MC	73-0131	20400	.280	.4200	.3000	SKILLED
39	MAXWELL	MC	13-0096	17900	.150	.4500	.4000	SKILLED
40	MAXWELL	MC	74-0012	21900	.250	.3000	.4500	SKILLED
41	MAXWELL	MC	74-0155	18700	.260	.1600	.5800	SKILLED
42	MAXWELL	MC	74-0206	37100	.170	.4500	.3800	SKILLED
43	MAXWELL	MC	74-0210	49000	.150	.3000	.5500	SKILLED
44	MALMSTROM	MC	74-0073	8600	.250	.2600	.4900	SKILLED
45	MALMSTROM	MC	73-0317	22800	.250	.4350	.3150	SKILLED
46	MALMSTROM	MC	73-0401	193000	.250	.3750	.3750	SKILLED
47	MALMSTROM	MC	74-0103	24000	.250	.4500	.3000	SKILLED
48	MALMSTROM	MC	75-0141	32600	.250	.3000	.4500	SKILLED
49	LOWRY	MC	402-3	99999	.265	.3860	.3490	SKILLED
50	LOWRY	MC	48-3697-2	77255	.265	.4224	.3126	SKILLED
51	LOWRY	MC	665-3	172032	.265	.3425	.3625	SKILLED
52	LOWRY	MC	27-1	31015	.265	.3308	.4042	SKILLED
53	KIRTLAND	MC	148-2	34888	.200	.4800	.3200	SKILLED
54	KIRTLAND	MC	223-3	156388	.200	.4800	.3200	SKILLED
55	KIRTLAND	MC	245-4	18370	.200	.5600	.2400	SKILLED

BASE DATA - MINOR CONSTRUCTION CONTRACTS

OBS	BASE	TYPE	PROJ_NUM	AMOUNT	SOP_PER	LAB_PER	MAT_PER	CATEGORY
56	KIRTLAND	MC	261-4	16623	.200	.440	.360	SKILLED
57	KIRTLAND	MC	65-5	6673	.200	.440	.360	SKILLED
58	KELLY	MC	227-2	27000	.250	.200	.550	UNSKILLED
59	KELLY	MC	P4-3	41000	.200	.300	.500	SKILLED
60	KELLY	MC	130-4	35000	.250	.270	.480	SKILLED
61	KELLY	MC	190-4	11000	.150	.350	.500	SKILLED
62	KELLY	MC	244-0	14000	.250	.490	.260	SKILLED
63	HILL	MC	61-3	34100	.220	.400	.380	SKILLED
64	HILL	MC	3E-4	47300	.200	.420	.380	SKILLED
65	HILL	MC	228-4	6600	.270	.580	.150	UNSKILLED
66	HILL	MC	229-4	11800	.250	.140	.610	SKILLED
67	HILL	MC	242-5	39500	.190	.510	.300	UNSKILLED
68	GRAND FORKS	MC	73-0272	39600	.265	.485	.250	SKILLED
69	GRAND FORKS	MC	73-6C37	4000	.265	.485	.250	SKILLED
70	GRAND FORKS	MC	73-0269	1900	.265	.485	.250	SKILLED
71	GRAND FORKS	MC	73-0101	21700	.265	.485	.250	SKILLED
72	GRAND FORKS	MC	14-C017	11100	.165	.435	.400	SKILLED
73	ELMENDORF	MC	14-0058	31600	.150	.650	.200	SKILLED
74	EDWARDS	MC	15-0512	46000	.160	.480	.360	SKILLED
75	EDWARDS	MC	14-C518	30000	.210	.250	.540	SKILLED
76	EDWARDS	MC	14-0521	43000	.250	.430	.320	SKILLED
77	EDWARDS	MC	14-0519	42000	.250	.390	.360	SKILLED
78	EDWARDS	MC	12-0510	105000	.250	.430	.320	SKILLED
79	CHARLESTON	MC	111-4	49600	.320	.280	.400	SKILLED
80	CHARLESTON	MC	156-4	8900	.240	.330	.430	SKILLED
81	CHARLESTON	MC	22-2	49200	.320	.350	.330	UNSKILLED
82	CHARLESTON	MC	168-4	1500	.240	.160	.600	SKILLED
83	CHARLESTON	MC	174A-4	6000	.250	.300	.450	SKILLED
84	BOLLING	MC	13-C030	40800	.250	.314	.436	SKILLED
85	BOLLING	MC	14-0063	6400	.253	.197	.550	SKILLED
86	BOLLING	MC	13-C204	15500	.230	.060	.710	SKILLED
87	BOLLING	MC	14-0067	5100	.262	.403	.335	SKILLED
88	BOLLING	MC	14-CC94	500	.237	.450	.313	SKILLED
89	HANSCOM	MC	14-CC53	38000	.275	.240	.485	SKILLED
90	HANSCOM	MC	14-0110	9400	.275	.260	.465	SKILLED
91	HANSCOM	MC	14-01408	26500	.275	.375	.350	UNSKILLED
92	HANSCOM	MC	15-0055	2500	.275	.260	.465	SKILLED
93	HANSCOM	MC	15-0067A	200	.275	.365	.360	UNSKILLED
94	MCCOY	MC	22-5	36856	.200	.520	.280	SKILLED
95	MCCOY	MC	24-4	30433	.300	.290	.410	SKILLED
96	MCCOY	MC	28-4(1)	5747	.250	.500	.250	SKILLED
97	MCCOY	MC	26-4	5213	.300	.430	.270	UNSKILLED
98	MCCOY	MC	57-7	24474	.360	.160	.480	SKILLED
99	NELLIS	MC	14-0176	4000	.170	.650	.180	SKILLED
100	NELLIS	MC	14-0106	33000	.170	.430	.400	SKILLED
101	NELLIS	MC	10-0018	8000	.170	.300	.530	SKILLED
102	NELLIS	MC	14-0104	23000	.170	.430	.400	SKILLED
103	NELLIS	MC	15-0070	22000	.170	.530	.300	SKILLED

BASE DATA - SERVICE CONTRACTS

OBS	BASE	TYPE	PROJ_NUM	AMOUNT	SOP_PER	LAB_PER	PAT_PER	CATEGORY
1	BRIGHT-PATTERSON	SVC	75-3	278287	.100	.870	.030	SKILLED
2	BRIGHT-PATTERSON	SVC	24-3	76310	.300	.600	.100	SKILLED
3	BRIGHT-PATTERSON	SVC	42-4	4681	.300	.600	.100	SKILLED
4	BRIGHT-PATTERSON	SVC	44-3	19583	.250	.600	.150	SKILLED
5	BRIGHT-PATTERSON	SVC	55-3	28600	.250	.740	.010	SKILLED
6	WILLIAMS	SVC	C7761/2/3	7000	.150	.550	.300	SKILLED
7	WILLIAMS	SVC	C7764/5/6	1000	.150	.850	.000	UNSKILLED
8	WILLIAMS	SVC	C7768	1023	.210	.120	.670	SKILLED
9	WILLIAMS	SVC	C9758	3000	.150	.350	.500	SKILLED
10	WILLIAMS	SVC	C5756	1000	.150	.150	.700	SKILLED
11	TYNDALL	SVC	3-5	2445	.094	.866	.040	UNSKILLED
12	TYNDALL	SVC	3-5	3744	.094	.866	.040	UNSKILLED
13	TYNDALL	SVC	11-4	360	.094	.866	.040	UNSKILLED
14	TINKER	SVC	14-15	3003	.250	.750	.000	SKILLED
15	TINKER	SVC	14-45	1803	.250	.750	.000	SKILLED
16	TINKER	SVC	14-60	11200	.250	.750	.000	SKILLED
17	TINKER	SVC	14-150	100	.250	.750	.000	SKILLED
18	TINKER	SVC	14-174	100	.250	.750	.000	SKILLED
19	SEYMOUR-JOHNSON	SVC	75-CC14	5467	.230	.700	.070	SKILLED
20	SEYMOUR-JOHNSON	SVC	75-0012	1908	.230	.730	.040	SKILLED
21	SEYMOUR-JOHNSON	SVC	75-0003	2288	.230	.770	.000	SKILLED
22	SEYMOUR-JOHNSON	SVC	75-0007	65768	.230	.770	.000	UNSKILLED
23	SEYMOUR-JOHNSON	SVC	75-CC11	10031	.230	.770	.000	UNSKILLED
24	SCOTT	SVC	22-0020	300477	.260	.680	.060	UNSKILLED
25	RICHARDS-GEBAUR	SVC	75-90043	2700	.250	.550	.200	SKILLED
26	RICHARDS-GEBAUR	SVC	75-90047	3200	.250	.550	.200	SKILLED
27	RICHARDS-GEBAUR	SVC	75-90047	3500	.250	.550	.200	SKILLED
28	RICHARDS-GEBAUR	SVC	75-90049	8700	.250	.550	.200	SKILLED
29	RICHARDS-GEBAUR	SVC	75-22322	4700	.250	.550	.200	SKILLED
30	OFFUTT	SVC	24-CC-0350	20000	.100	.800	.100	UNSKILLED
31	OFFUTT	SVC	24-CC-0411	306500	.280	.670	.050	UNSKILLED
32	OFFUTT	SVC	24-CC-0265	365900	.280	.670	.050	UNSKILLED
33	OFFUTT	SVC	24-CC-0394	115100	.280	.620	.100	UNSKILLED
34	OFFUTT	SVC	23-CC-0293	13900	.300	.620	.080	SKILLED
35	MAXWELL	SVC	37-5X	6400	.250	.550	.200	SKILLED
36	MAXWELL	SVC	38-5X	18000	.300	.600	.100	UNSKILLED
37	MAXWELL	SVC	62-5X	1500	.250	.600	.150	SKILLED
38	MAXWELL	SVC	62-5X	2500	.250	.550	.200	SKILLED
39	MAXWELL	SVC	62-5X	2000	.200	.600	.200	SKILLED
40	MALMSTROM	SVC	15-0097	1300	.250	.600	.150	UNSKILLED
41	MALMSTROM	SVC	15-CC92	22000	.250	.650	.100	UNSKILLED
42	MALMSTROM	SVC	15-0C97	56400	.250	.600	.150	UNSKILLED
43	MALMSTROM	SVC	15-C137	6900	.250	.600	.150	SKILLED
44	MALMSTROM	SVC	15-0130	1000	.250	.450	.300	SKILLED
45	LOWRY	SVC	FC-5049	400	.265	.735	.000	SKILLED
46	LOWRY	SVC	FC-4260	10000	.265	.735	.000	SKILLED
47	LOWRY	SVC	BC-75-LP1	2000	.265	.735	.000	SKILLED
48	LOWRY	SVC	BC-75-LP3	1642	.265	.735	.000	SKILLED
49	LOWRY	SVC	BC-75-LP4	6900	.265	.685	.050	SKILLED
50	KIRTLAND	SVC	14-5	555178	.270	.500	.230	UNSKILLED
51	KIRTLAND	SVC	17-4	134990	.200	.560	.240	SKILLED
52	KIRTLAND	SVC	25-4	7956	.200	.640	.160	SKILLED
53	KIRTLAND	SVC	14-4	8536	.200	.640	.160	SKILLED
54	KIRTLAND	SVC	22-5	6841	.200	.560	.240	SKILLED
55	KIRTLAND	SVC	1-5	3850	.270	.500	.230	SKILLED

BASE DATA - SERVICE CONTRACTS

JOB	BASE	TYPE	PROJ_NUM	AMOUNT	SUP_PER	LAB_PER	MAT_PER	CATEGORY
56	KIRTLAND	SVCE	2-5	3200	.270	.500	.230	SKILLED
57	KELLY	SVCE	15-37	6300	.150	.850	.000	SKILLED
58	KELLY	SVCE	15-0006	2000	.250	.450	.300	SKILLED
59	KELLY	SVCE	15-0037	1000	.200	.200	.600	SKILLED
60	KELLY	SVCE	15-0021	4000	.200	.250	.550	SKILLED
61	KELLY	SVCE	15-0005	1000	.250	.450	.300	SKILLED
62	[illegible] FLORES	SVCE	15-0267	5000	.265	.535	.200	SKILLED
63	[illegible] FLORES	SVCE	15-0039	6200	.265	.635	.100	SKILLED
64	[illegible] FLORES	SVCE	15-0071	5000	.265	.700	.035	SKILLED
65	[illegible] FLORES	SVCE	76-0028	1600	.265	.235	.500	SKILLED
66	[illegible]	SVCE	70-0019	2100	.265	.710	.025	UNSKILLED
67	ELMENDORF	SVCE	15-0021	1900	.100	.450	.450	SKILLED
68	ELMENDORF	SVCE	15-0001	467600	.050	.940	.010	UNSKILLED
69	ELMENDORF	SVCE	15-0002	5000	.050	.900	.050	SKILLED
70	ELMENDORF	SVCE	75-0005	6600	.050	.900	.050	UNSKILLED
71	ELMENDORF	SVCE	15-0007	6600	.150	.550	.300	SKILLED
72	[illegible]	SVCE	75CO	55000	.200	.600	.200	UNSKILLED
73	[illegible]	SVCE	74CC405	22000	.200	.720	.080	UNSKILLED
74	[illegible]	SVCE	74CO364	8000	.220	.730	.050	SKILLED
75	[illegible]	SVCE	74CC403	6000	.200	.740	.060	SKILLED
76	[illegible]	SVCE	74CO	18000	.220	.500	.280	SKILLED
77	[illegible]	SVCE	510-5	1800	.266	.428	.306	SKILLED
78	[illegible]	SVCE	511-5	1000	.200	.800	.000	SKILLED
79	[illegible]	SVCE	512-5	300	.250	.550	.200	SKILLED
80	[illegible]	SVCE	513-5	400	.270	.400	.330	SKILLED
81	[illegible]	SVCE	530-5	500	.160	.640	.200	SKILLED
82	MCCOY	SVCE	3675098	1650	.200	.600	.200	SKILLED
83	MCCOY	SVCE	3001511121	1218	.250	.550	.200	UNSKILLED
84	MCCOY	SVCE	3001511122	500	.300	.700	.000	SKILLED
85	MCCOY	SVCE	3001511123	500	.300	.700	.000	SKILLED
86	MCCOY	SVCE	3C015083	625	.250	.300	.450	SKILLED
87	NELLIS	SVCE	74-9C150	247500	.170	.800	.030	UNSKILLED
88	NELLIS	SVCE	73-C-0076	264800	.170	.830	.000	UNSKILLED
89	NELLIS	SVCE	72-C-0176	11400	.170	.830	.000	SKILLED
90	NELLIS	SVCE	15-9C185	4800	.170	.830	.000	SKILLED
91	NELLIS	SVCE	75-90001	1200	.170	.830	.000	UNSKILLED

BASE HOURLY RATE DATA

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	CUST CTR	ISHOP RT	ASHOP RT	DIR PHRS	CATEGORY	UNION RT	WAGE RTE	THHRS	CITY AVG	ISHOP	ASHOP	BISHOP	BASHOP
1	BOLLING	441	10.05	8.41	7121	EQUIPMENT OPERATIONS	10.25	10.87	216936	9.88	0.32985	0.27606	0.32985	0.27606
2	BOLLING	442	7.08	6.54	5515	PAVEMENTS			216936	9.88	0.33685	0.30439	0.66675	0.58046
3	BOLLING	443	0.38	0.19	30435	GROUNDS			216936	9.88	0.65508	0.66643	1.56183	1.44888
4	BOLLING	451	8.00	7.65	16724	STRUCTURES	9.31	9.31	216936	9.88	0.68309	0.60517	2.24486	2.05405
5	BOLLING	452	8.72	7.69	13254	PROTECTIVE COATING	9.29	9.61	216936	9.88	0.53276	0.46983	2.77762	2.52368
6	BOLLING	453	8.74	8.22	16998	PLUMBING	11.02	10.74	216936	9.88	0.68482	0.64408	3.46244	3.16776
7	BOLLING	454	8.50	7.97	6618	METAL	10.14	10.50	216936	9.88	0.25921	0.24314	3.72175	3.41110
8	BOLLING	455	7.51	6.79	4832	MASON	9.81	9.91	216936	9.88	0.16728	0.15124	3.88903	3.56234
9	BOLLING	457	5.36	5.13	7528	CARPENTER			216936	9.88	0.18600	0.17802	4.07503	3.74036
10	BOLLING	461	7.18	6.97	32098	REFRIGERATION		10.74	216936	9.88	1.06236	1.02129	5.13738	4.77164
11	BOLLING	463	6.74	6.37	36736	HEATING		10.74	216936	9.88	1.14135	1.07676	6.27874	5.85034
12	BOLLING	471	8.09	6.71	11960	INTERIOR ELECTRIC	10.84	10.64	216936	9.88	0.44601	0.36993	6.72475	6.22027
13	BOLLING	474	9.02	8.26	5225	EXTERIOR ELECTRIC		10.54	216936	9.88	0.21725	0.19895	6.94200	6.41922
14	BOLLING	480	7.78	7.50	2840	POWER PRODUCTION			216936	9.88	0.10165	0.09819	7.04365	6.51740
15	BOLLING	491	5.33	5.26	7839	WATER AND WASTE			216936	9.88	0.19260	0.19007	7.23625	6.70747
16	BOLLING	493	6.54	6.41	7213	ENTOMOLOGY			216936	9.88	0.21745	0.21313	7.45390	6.92060

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST_CTR	ISHOP_RT	DIR_MHRS	CATEGORY	UNION_RT	WAGE_RTE	TMHRS	CITY_AVG	ISHOP	WISHOP
1	CHARLESTON	441	9.53	2020	EQUIPMENT OPERATIONS	6.50	4.50	33216	5.71	0.57956	0.57956
2	CHARLESTON	442	5.67	2279	PAVEMENTS			33216	5.71	0.40275	0.98231
3	CHARLESTON	443	6.47	2650	GROUNDS			33216	5.71	0.52357	1.50628
4	CHARLESTON	451	12.16	2786	STRUCTURES	6.10	4.30	33216	5.71	1.01992	2.52620
5	CHARLESTON	452	12.77	1765	PROTECTIVE COATING		3.25	33216	5.71	0.68010	3.20630
6	CHARLESTON	453	7.81	2550	PLUMBING	8.00	7.24	33216	5.71	0.70303	3.90933
7	CHARLESTON	454	8.49	1842	METALS	6.12	5.92	33216	5.71	0.47081	4.38015
8	CHARLESTON	455	11.35	1603	MASON	4.00	4.00	33216	5.71	0.27439	4.65454
9	CHARLESTON	457	1.89	1187	SMART			33216	5.71	0.06754	4.72208
10	CHARLESTON	461	11.22	2846	REFRIGERATION		6.50	33216	5.71	0.96135	5.68342
11	CHARLESTON	463	7.52	5163	HEATING			33216	5.71	1.16989	6.85231
12	CHARLESTON	471	9.71	2400	INTERIOR ELECTRIC		7.40	33216	5.71	0.70393	7.55624
13	CHARLESTON	472	9.10	1065	EXTERIOR ELECTRIC			33216	5.71	0.29177	7.84801
14	CHARLESTON	480	6.01	1168	POWER PRODUCTION			33216	5.71	0.21133	8.05935
15	CHARLESTON	491	6.05	1656	WATER AND WASTE			33216	5.71	0.30864	8.36826
16	CHARLESTON	493	8.19	504	ENTOMOLOGY			33216	5.71	0.12427	8.49253

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	EDWARDS	441	13.01	9.85	17967	EQUIPMENT OPERATIONS	11.96	10.92	419628	11.34	0.55704	.421742	0.55704	0.42174
2	EDWARDS	442	9.42	7.80	29087	PAVEMENTS			419628	11.34	0.65296	.540666	1.21000	0.96241
3	EDWARDS	443	7.52	7.09	42632	GROUNDS			419628	11.34	0.76359	.720307	1.97399	1.68272
4	EDWARDS	451	8.26	7.77	39316	STRUCTURES	10.77	11.05	419628	11.34	0.77390	.727991	2.74789	2.41071
5	EDWARDS	452	9.39	8.63	16798	PROTECTIVE COATING	10.43	10.63	419628	11.34	0.37589	.345465	3.12378	2.75617
6	EDWARDS	453	9.52	7.70	46109	PLUMBING	14.39	14.34	419628	11.34	1.02409	.846081	4.14787	3.60223
7	EDWARDS	454	8.89	8.66	20498	METAL	12.99	10.80	419628	11.34	0.43426	.423024	4.58213	4.02528
8	EDWARDS	455	7.78	7.67	11581	MASON		10.89	419628	11.34	0.21471	.211679	4.79684	4.23695
9	EDWARDS	457	6.01	5.61	7249	SMART			419628	11.34	0.10382	.096912	4.90066	4.33387
10	EDWARDS	461	8.57	8.27	42182	REFRIGERATION		9.68	419628	11.34	0.86148	.831320	5.76214	5.16519
11	EDWARDS	463	7.50	7.30	50548	HEATING		9.68	419628	11.34	0.90344	.879351	6.66558	6.04454
12	EDWARDS	471	7.86	7.15	35909	INTERIOR ELECTRIC	13.19	10.94	419628	11.34	0.67261	.611850	7.33819	6.65639
13	EDWARDS	472	6.59	6.23	21366	EXTERIOR ELECTRIC		10.19	419628	11.34	0.33554	.317210	7.67373	6.97360
14	EDWARDS	480	7.78	7.60	12486	POWER PRODUCTION			419628	11.34	0.23149	.226137	7.90522	7.19973
15	EDWARDS	491	5.88	5.75	23993	WATER AND WASTE			419628	11.34	0.33620	.328767	8.24142	7.52850
16	EDWARDS	493	5.54	5.54	1907	ENTOMOLOGY			419628	11.34	0.02518	.025177	8.26660	7.55368

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ISHOP MT	DIR HRS	CATEGORY	UNION RT	WAGE RTE	THRS	CITY AVG	ISHOP	ASHOP	BISHOP	WASHOP
1	ELMENDORF	441	7.71	6.51	37391	EQUIPMENT OPERATIONS	15.32	14.38	650750	13.64	0.44200	0.37405	0.44300	0.37405
2	ELMENDORF	442	7.10	5.88	38007	PAVEMENTS			650750	13.64	0.42597	0.34864	0.86857	0.72290
3	ELMENDORF	443	9.30	6.88	112015	GROUNDS			650750	13.64	1.54519	1.18427	2.41816	1.90717
4	ELMENDORF	451	9.44	8.10	46812	STRUCTURES	14.26	14.78	650750	13.64	0.67507	0.58268	3.09723	2.48984
5	ELMENDORF	452	9.09	7.91	42307	PROTECTIVE COATING	12.40	12.55	650750	13.64	0.59057	0.48044	3.68820	2.97029
6	ELMENDORF	453	9.08	7.66	33079	PLUMBING	14.88	15.65	650750	13.64	0.50098	0.36538	4.18918	3.33567
7	ELMENDORF	454	9.07	8.33	26807	METAL	14.86	15.70	650750	13.64	0.40658	0.36374	4.59576	3.69941
8	ELMENDORF	455	14.24	8.90	14758	MASON		13.98	650750	13.64	0.25491	0.20184	4.85067	3.90125
9	ELMENDORF	457	8.48	5.29	24794	SHEET			650750	13.64	0.24689	0.20155	5.09156	4.10280
10	ELMENDORF	461	13.13	9.50	21790	REFRIGERATION			650750	13.64	0.43565	0.31810	5.53721	4.42091
11	ELMENDORF	463	11.94	10.34	45265	HEATING			650750	13.64	0.83052	0.71923	6.36773	5.14014
12	ELMENDORF	471	10.38	8.79	57778	INTERIOR ELECTRIC	13.53	13.65	650750	13.64	0.92161	0.78044	7.28534	5.92057
13	ELMENDORF	472	9.40	7.31	39661	EXTERIOR ELECTRIC		13.65	650750	13.64	0.57290	0.44552	7.86224	6.36609
14	ELMENDORF	483	11.87	10.51	82068	POWER PRODUCTION			650750	13.64	1.49696	1.32545	9.35950	7.69154
15	ELMENDORF	491	11.15	9.67	173C6	WATER AND WASTE			650750	13.64	0.29652	0.25716	9.65572	7.94870
16	ELMENDORF	493	6.43	5.73	9712	ENTOMOLOGY			650750	13.64	0.09596	0.08552	9.75165	8.03422

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR EHRS	CATEGORY	UNION RT	WAGE RTE	CITY TAVG	TKHRS	ISHOP	ASHOP	WSHOP	WASHOP
1	GRAND FJARS	441	7.43	5.46	5506	EQUIPMENT OPERATIONS	7.50	7.80	8.4	37844	1.86633	1.37149	1.86633	1.37149
2	GRAND FJARS	442	4.61	4.23	2857	PAVEMENTS			8.4	37844	0.34803	0.31934	4.21436	1.69083
3	GRAND FJARS	443	7.59	7.23	3149	GROUNDS			8.4	37844	0.66485	0.60161	2.87521	2.29244
4	GRAND FJARS	451	7.14	6.31	1388	STRUCTURES	7.31	7.37	8.4	37844	0.26187	0.23143	3.14108	2.52387
5	GRAND FJARS	452	8.23	7.14	2571	PROTECTIVE COATING	7.26	7.26	8.4	37844	0.55912	0.48507	3.70020	3.00894
6	GRAND FJARS	453	7.23	6.48	2297	PLUMBING	9.09	9.09	8.4	37844	0.43884	0.39331	4.13904	3.40225
7	GRAND FJARS	454	8.99	8.52	1243	METAL	8.55	8.55	8.4	37844	0.29528	0.27984	4.43432	3.68210
8	GRAND FJARS	455	7.63	6.31	347	MASON	6.80	6.40	8.4	37844	0.06556	0.05786	4.50128	3.73595
9	GRAND FJARS	457	8.26	7.19	1412	SMART			8.4	37844	0.30819	0.26827	4.81247	4.00822
10	GRAND FJARS	461	11.01	9.67	1906	REFRIGERATION			8.4	37844	0.55451	0.48703	5.36698	4.49525
11	GRAND FJARS	463	9.29	7.99	4430	HEATING			8.4	37844	1.08748	0.93531	6.45447	5.43055
12	GRAND FJARS	471	9.08	8.26	2746	INTERIOR ELECTRIC	8.56	9.05	8.4	37844	0.65685	0.59935	7.11332	6.02991
13	GRAND FJARS	472	8.20	7.39	575	EXTERIOR ELECTRIC			8.4	37844	0.21126	0.19039	7.32458	6.22030
14	GRAND FJARS	480	7.75	7.33	739	POWER PRODUCTION			8.4	37844	0.15934	0.14314	7.47592	6.36344
15	GRAND FJARS	491	7.22	6.38	1900	WATER AND WASTE			8.4	37844	0.36249	0.32031	7.83841	6.68375
16	GRAND FJARS	493	6.36	6.23	378	ENTOMOLOGY			8.4	37844	0.06353	0.06223	7.90194	6.74598

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	CATEGORY	OTHER HIRES	1ST SHIFT HR	2ND SHIFT HR	3RD SHIFT HR	AVG SHIFT HR
1	HANSCOM	EQUIPMENT OPERATIONS	2	10.54	11.03	11.78	11.12
2	HANSCOM	FABRICATIVE PROCESSES	0	10.54	11.03	11.78	11.12
3	HANSCOM	COATING	0	10.54	11.03	11.78	11.12
4	HANSCOM	WELDING	0	10.54	11.03	11.78	11.12
5	HANSCOM	MACHINING	0	10.54	11.03	11.78	11.12
6	HANSCOM	ASSEMBLY	0	10.54	11.03	11.78	11.12
7	HANSCOM	INSPECTION	0	10.54	11.03	11.78	11.12
8	HANSCOM	MATERIAL HANDLING	0	10.54	11.03	11.78	11.12
9	HANSCOM	UTILITIES GENERATION	0	10.54	11.03	11.78	11.12
10	HANSCOM	ELECTRIC POWER DISTRIBUTION	0	10.54	11.03	11.78	11.12
11	HANSCOM	WATER AND WASTE	0	10.54	11.03	11.78	11.12
12	HANSCOM	OTHER	0	10.54	11.03	11.78	11.12
13	HANSCOM	ALL	2	10.54	11.03	11.78	11.12
14	HILL	EQUIPMENT OPERATIONS	2	10.47	10.66	10.46	10.53
15	HILL	FABRICATIVE PROCESSES	0	10.47	10.66	10.46	10.53
16	HILL	COATING	0	10.47	10.66	10.46	10.53
17	HILL	WELDING	0	10.47	10.66	10.46	10.53
18	HILL	MACHINING	0	10.47	10.66	10.46	10.53
19	HILL	ASSEMBLY	0	10.47	10.66	10.46	10.53
20	HILL	INSPECTION	0	10.47	10.66	10.46	10.53
21	HILL	MATERIAL HANDLING	0	10.47	10.66	10.46	10.53
22	HILL	UTILITIES GENERATION	0	10.47	10.66	10.46	10.53
23	HILL	ELECTRIC POWER DISTRIBUTION	0	10.47	10.66	10.46	10.53
24	HILL	WATER AND WASTE	0	10.47	10.66	10.46	10.53
25	HILL	OTHER	0	10.47	10.66	10.46	10.53
26	HILL	ALL	2	10.47	10.66	10.46	10.53

HOURLY RATE ANALYSIS BY BASE

CASE	SIC	CATEGORY	PCT EMP	PCT EST	AVG RATE	STD DEV
1	3441	EQUIPMENT OPERATIONS	11.24	9.28	9.13	1.55
2	3441	EQUIPMENT OPERATIONS	87.37	10.01	8.99	1.35
3	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
4	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
5	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
6	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
7	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
8	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
9	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
10	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
11	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
12	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
13	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
14	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
15	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
16	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
17	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
18	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
19	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
20	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
21	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
22	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
23	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
24	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
25	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
26	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
27	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
28	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
29	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
30	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
31	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
32	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
33	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
34	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
35	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
36	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
37	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
38	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
39	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
40	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
41	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
42	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
43	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
44	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
45	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
46	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
47	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
48	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
49	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
50	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
51	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
52	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
53	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
54	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
55	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
56	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
57	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
58	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
59	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
60	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
61	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
62	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
63	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
64	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
65	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
66	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
67	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
68	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
69	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
70	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
71	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
72	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
73	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
74	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
75	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
76	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
77	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
78	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
79	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
80	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
81	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
82	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
83	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
84	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
85	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
86	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
87	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
88	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
89	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
90	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
91	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
92	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
93	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
94	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
95	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
96	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
97	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
98	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
99	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00
100	3441	EQUIPMENT OPERATIONS	87.68	0.00	8.99	0.00

HOURLY RATE ANALYSIS BY BASE

SEQ. NO.	CRAFT/WORKER	SKILL RATES	BASIC RATE	SHIFT RATE	SHIFT HRS	SHIFT DIFF	NEW RATE	UNION RATE	NON-UNION RATE
1	ELECTRICIANS	4.23	8.47		8	0	8.27	8.47	8.47
2	EQUIPMENT OPERATORS	4.23	8.47		8	0	8.27	8.47	8.47
3	FABRICATED PIPE	4.23	8.47		8	0	8.27	8.47	8.47
4	FIREMEN	4.23	8.47		8	0	8.27	8.47	8.47
5	GLAZIERS	4.23	8.47		8	0	8.27	8.47	8.47
6	INSULATORS	4.23	8.47		8	0	8.27	8.47	8.47
7	IRONWORKERS	4.23	8.47		8	0	8.27	8.47	8.47
8	LABORERS	3.61	7.22		8	0	7.06	7.22	7.22
9	MILLWRIGHTS	4.23	8.47		8	0	8.27	8.47	8.47
10	PAINTERS	4.23	8.47		8	0	8.27	8.47	8.47
11	PLASTERERS	4.23	8.47		8	0	8.27	8.47	8.47
12	PLUMBERS	4.23	8.47		8	0	8.27	8.47	8.47
13	ROOFERS	4.23	8.47		8	0	8.27	8.47	8.47
14	SHEETMETAL	4.23	8.47		8	0	8.27	8.47	8.47
15	SPRINKLERFITTERS	4.23	8.47		8	0	8.27	8.47	8.47
16	TILE SETTERS	4.23	8.47		8	0	8.27	8.47	8.47
17	TRUCK DRIVERS	3.61	7.22		8	0	7.06	7.22	7.22
18	WELDERS	4.23	8.47		8	0	8.27	8.47	8.47
19	ELECTRICIANS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
20	EQUIPMENT OPERATORS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
21	FABRICATED PIPE	4.23	8.47	1.69	10	2	8.46	8.91	8.91
22	FIREMEN	4.23	8.47	1.69	10	2	8.46	8.91	8.91
23	GLAZIERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
24	INSULATORS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
25	IRONWORKERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
26	LABORERS	3.61	7.22	1.44	10	2	7.21	7.58	7.58
27	MILLWRIGHTS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
28	PAINTERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
29	PLASTERERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
30	PLUMBERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
31	ROOFERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
32	SHEETMETAL	4.23	8.47	1.69	10	2	8.46	8.91	8.91
33	SPRINKLERFITTERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
34	TILE SETTERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91
35	TRUCK DRIVERS	3.61	7.22	1.44	10	2	7.21	7.58	7.58
36	WELDERS	4.23	8.47	1.69	10	2	8.46	8.91	8.91

HOURLY RATE ANALYSIS BY BASE

OBS	MSPE	CODE	DESCRIPTION	COUNT	MIN	MAX	MEAN	STD DEV	CV
1		1	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
2		2	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
3		3	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
4		4	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
5		5	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
6		6	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
7		7	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
8		8	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
9		9	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
10		10	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
11		11	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
12		12	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
13		13	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
14		14	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
15		15	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
16		16	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
17		17	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
18		18	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
19		19	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
20		20	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
21		21	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
22		22	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
23		23	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
24		24	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
25		25	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
26		26	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
27		27	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
28		28	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
29		29	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
30		30	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
31		31	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
32		32	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
33		33	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
34		34	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
35		35	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
36		36	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
37		37	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
38		38	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
39		39	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
40		40	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
41		41	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
42		42	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
43		43	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
44		44	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
45		45	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
46		46	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
47		47	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
48		48	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
49		49	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
50		50	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
51		51	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
52		52	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
53		53	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
54		54	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
55		55	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
56		56	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
57		57	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
58		58	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
59		59	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
60		60	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
61		61	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
62		62	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
63		63	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
64		64	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
65		65	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
66		66	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
67		67	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
68		68	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
69		69	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
70		70	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
71		71	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
72		72	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
73		73	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
74		74	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
75		75	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
76		76	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
77		77	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
78		78	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
79		79	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
80		80	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
81		81	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
82		82	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
83		83	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
84		84	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
85		85	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
86		86	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
87		87	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
88		88	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
89		89	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
90		90	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
91		91	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
92		92	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
93		93	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
94		94	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
95		95	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
96		96	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
97		97	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
98		98	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
99		99	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6
100		100	EQUIPMENT OPERATIONS	7	7.72	9.40	8.25	0.63	7.6

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	LOWRY	441	5.98	5.05	2255	EQUIPMENT OPERATIONS	8.21	7.10	35082	9.57	0.38438	0.32460	0.38438	0.32460
2	LOWRY	442	6.98	6.35	1346	PAVEMENTS			35082	9.57	0.26780	0.24363	0.65219	0.56824
3	LOWRY	443	7.38	6.89	2599	GROUNDS			35082	9.57	0.54674	0.51044	1.15892	1.07867
4	LOWRY	451	10.81	9.32	3030	STRUCTURES	9.67	9.67	35082	9.57	0.93365	0.80496	2.13257	1.88363
5	LOWRY	452	8.08	7.64	4278	PROTECTIVE COATING	9.50	7.93	35082	9.57	0.98530	0.93164	3.11787	2.81528
6	LOWRY	453	8.28	8.00	2557	PLUMBING	10.45	10.70	35082	9.57	0.60350	0.58309	3.72137	3.39837
7	LOWRY	454	9.98	9.26	1216	METAL	10.46	10.39	35082	9.57	0.34592	0.32097	4.06729	3.71933
8	LOWRY	455	7.61	7.30	790	MASON	8.61	8.89	35082	9.57	0.17137	0.16439	4.23866	3.88372
9	LOWRY	457	7.09	6.69	1209	SMAP			35082	9.57	0.24434	0.23055	4.48300	4.11427
10	LOWRY	461	7.78	7.78	3333	REFRIGERATION			35082	9.57	0.73915	0.73915	5.22214	4.85342
11	LOWRY	463	8.50	8.50	7464	HEATING			35082	9.57	1.80845	1.80845	7.03059	6.66187
12	LOWRY	471	8.69	8.44	2571	INTERIOR ELECTRIC	9.94	9.83	35082	9.57	0.63685	0.61853	7.66744	7.28040
13	LOWRY	472	8.98	8.52	1017	EXTERIOR ELECTRIC		9.89	35082	9.57	0.26032	0.24699	7.92777	7.52738
14	LOWRY	480	8.54	8.54		POWER PRODUCTION			35082	9.57	0.00000	0.00000	7.92777	7.52738
15	LOWRY	491	7.66	7.66	306	WATER AND WASTE			35082	9.57	0.06681	0.06681	7.99458	7.59420
16	LOWRY	493	6.06	5.79	612	ENTOMOLOGY			35082	9.57	0.10572	0.10101	8.10030	7.69520

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIP HRS	CATEGORY	UNION RT	WAGE RTE	THHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	MALMSTRCM	441	10.06	8.11	24993	EQUIPMENT OPERATIONS	8.51	8.67	338249	8.6	0.74333	0.59924	0.74333	0.59924
2	MALMSTRCM	442	8.96	9.70	25345	PAVEMENTS			338249	8.6	0.52151	0.42710	1.26484	1.02634
3	MALMSTRCM	443	8.64	7.24	43816	GROUNDS			338249	8.6	1.11921	0.93765	2.38405	1.96420
4	MALMSTRCM	451	9.20	7.76	20800	STRUCTURES	7.94	8.14	338249	8.6	0.72853	0.61464	3.11298	2.57903
5	MALMSTRCM	452	9.40	8.70	19754	PROTECTIVE COATING	7.59	7.19	338249	8.6	0.54857	0.50809	3.66194	3.08712
6	MALMSTRCM	453	10.06	7.42	15947	PLUMBING	8.81	9.63	338249	8.6	0.64043	0.43757	4.30237	3.52469
7	MALMSTRCM	454	10.29	9.02	13374	METALS	7.87	8.95	338249	8.6	0.46696	0.35664	4.76923	3.88133
8	MALMSTRCM	457	10.10	9.05	9119	SMART			338249	8.6	0.30141	0.24398	5.07063	4.12531
9	MALMSTRCM	458	10.59	9.28	14132	REFRIGERATION			338249	8.6	0.44245	0.38772	5.45308	4.51303
10	MALMSTRCM	463	8.64	7.49	58374	HEATING			338249	8.6	1.74650	1.51404	7.19958	6.02707
11	MALMSTRCM	471	11.02	9.32	20722	INTERIOR ELECTRIC	8.82	8.50	338249	8.6	0.67511	0.57097	7.87469	6.59803
12	MALMSTRCM	472	9.70	7.48	7906	EXTERIOR ELECTRIC		7.45	338249	8.6	0.22672	0.17483	8.10142	6.77286
13	MALMSTRCM	480	9.14	7.28	12557	POWER PRODUCTION			338249	8.6	0.33931	0.27026	8.44072	7.04312
14	MALMSTRCM	491	8.91	5.96	26634	WATER AND WASTE			338249	8.6	0.54410	0.46936	8.98482	7.51242
15	MALMSTRCM	493	9.06	8.79	4776	ENTOMOLOGY			338249	8.6	0.12821	0.12411	9.11303	7.63653

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	MAXWELL	442	10.18	8.36	1949	PAVEMENTS			21841	8.32	0.90842	0.74601	0.90842	0.74601
2	MAXWELL	443	8.14	7.16	932	GROUNDS			21841	8.32	0.34735	0.30553	1.25577	1.09154
3	MAXWELL	451	8.85	7.59	450	STRUCTURES	7.05	7.25	21841	8.32	0.18234	0.15638	1.43811	1.20792
4	MAXWELL	452	13.12	11.81	1804	PROTECTIVE COATING	7.05		21841	8.32	1.08367	0.97547	2.52178	2.18339
5	MAXWELL	453	10.20	8.26	1333	PLUMBING	8.80		21841	8.32	0.62253	0.50412	3.14431	2.68752
6	MAXWELL	454	14.00	12.69	1155	METAL			21841	8.32	0.74035	0.67108	3.88466	3.35859
7	MAXWELL	457	6.08	5.24	940	SMART			21841	8.32	0.26167	0.22552	4.14633	3.58411
8	MAXWELL	461	9.11	7.49	2916	REFRIGERATION			21841	8.32	1.21628	0.99999	5.36261	4.58411
9	MAXWELL	463	8.09	7.38	5873	HEATING			21841	8.32	2.17538	1.98447	7.53800	6.56857
10	MAXWELL	471	11.59	8.02	1562	INTERIOR ELECTRIC	7.81	7.81	21841	8.32	0.82888	0.57357	8.36688	7.14214
11	MAXWELL	472	7.95	6.64	1055	EXTERIOR ELECTRIC			21841	8.32	0.38401	0.32074	8.75089	7.46287
12	MAXWELL	480	9.37	8.92	609	POWER PRODUCTION			21841	8.32	0.26127	0.24872	9.01216	7.71159
13	MAXWELL	491	6.80	6.60	507	WATER AND WASTE			21841	8.32	0.15785	0.15321	9.17001	7.86480
14	MAXWELL	493	4.27	4.11	756	ENTOMOLOGY			21841	8.32	0.14780	0.14226	9.31781	8.00706

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	CIR RTES	CATEGORY	UNION RT	WAGE RTE	THHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHCP
1	MOODY	451	9.70	8.42	16146	STRUCTURES	7.45	4.45	187252	7.44	0.833639	0.726C2	0.83639	0.72602
2	MOODY	452	8.16	7.34	15948	PRCTECTIVE COATING	6.35	2.75	187252	7.44	0.699498	0.62514	1.53137	1.35116
3	MOODY	453	9.79	8.33	10056	PLUMBING	8.57	4.32	187252	7.44	0.522575	0.44735	2.05712	1.76851
4	MOODY	454	10.12	9.78	4217	METAL	7.92	3.00	187252	7.44	0.22791	0.22025	2.28503	2.01876
5	MOODY	455	6.42	8.42	2936	MASCN		2.85	187252	7.44	0.13202	0.13202	2.41705	2.15078
6	MOODY	461	8.69	8.17	22375	REFRIGERATION		3.50	187252	7.44	1.03857	0.97642	3.45561	3.12720
7	MOODY	463	6.86	6.53	23895	HEATING			187252	7.44	0.887540	0.833329	4.33101	3.96046
8	MOODY	471	9.18	7.96	11245	INTERICR ELECTRIC	8.20	3.50	187252	7.44	0.55128	0.47922	4.88230	4.43570
9	MOODY	472	8.41	7.70	10430	EXTERICR ELECTRIC			187252	7.44	0.46844	0.42889	5.35074	4.86460
10	MOODY	480	9.41	9.05	73000	PCWER PRODUCTION			187252	7.44	3.51772	3.38314	8.86845	8.25174

HOURLY RATE ANALYSIS BY BASE

| CATEGORY | | |

HOURLY RATE ANALYSIS BY BASE

OBS	CATEGORY	UNION RT	AVG RATE	STATE	CITY AVG	REGION 1	REGION 2	REGION 3	REGION 4
1	EQUIPMENT OPERATIONS	9.02	7.43	44	999	41277	44733	44765	44793
2	EQUIPMENTS			44	999	41277	44733	44765	44793
3	FABRICATED PRODUCTS			44	999	41277	44733	44765	44793
4	FABRICATING			44	999	41277	44733	44765	44793
5	METAL COATING	8.58	8.98	44	999	41277	44733	44765	44793
6	METAL FABRICATING	8.79	8.98	44	999	41277	44733	44765	44793
7	METAL-WORKING	10.46	9.76	44	999	41277	44733	44765	44793
8	MACHINERY	10.80	10.43	44	999	41277	44733	44765	44793
9	REFRIGERATION	10.99	9.44	44	999	41277	44733	44765	44793
10	INDUSTRIAL MACHINERY	11.04	11.17	44	999	41277	44733	44765	44793
11	ELECTRICAL EQUIPMENT		8.71	44	999	41277	44733	44765	44793
12	ELECTRICAL MACHINERY			44	999	41277	44733	44765	44793
13	ELECTRICAL EQUIPMENT			44	999	41277	44733	44765	44793
14	ELECTRICAL PRODUCTION			44	999	41277	44733	44765	44793
15	ELECTRICAL WORK			44	999	41277	44733	44765	44793
16	ELECTRICIANS			44	999	41277	44733	44765	44793
17	ELECTRICIANS, MAINTENANCE			44	999	41277	44733	44765	44793
18	ELECTRICIANS, MAINTENANCE			44	999	41277	44733	44765	44793
19	ELECTRICIANS, MAINTENANCE			44	999	41277	44733	44765	44793

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHCP	ASHCP	WISHCP	WASHCP
1	RICHARDS-GEBAUR	441	8.14	6.76	20102	EQUIPMENT OPERATIONS	11.55	11.35	338363	10.45	0.48359	0.40161	0.48359	0.40161
2	RICHARDS-GEBAUR	442	9.86	7.73	10476	PAVEMENTS			338363	10.45	0.48012	0.37640	0.96371	0.77801
3	RICHARDS-GEBAUR	443	6.66	6.05	37579	GROUNDS			338363	10.45	0.73967	0.67192	1.70338	1.44953
4	RICHARDS-GEBAUR	451	12.41	10.22	20226	STRUCTURES	9.55	9.55	338363	10.45	0.74182	0.61091	2.44520	2.06084
5	RICHARDS-GEBAUR	452	8.58	7.78	18637	PROTECTIVE COATING	9.45	9.45	338363	10.45	0.46157	0.42852	2.90677	2.48936
6	RICHARDS-GEBAUR	453	9.02	7.55	15501	PLUMBING	10.80	9.94	338363	10.45	0.41322	0.34568	3.31999	2.83524
7	RICHARDS-GEBAUR	454	7.74	6.81	13177	METAL	10.97	11.53	338363	10.45	0.30142	0.26520	3.62141	3.10044
8	RICHARDS-GEBAUR	455	7.43	6.96	7195	MASON	10.01	9.88	338363	10.45	0.15799	0.14800	3.77940	3.24844
9	RICHARDS-GEBAUR	457	9.31	8.74	5449	SMART			338363	10.45	0.14993	0.14075	3.92933	3.38919
10	RICHARDS-GEBAUR	461	7.07	6.74	43534	REFRIGERATION			338363	10.45	0.90963	0.86717	4.83896	4.25636
11	RICHARDS-GEBAUR	463	8.59	8.13	50722	HEATING			338363	10.45	1.28768	1.21872	6.12664	5.47508
12	RICHARDS-GEBAUR	471	8.44	7.69	16007	INTERIOR ELECTRIC	10.44	10.65	338363	10.45	0.39927	0.36379	6.52591	5.83888
13	RICHARDS-GEBAUR	472	8.11	6.65	9152	EXTERIOR ELECTRIC		9.33	338363	10.45	0.21936	0.17987	6.74527	6.01874
14	RICHARDS-GEBAUR	480	5.19	4.48	39611	POWER PRODUCTION			338363	10.45	0.60758	0.52446	7.35285	6.54320
15	RICHARDS-GEBAUR	491	6.07	5.85	18009	WATER AND WASTE			338363	10.45	0.32307	0.31136	7.67591	6.85456
16	RICHARDS-GEBAUR	493	6.04	5.75	6986	ENTOMOLOGY			338363	10.45	0.12470	0.11872	7.80062	6.97328

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HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIP MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	SCOTT	441	8.63	7.57	1869	EQUIPMENT OPERATIONS	12.00	10.95	29809	10.71	0.55363	0.47463	0.55363	0.47463
2	SCOTT	442	5.75	4.36	2212	PAVEMENTS			29809	10.71	0.42668	0.32354	0.98032	0.79817
3	SCOTT	443	10.89	10.02	1665	GROUNDS			29809	10.71	0.60827	0.55967	1.58858	1.35784
4	SCOTT	451	10.64	8.63	2323	STRUCTURES	10.83	10.59	29809	10.71	0.84476	0.67643	2.43324	2.03427
5	SCOTT	452	9.30	7.97	1368	PROTECTIVE COATING	9.75	9.30	29809	10.71	0.42680	0.36576	2.86014	2.40003
6	SCOTT	453	13.14	11.66	1456	PLUMBING	11.02	11.76	29809	10.71	0.64161	0.56952	3.50155	2.96956
7	SCOTT	454	8.66	8.18	1332	METAL	12.67	9.13	29809	10.71	0.39590	0.36552	3.89786	3.33508
8	SCOTT	457	9.55	9.10	595	SMART			29809	10.71	0.19082	0.18164	4.08868	3.51672
9	SCOTT	461	10.84	10.26	1811	REFRIGERATION			29809	10.71	0.65857	0.62333	4.74725	4.14005
10	SCOTT	463	7.52	7.05	8055	HEATING			29809	10.71	2.03206	1.90505	6.77930	6.04510
11	SCOTT	471	10.46	8.95	1701	INTERIOR ELECTRIC	10.23	11.26	29809	10.71	0.59688	0.51072	7.37619	6.55582
12	SCOTT	472	7.91	6.44	1023	EXTERIOR ELECTRIC			29809	10.71	0.27146	0.22101	7.64764	6.77683
13	SCOTT	480	8.83	8.37	535	POWER PRODUCTION			29809	10.71	0.15848	0.15022	7.80612	6.92705
14	SCOTT	491	7.79	7.47	3222	WATER AND WASTE			29809	10.71	0.84201	0.80742	8.64813	7.73447
15	SCOTT	493	15.65	14.96	642	ENTOMOLOGY			29809	10.71	0.33706	0.32220	8.98518	8.05666

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST PTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	SEYMOUR-JOHNSON	441	15.60	13.03	423	EQUIPMENT OPERATIONS		5.25	22428	7.48	0.25799	0.24575	0.2980	0.24575
2	SEYMOUR-JOHNSON	442	9.20	7.25	904	PAVEMENTS			22428	7.48	0.37082	0.29222	0.6684	0.53797
3	SEYMOUR-JOHNSON	443	8.67	6.39	1655	GROUNDS			22428	7.48	0.49219	0.47153	1.1510	1.00550
4	SEYMOUR-JOHNSON	451	11.57	7.64	1916	STRUCTURES	6.15	4.00	22428	7.48	0.98841	0.66976	2.1494	1.67927
5	SEYMOUR-JOHNSON	452	8.76	6.84	1314	PROTECTIVE COATING	4.40	3.75	22428	7.48	0.51323	0.40308	2.6626	2.08235
6	SEYMOUR-JOHNSON	453	8.44	6.47	1541	PLUMBING	7.18	4.71	22428	7.48	0.61753	0.47339	3.2832	2.55574
7	SEYMOUR-JOHNSON	454	11.76	9.53	760	METAL		3.00	22428	7.48	0.35850	0.33645	3.6787	2.89223
8	SEYMOUR-JOHNSON	455	15.07	14.73	509	MASON	5.15	3.00	22428	7.48	0.34201	0.33361	4.0207	3.22585
9	SEYMOUR-JOHNSON	457	2.95	2.95	959	SMART			22428	7.48	0.12614	0.12614	4.1468	3.35159
10	SEYMOUR-JOHNSON	461	10.96	7.79	3360	REFRIGERATION			22428	7.48	1.64155	1.16704	5.7883	4.51903
11	SEYMOUR-JOHNSON	463	9.07	8.84	4456	HEATING			22428	7.48	1.80203	1.75633	7.5908	6.27536
12	SEYMOUR-JOHNSON	471	15.38	11.66	1225	INTERIOR ELECTRIC	6.75	4.75	22428	7.48	0.83855	0.60518	8.4258	6.86054
13	SEYMOUR-JOHNSON	472	11.51	9.36	766	EXTERIOR ELECTRIC			22428	7.48	0.39311	0.32036	8.8229	7.20090
14	SEYMOUR-JOHNSON	480	10.26	8.22	825	POWER PRODUCTION			22428	7.48	0.37741	0.30237	9.2003	7.50327
15	SEYMOUR-JOHNSON	491	17.24	16.36	1141	WATER AND WASTE			22428	7.48	0.87707	0.84247	10.0773	8.34574
16	SEYMOUR-JOHNSON	493	12.55	12.24	574	ENTOMOLOGY			22428	7.48	0.32119	0.31326	10.3985	8.65900

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FCLRLY RATE ANALYSIS BY BASE

| SIC | CATEGORY | UNION RT | HIGH RT | STATUS | CITY AVG | STATUS | STATUS | STATUS

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	COST CTR	ISHOP RT	ASHOP RT	DIR MHRS	CATEGORY	UNION RT	WAGE RTE	TMHRS	CITY AVG	ISHOP	ASHOP	WISHOP	WASHOP
1	TYNDALL	441	7.19	7.03	24299	EQUIPMENT OPERATIONS	9.50	7.69	318480	8.64	.548574	.536366	0.54857	0.53637
2	TYNDALL	442	7.15	6.76	14597	PAVEMENTS			318480	8.64	.327708	.309833	0.87628	0.84620
3	TYNDALL	443	6.66	6.31	26716	GROUNDS			318480	8.64	.558680	.529320	1.43496	1.37552
4	TYNDALL	451	8.23	6.12	20467	STRUCTURES	9.06	7.55	318480	8.64	.528898	.393300	1.96386	1.76882
5	TYNDALL	452	7.07	5.53	12347	PROTECTIVE COATING	8.86	5.40	318480	8.64	.274093	.214390	2.23795	1.98321
6	TYNDALL	453	8.13	7.07	13293	PLUMBING	10.35	5.10	318480	8.64	.339337	.295094	2.57729	2.27830
7	TYNDALL	454	7.67	7.23	14331	METAL	7.76	5.00	318480	8.64	.354135	.325336	2.93143	2.60364
8	TYNDALL	455	6.23	7.34	6094	MASON	8.85		318480	8.64	.158435	.150016	3.08986	2.75366
9	TYNDALL	457	6.30	4.42	6769	SMART			318480	8.64	.134296	.094221	3.22416	2.84788
10	TYNDALL	461	7.47	5.50	32627	REFRIGERATION			318480	8.64	.765272	.665699	3.98943	3.51378
11	TYNDALL	463	6.97	6.72	44242	HEATING			318480	8.64	.968245	.933516	4.95767	4.44729
12	TYNDALL	471	7.70	7.00	25214	INTERIOR ELECTRIC	7.51	5.16	318480	8.64	.609608	.554189	5.56728	5.00148
13	TYNDALL	472	9.20	7.98	13562	EXTERIOR ELECTRIC			318480	8.64	.391768	.339817	5.95905	5.34130
14	TYNDALL	480	6.07	5.64	14539	POWER PRODUCTION			318480	8.64	.277103	.257473	6.23615	5.59677
15	TYNDALL	491	6.01	5.68	38894	WATER AND WASTE			318480	8.64	.733964	.693663	6.97012	6.29243
16	TYNDALL	493	6.04	5.86	10469	ENTOMOLOGY			318480	8.64	.198545	.193286	7.16866	6.48572

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HOURLY RATE ANALYSIS BY BASE

OBS	BASE	JOB CLASS	JOB CLASS DESCRIPTION	JOB CAT	JOB CAT DESCRIPTION	JOB RATE	JOB RATE MIN	JOB RATE MAX	JOB RATE MEAN	JOB RATE STD	JOB RATE N	JOB RATE SUM
1	WILLIAMS	4512	STRUCTURES	5	MANUFACTURING	7.53	10.35	10.00	10.227	.02753	143979	1472.6
2	WILLIAMS	4532	PROTECTIVE COATING	5	MANUFACTURING	9.39	19.24	19.00	10.227	.05434	143979	1472.6
3	WILLIAMS	4554	PLUMBING	5	MANUFACTURING	9.79	11.01	12.00	10.227	.02124	143979	1472.6
4	WILLIAMS	4564	REFRIGERATION	5	MANUFACTURING	10.05	11.01	10.00	10.227	.02607	143979	1472.6
5	WILLIAMS	4603	AIRCONDITIONING	5	MANUFACTURING	7.91	11.01	11.00	10.227	.02014	143979	1472.6
6	WILLIAMS	4774	ELECTRIC MOTOR	5	MANUFACTURING	8.36	11.75	11.95	10.227	.03447	143979	1472.6
7	WILLIAMS	4780	ELECTRIC PRODUCTION	5	MANUFACTURING	3.03	11.47	11.47	10.227	.05577	143979	1472.6
8	WILLIAMS	4512	STRUCTURES	5	MANUFACTURING	7.53	10.35	10.00	10.227	.03694	143979	1472.6
9	WILLIAMS	4532	PROTECTIVE COATING	5	MANUFACTURING	9.39	19.24	19.00	10.227	.06436	143979	1472.6
10	WILLIAMS	4554	PLUMBING	5	MANUFACTURING	9.79	11.01	12.00	10.227	.02756	143979	1472.6
11	WILLIAMS	4564	REFRIGERATION	5	MANUFACTURING	10.05	11.01	10.00	10.227	.02607	143979	1472.6
12	WILLIAMS	4603	AIRCONDITIONING	5	MANUFACTURING	7.91	11.01	11.00	10.227	.02014	143979	1472.6
13	WILLIAMS	4774	ELECTRIC MOTOR	5	MANUFACTURING	8.36	11.75	11.95	10.227	.03447	143979	1472.6
14	WILLIAMS	4780	ELECTRIC PRODUCTION	5	MANUFACTURING	3.03	11.47	11.47	10.227	.05577	143979	1472.6
15	WILLIAMS	4512	STRUCTURES	5	MANUFACTURING	7.53	10.35	10.00	10.227	.03694	143979	1472.6
16	WILLIAMS	4532	PROTECTIVE COATING	5	MANUFACTURING	9.39	19.24	19.00	10.227	.06436	143979	1472.6
17	WILLIAMS	4554	PLUMBING	5	MANUFACTURING	9.79	11.01	12.00	10.227	.02756	143979	1472.6
18	WILLIAMS	4564	REFRIGERATION	5	MANUFACTURING	10.05	11.01	10.00	10.227	.02607	143979	1472.6
19	WILLIAMS	4603	AIRCONDITIONING	5	MANUFACTURING	7.91	11.01	11.00	10.227	.02014	143979	1472.6
20	WILLIAMS	4774	ELECTRIC MOTOR	5	MANUFACTURING	8.36	11.75	11.95	10.227	.03447	143979	1472.6

HOURLY RATE ANALYSIS BY BASE

OBS	BASE	1987 INST	1987 INSTAL	1987 ASHOP	CIR #'S	CATEGORY	UNION RT	WAGE RATE	THRS	CITY AVG	HISTOP	ASHOP	HISTOP	WASHOP
1	WRIGHT-PATTERSON	441	5.63	7.14	45034	EQUIPMENT OPERATIONS	10.82	10.99	946107	10.14	0.44715	0.34590	0.44715	0.34590
2	WRIGHT-PATTERSON	442	7.57	6.04	25220	PAVEMENTS			946107	10.14	0.23307	0.20999	0.68022	0.55588
3	WRIGHT-PATTERSON	443	7.99	7.15	62700	GROUNDS			946107	10.14	0.70010	0.62738	1.38032	1.18326
4	WRIGHT-PATTERSON	451	11.11	9.13	60860	STRUCTURES	9.66	9.62	946107	10.14	0.71467	0.56116	2.09495	1.77442
5	WRIGHT-PATTERSON	452	9.27	8.43	44054	PROTECTIVE COATING	10.33	9.40	946107	10.14	0.43164	0.39253	2.52659	2.16695
6	WRIGHT-PATTERSON	453	10.16	7.76	34684	PLUMBING	11.23	10.82	946107	10.14	0.37100	0.28521	2.89763	2.45216
7	WRIGHT-PATTERSON	454	10.18	10.18	26445	METAL	11.00	9.90	946107	10.14	0.39219	0.39219	3.28982	2.84435
8	WRIGHT-PATTERSON	455	9.44	9.46	13842	MASON	9.03	9.01	946107	10.14	0.14806	0.13840	3.43788	2.98275
9	WRIGHT-PATTERSON	457	9.09	9.14	19743	SMART			946107	10.14	0.11459	0.08639	3.55244	3.06915
10	WRIGHT-PATTERSON	461	8.93	8.42	64554	REFRIGERATION			946107	10.14	0.76987	0.73463	4.32230	3.80377
11	WRIGHT-PATTERSON	463	10.88	9.07	262980	HEATING			946107	10.14	2.56686	2.71854	7.34816	6.52231
12	WRIGHT-PATTERSON	471	10.83	9.05	57344	INTERIOR ELECTRIC	12.08	11.06	946107	10.14	1.11635	0.93115	8.46451	7.45345
13	WRIGHT-PATTERSON	472	8.90	8.05	45252	EXTERIOR ELECTRIC		10.48	946107	10.14	0.42568	0.38503	8.89119	7.83848
14	WRIGHT-PATTERSON	480	5.96	5.59	22021	PC&ER PRODUCTION			946107	10.14	0.14231	0.13484	9.03350	7.97332
15	WRIGHT-PATTERSON	491	7.40	7.28	44252	WATER AND WASTE			946107	10.14	0.34586	0.34051	9.38936	8.31382
16	WRIGHT-PATTERSON	493	7.76	7.44	17018	ENTOMOLOGY			946107	10.14	0.14450	0.13654	9.52787	8.45037

APPENDIX C

SAMPLE QUESTIONNAIRE

This appendix includes the letter requesting support from the Major Commands to accomplish the survey, and a sample questionnaire. The importance of this research effort is reinforced by the fact that Brigadier General Jack I. Fosner, the Director of Manpower and Organization for the United States Air Force, signed the letter requesting support. The questionnaire represented a coordinated effort between Base Civil Engineering, Base Procurement, and the local Management Engineering Team.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C. 20330

REPLY TO ATTN OF: PRMER

20 MAR 1975

SUBJECT: Determination of Contract Manpower Equivalents

TO: AAC, ADC, AFCS, AFSC, ATC, AU, SAC, HQ COMD USAF, MAC, TAC, USAFSS, AFLC

(Manpower & Organization/Engineering and Services)

1. Under the AFIT program, students are encouraged to conduct research in areas that will significantly benefit the Air Force. In accordance with the above policy, AF/PRM and AF/PRE have recently approved an AFIT study concerning contract manpower equivalents which will be conducted by Capt Robert E. Corsi, Jr., a graduate student at West Virginia University.

2. Capt Corsi's project will focus on developing a methodology for determining contract manpower equivalents. It is anticipated that this research will identify specific relationships between Civil Engineering in-house and contract manhours and dollars. The end result should provide a methodology for evaluating existing and projected requirements.

3. To meet these objectives, a questionnaire will be forwarded to major commands during the month of March 1975 for completion by METs assigned to 23 Air Force installations. The questionnaire will require approximately one man-week of effort and will request data in the following areas: contract costs and contract manhours, in-house BCE manhour rates, and federal wage rates. Upon completion, METs should forward questionnaires directly to Captain Robert Corsi, AFROTC, Det 915, West Virginia University, Morgantown, West Virginia, 26501 (telephone number: 304-293-0111).

4. Attached is a list of bases selected to participate in this study. The selection was based on factors such as: geographic location, area labor costs, contract costs, and interface with available Bureau of Labor statistics information. Request that you notify affected METs of this project.

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5. While your complete support is necessary to insure the success of this endeavor, it should be emphasized that AFIT regulations clearly stipulate that the questionnaire response must be voluntary. Therefore, if this workload critically conflicts with scheduled management engineering studies, request that you notify the Civil Engineering MET at Dover AFB, project officer Major James G. Floodas, Autovon 455-6891/92.

FOR THE CHIEF OF STAFF

Jack I. Posner

JACK I. POSNER, Brig Gen, USAF
Director of Manpower and Organization

1 Atch
Selected Bases

Cy to: Det 4, 1600 MES (MAC)
Dover AFB, Del 19901
HQ USAF/PREMC
HQ USAF/PRMRE

BASE LEVEL

SURVEY AND QUESTIONNAIRE

FOR

A METHODOLOGY FOR DETERMINING CONTRACT MANPOWER EQUIVALENTS STUDY

SCN: 75-86

SURVEY MONITOR

Capt Robert E. Corsi Jr.
1293 Van Voorhis Rd. Apt#1.
Morgantown, West Virginia 26505
Graduate Student
West Virginia University

INSTRUCTIONS FOR COMPLETION OF QUESTIONNAIRE

1. This questionnaire is being used in an effort to establish a method for determining contract manpower equivalents.

2. Your response is voluntary and the names of the respondents will not be used in the report. I do request that if at all possible a contact name and phone number be provided in the remarks section of each portion of the questionnaire. Again, I emphasize that the names of respondents will not be used.

3. The Management Engineering Detachment is the OPR for this questionnaire and will require extensive coordination with the Base Civil Engineering organization and Base Procurement in order to complete the survey.

4. Individual instructions are provided for each section of the questionnaire. In order to insure that all items have been completed the following checklist is provided:

   - Contract Data - Questionnaire Number I.
   - Contract Data - Questionnaire Number II
     (3 questionnaires should be included- 1 for each of the categories: Maintenance, Repair, and Minor Construction)
   - Shop Rate Analysis- Questionnaire Number III
   - Copies of the worksheets used to determine the present shop rate that is in affect for each cost center(Should be 20-30 worksheets)
   - Copies of the current Federal Wage Rates that are presently being used on Maintenance, Repair, Minor Construction, and Service Contracts
     (This is the only time that this item is mentioned- Federal Wage Rates can be obtained from Base Procurement)
   - BCE'S Remarks as to how the contract work force compares to the in-house work force
   - Local MET comments concerning their method for calculating contract manpower equivalents

5. To Clarify Questionnaire Number II - the respondent must review the completed contract file on a project in the Maintenance, Repair, and Minor Construction categories in order to summarize the total manhours per trade that were used over the life of the project. The information must be obtained from the weekly man-hour reports which are required by the Davis-Bacon Act for contracts over $2000. Insure that the contracts selected have already been identified on Contract Data-Questionnaire Number I.

6. I realize that the amount of data required is extensive and will require considerable effort to obtain; however, if you provide the necessary data, I am confident my objectives will be realized. I thank you for your cooperation in this effort. If there are any questions, please feel free to call me at (304) 599-1599 or at the West Virginia University ROTC Detachment(USAF) (304) 293-5121.

ROBERT E. CORSI JR.
Captain, USAF

CONTRACT DATA - QUESTIONNAIRE NUMBER I

SOURCE: - 31 December 1974 Maremic(Maintenance, Repair, Minor Construction)
-Service Contract Project Records or AF Form 9's

PURPOSE: To determine the elemental breakdown of the contract price, by percentages of the total contract price, into the following categories: Supervision, Overhead, and Profit; Materials; and Labor.

GENERAL COMMENTS:

1. Although very little information is available regarding the actual breakout of contractor's costs, we expect that the Project Engineer most familiar with the project can give a reasonable estimate for the costs associated with materials, labor, and contractor's supervision, overhead, and profit. NOTE: The Project Engineer is encouraged to use his best judgement, if he feels that the present estimating guides are unrealistic.

2. The Chief of Programs, in conjunction with the Chief of Engineering, will select five(5) projects in each of the following categories: Maintenance, Repair, Minor Construction, and Service Contracts. The projects should be representative of the type of work that can be accomplished using in-house forces; however, due to the lack of in-house manhours or work exceeded base limitations(cost), the contract method was used.

INSTRUCTIONS(See Sample)

Item 1: Project Number

Item 2: EEIC Number(123,125,etc- NOTE: For Service Contracts use- "SVCE")

Item 3: Funds Type(MFH,ORM,Medical, etc)

Item 4: Contract Amount(Final Cost of contract in $000)

Item 5: Supervision, Overhead, and Profit(% of Item 4 that can be attributed to contractor's supervision, overhead, and profit)

Item 6: Labor(% of Item 4 that can be attribute to labor)

Item 7: Material(% of Item 4 that can be attributed to material)

Item 8: Sum(Sum of items 5,6,7 should equal 100%)

Item 9: Skilled or Unskilled Labor Required(Indicate: S-Skilled, U-Unskilled) If over 25% of the contract involves skilled labor, consider the labor required as being skilled, under 25% as being unskilled)

Item10: Engineer's Signature(Signature of Project Engineer making estimates)

Item11: Remarks(List any estimating guides used in the process or any comments as to the survey)

BASE:_____

CONTRACT DATA- QUESTIONNAIRE NUMBER I

(1) PROJECT NUMBER	(2) EEIC	(3) FUNDS TYPE	(4) CONTRACT AMOUNT ($000)	(5) SUPERVISION OVERHEAD PROFIT(%)	(6) LABOR(%)	(7) MATERIAL(%)	(8) SUM(%)	(9) LABOR ($or U)	(10) ESTIMATING ENGINEER'S SIGNATURE

(11)
REMARKS:

CONTRACT DATA - QUESTIONNAIRE NUMBER II

SOURCE: Weekly manhour reports for Maintenance, Repair, and Minor Construction projects over $2000 (Base Procurement)

PURPOSE: To determine the total manhours per trade related to the labor dollars in the contract

GENERAL COMMENTS: Select the largest project(dollar amount) in each of the following three categories: Maintenance, Repair, and Minor Construction. Insure that the selected projects are already on Contract Data-Questionnaire Number I.

INSTRUCTIONS - Contract Data - Questionnaire Number II

Item 1: Construction Trade(List all the construction trades involved in the project until it was finalized - Ex. mortarmen, electrician)

Item 2: Hourly Rate(Indicate the hourly rate, including benefits, that was paid to each trade)

Item 3: Manhours(Indicate the total manhours per trade that was used over the life of the project)

Item 4: Cost(Multiply Item 2 and Item 3)

Item 5: Total Labor Costs(Sum up the costs in Item 4)

BASE:_____ PROJECT NUMBER:_____

CONTRACT DATA - QUESTIONNAIRE NUMBER II

(1) CONSTRUCTION TRADE	(2) HOURLY RATE	(3) MANHOURS	(4) COST

(5) TOTAL COST =

SHOP RATE ANALYSIS - QUESTIONNAIRE NUMBER III

SOURCE: - Monthly Inservice Work Plan Report, PCN: N200252
- Shop Rate Analysis Report, Part 1, PCN: N200474

PURPOSE: To obtain a weighted average shop rate that includes all the cost centers authorized on the UDL for the current Fiscal Year.

INSTRUCTIONS(See Sample)

Item 1: Cost Center Number

Item 2: Cost Center Name(Pavement, Electrical, etc)

Item 3: Present Shop Rate(Most current shop rate being used for each cost center)

Item 4: Available Manhours(Total manhours for each cost center used in the calculation of Item 3)

Item 5: Total Available Manhours(Total manhours for all costcenters combined- this number should be the same for all calculations)

Item 6: Factor(Divide Item 4 by Item 5)

Item 7: Result(Multiply Item 3 by Item 6)

Item 8: Weighted Average Shop Rate(Sum up Item 7 for all cost centers)

NOTE: In addition to the attached questionnaire on weighted average shop rate, include copies of the worksheets used to calculate your present shop rate for all cost centers authorized under the UDL.

BASE:_____ DATE:_____

SHOP RATE ANALYSIS - QUESTIONNAIRE NUMBER III

(1) COST CENTER	(2) NAME OF COST CENTER	(3) PRESENT SHOP RATE	(4) AVAILABLE MANHOURS	(5) TOTAL AVAILABLE MANHOURS	(6) FACTOR	(7) RESULT

(8) WEIGHTED AVERAGE SHOP RATE = _____

BASE CIVIL ENGINEER'S COMMENT

ITEM IN QUESTION:

At the present time, the Civil Engineering shops contain individuals that are highly skilled in most of the disciplines that compose a contractor's work force, yet it is often postulated that the in-house forces could not keep pace with a contractor's disciplined work force. Do you agree with the above statement? Why? If you feel that there is a difference, can you quantify it?

BASE CIVIL ENGINEER'S SIGNATURE:_____

COMMANDER - MANAGEMENT ENGINEERING DETACHMENT'S COMMENTS

I. Detail the present procedures used in calculating contract manpower equivalents.

II. Detail the problems, if any, at the base level in computing manpower equivalents.

APPENDIX D

SUMMARY OF CONTRACT DATA BY CONTRACT CATEGORY

This appendix includes a summary of the contract data, by base and contract category, which includes the following: number of projects submitted by each base, total labor dollars of the projects submitted, total amount of all the contracts submitted, and the weighted labor percentage attributed to a particular base, based on the contracts submitted.

TABLE D.1

LABOR PERCENTAGES--FY 75 MAINTENANCE CONTRACTS

Base	Number of Project	Labor Dollars (000)	Contract Dollars (000)	Weighted Labor Percentage
Bolling	5	127.0	251.9	50.4
Charleston	5	179.3	414.3	43.3
Edwards	5	200.9	328.0	61.2
Elmendorf	5	205.1	330.3	62.1
Grand Forks	5	71.7	161.7	44.3
Hanscom	5	50.2	119.3	42.1
Hill	5	128.9	214.5	60.0
Kelly	5	148.2	410.0	36.2
Kirtland	3	41.3	76.4	54.0
Lowry	4	112.4	285.7	39.3
Malmstrom	5	266.8	555.6	48.0
Maxwell	5	55.7	108.7	51.2
Moody	5	55.0	142.1	38.7
Nellis	5	100.0	192.3	52.0
Offutt	5	62.3	122.6	50.8
Richards-Gebaur	5	121.7	221.2	55.0
Scott	3	96.1	213.1	45.1
Seymour-Johnson	5	64.7	131.4	49.2
Tinker	5	181.0	405.5	44.6
Tyndall	5	283.9	405.0	70.1
Williams	2	44.0	98.0	44.9
Wright-Patterson	5	127.4	274.6	46.4
TOTAL	102	2723.6	5462.2	49.9

TABLE D.2

LABOR PERCENTAGES--FY 75 REPAIR CONTRACTS

Base	Number of Project	Labor Dollars (000)	Contract Dollars (000)	Weighted Labor Percentage
Bolling	5	160.8	354.7	45.3
Charleston	5	125.4	421.2	29.8
Edwards	5	165.7	419.0	39.5
Elmendorf	5	310.2	572.1	54.2
Grand Forks	5	84.1	333.9	25.2
Hanscom	5	70.4	195.3	36.0
Hill	5	125.6	324.3	38.7
Kelly	5	312.6	1048.0	29.8
Kirtland	5	219.4	424.8	51.6
Lowry	4	136.9	333.2	41.1
Malmstrom	4	39.6	91.1	43.5
Maxwell	5	41.7	144.1	30.0
Moody	5	44.3	126.8	34.9
Nellis	5	152.9	334.6	45.7
Offutt	5	73.0	356.2	20.5
Richards-Gebaur	5	25.6	46.6	54.9
Scott	3	41.9	108.5	38.6
Seymour-Johnson	5	176.9	607.9	29.1
Tinker	5	201.9	501.0	40.3
Tyndall	5	198.6	284.2	69.9
Williams	3	57.4	141.0	40.7
Wright-Patterson	5	54.5	130.3	41.9
TOTAL	104	2819.4	7298.8	38.6

TABLE D.3

LABOR PERCENTAGES--FY 75 MINOR CONSTRUCTION CONTRACTS

Base	Number of Project	Labor Dollars (000)	Contract Dollars (000)	Weighted Labor Percentage
Bolling	5	17.3	68.3	25.3
Charleston	5	36.1	115.2	31.3
Edwards	5	111.9	272.0	41.2
Elmendorf	1	20.5	31.6	65.0
Grand Forks	5	37.4	78.3	47.8
Hanscom	5	22.2	76.6	29.0
Hill	5	60.3	141.3	42.7
Kelly	5	37.9	128.0	29.5
Kirtland	5	87.3	232.8	37.5
Lowry	4	140.4	380.3	36.9
Malmstrom	5	107.0	286.0	37.4
Maxwell	5	49.0	144.6	33.9
Moody	5	37.0	102.7	36.0
Nellis	5	40.7	90.0	45.3
Offutt	5	32.2	95.9	33.6
Richards-Gebaur	5	13.6	24.8	55.0
Scott	5	49.9	117.3	42.5
Seymour-Johnson	4	34.1	104.6	32.6
Tinker	5	55.0	157.1	35.0
Tyndall	4	30.1	44.0	68.4
Williams	5	51.9	135.0	38.4
Wright-Patterson	5	32.2	101.3	31.8
TOTAL	103	1104.0	2927.7	37.7

TABLE D.4

LABOR PERCENTAGES--FY 75 SERVICE CONTRACTS

Base	Number of Project	Labor Dollars (000)	Contract Dollars (000)	Weighted Labor Percentage
Bolling	5	2.2	4.0	55.4
Charleston	-	-	-	-
Edwards	5	68.1	109.0	62.5
Elmendorf	5	454.5	487.7	93.1
Grand Forks	5	12.0	19.9	60.3
Hanscom	-	-	-	-
Hill	-	-	-	-
Kelly	5	7.7	14.0	54.6
Kirtland	7	371.1	720.5	51.5
Lowry	5	15.1	20.9	71.9
Malmstrom	5	53.3	87.3	61.1
Maxwell	5	8.1	14.2	56.9
Moody	5	2.6	4.5	57.8
Nellis	5	432.2	529.7	81.6
Offutt	5	546.5	821.4	66.5
Richards-Gebaur	5	12.5	22.8	55.0
Scott	1	204.3	300.5	68.0
Seymour-Johnson	5	65.4	85.5	76.4
Tinker	5	12.2	16.2	75.0
Tyndall	3	5.7	6.6	85.9
Williams	5	6.0	13.0	46.3
Wright-Patterson	5	323.6	407.5	79.4
TOTAL	91	2603.1	3685.2	70.6

NOTE: No service Contracts submitted by Charleston, Hanscom, and Hill

APPENDIX E

SUMMARY OF MANHOUR DATA

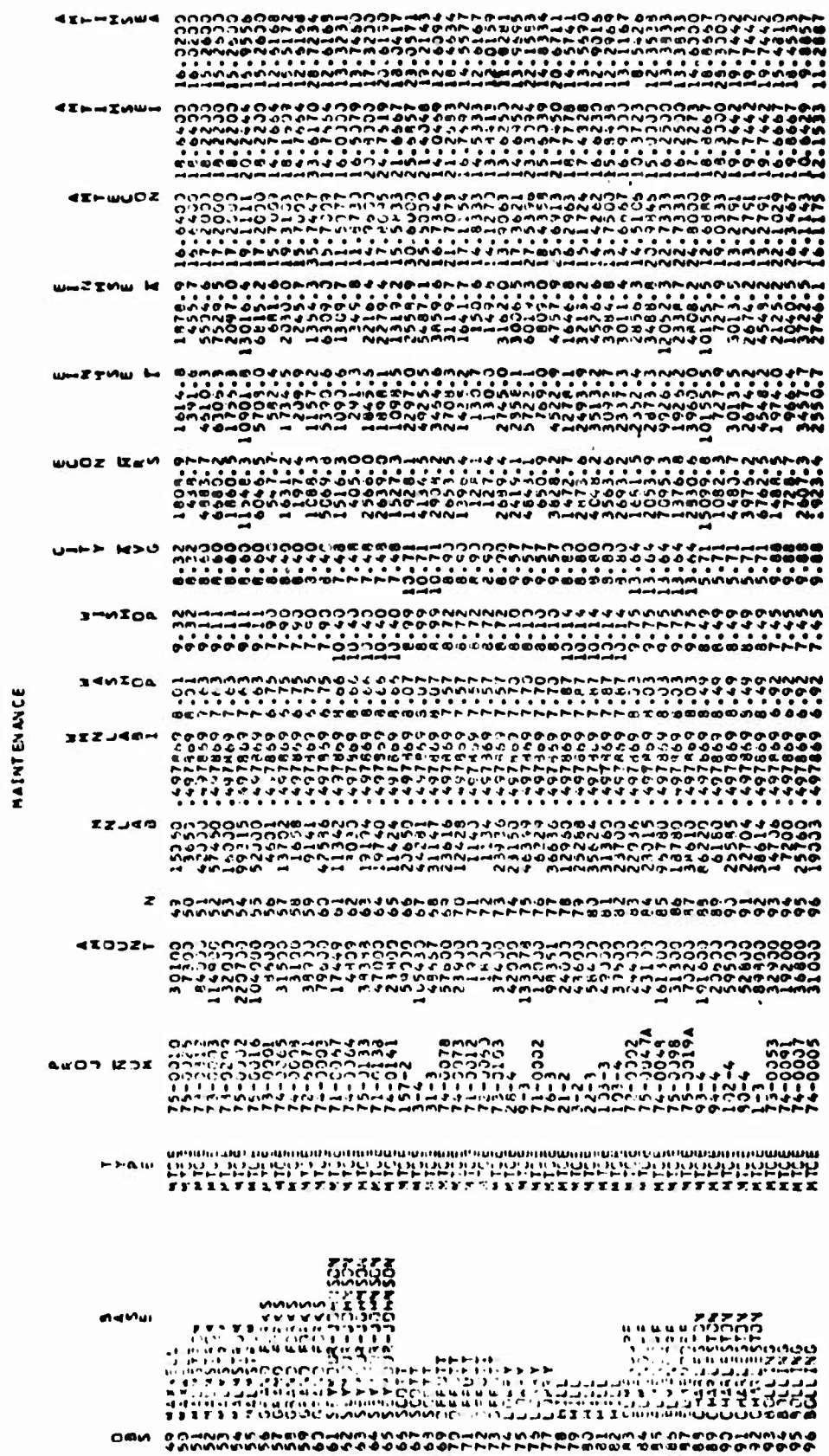
This appendix includes all the manhour data that was used in the development of the equivalent manhour models. To assist in interpreting the data, the following explanation is provided for each term in the data set that has not been explained to this point. Again, the data is presented by contract category which is indicated at the top of each page.

Explanation of Terms Used

VARIABLE NAME	EXPLANATION
AMTECON	Aggregate contract cost per hour for total contract and is obtained by dividing AMOUNT by ECON-HRS
AMTIHSEA	Aggregate adjusted in-house estimated cost per hour for total contract and is obtained by dividing AMOUNT by EINHSE-A
AMTIHSEI	Aggregate indicated in-house estimated cost per hour for total contract and is obtained by dividing AMOUNT by EINHSE-I.
ECON-HRS	Estimated skilled contractor hours per contract and is obtained by dividing the labor dollars per contract by CITY-AVG
EINHSE-A	Estimated adjusted in-house manhours per contract and is obtained by dividing the labor dollars per contract by WASHOP
EINHSE-I	Estimated indicated in-house manhours per contract and is obtained by dividing the labor dollars per contract by WISHOP

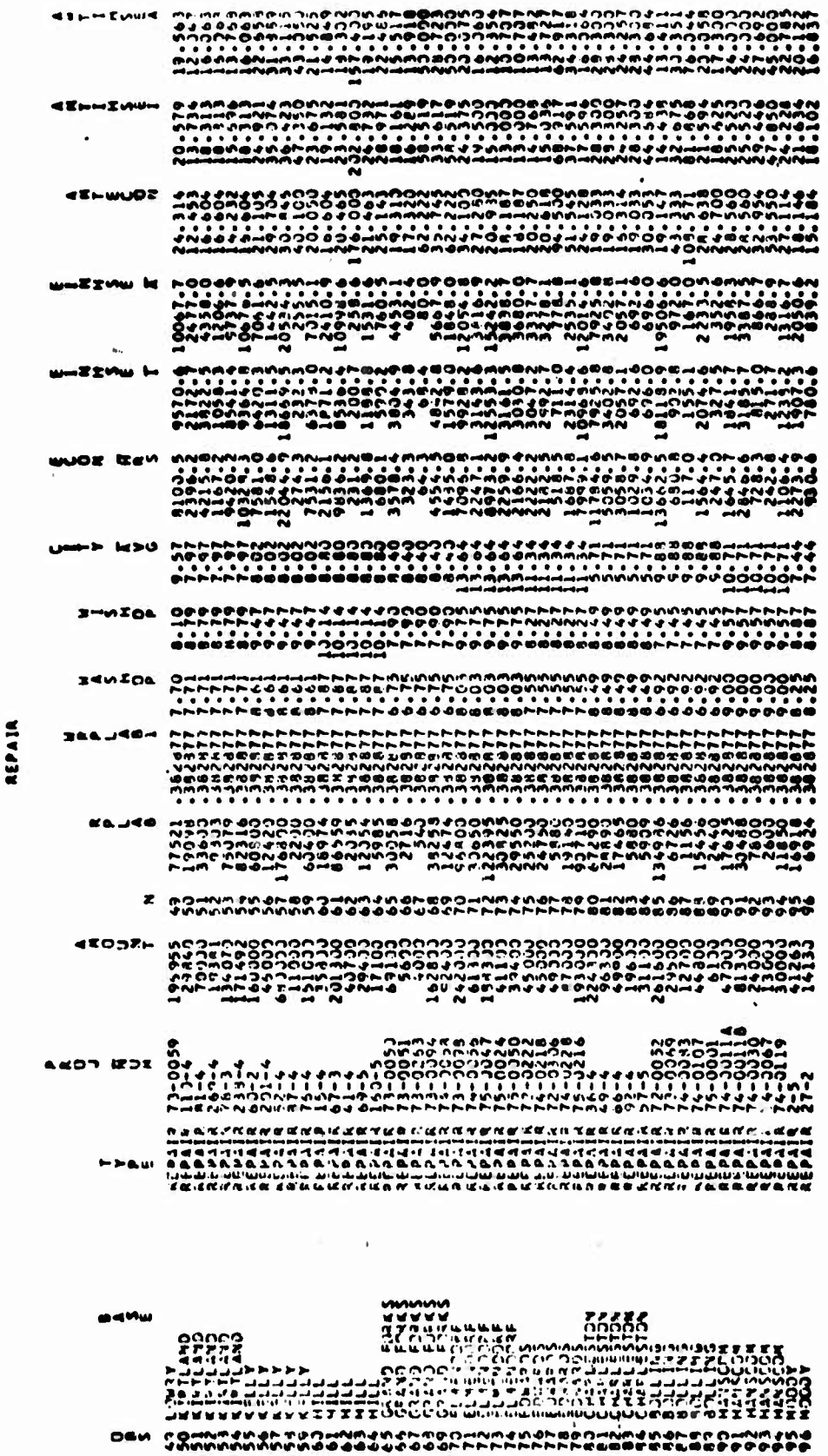
MCLAB	Labor dollars per contract for minor construction contracts and is obtained by multiplying LAB-PER and AMOUNT
MNLAB	Labor dollars per contract for maintenance contracts and is obtained by multiplying LAB-PER and AMOUNT
RPLAB	Labor dollars per contract for repair contracts and is obtained by multiplying LAB-PER and AMOUNT
SVLAB	Labor dollars per contract for service contracts and is obtained by multiplying LAB-PER and AMOUNT
WMCLABI	Weighted labor percentage for all minor construction contracts
WMNLABI	Weighted labor percentage for all maintenance contracts
WRPLABI	Weighted labor percentage for all repair contracts
WSVLABI	Weighted labor percentage for all service contracts

MAINTENANCE


MAINTENANCE

MAINTENANCE

REPAIR



REPAIR

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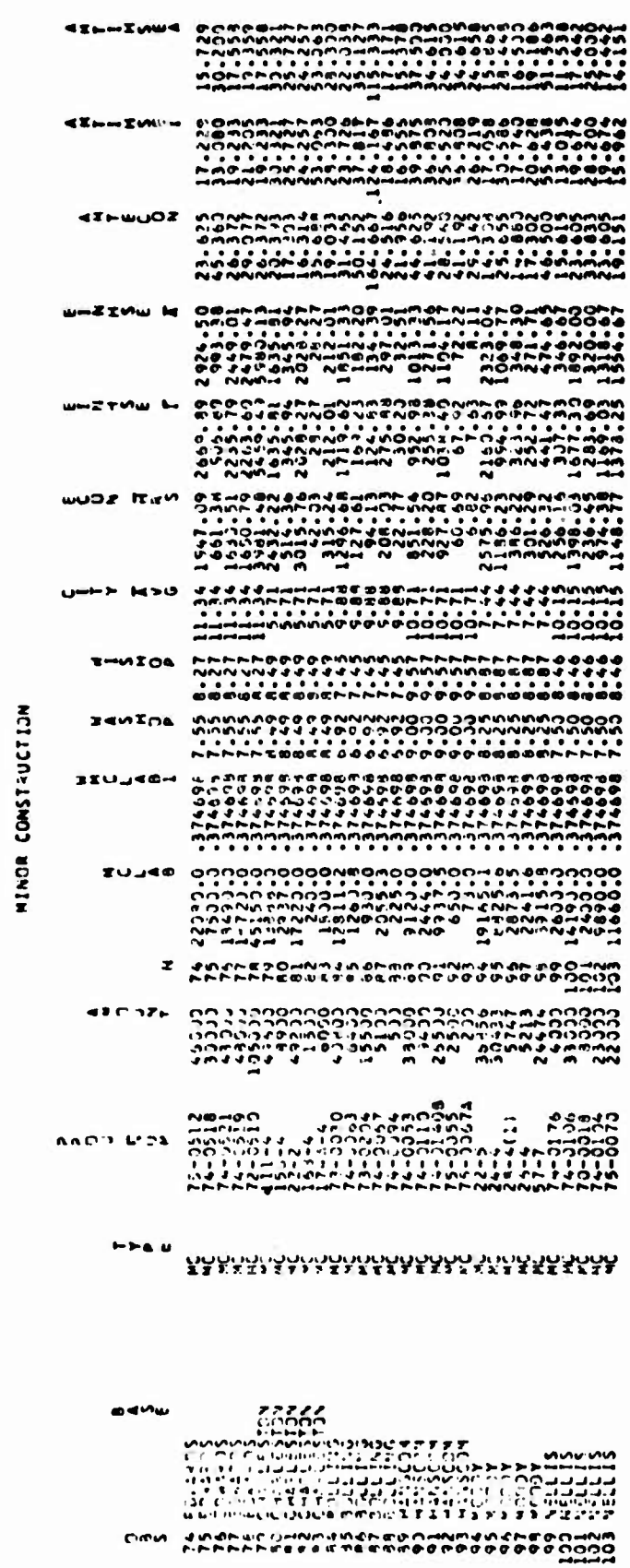
MINOR CONSTRUCTION

OBS	BASE	TYPE	PROJ_NUM	AMOUNT	N	MCLAB	MCLABI	MASHOP
49	LOCAL	XXXX


MINOR CONSTRUCTION

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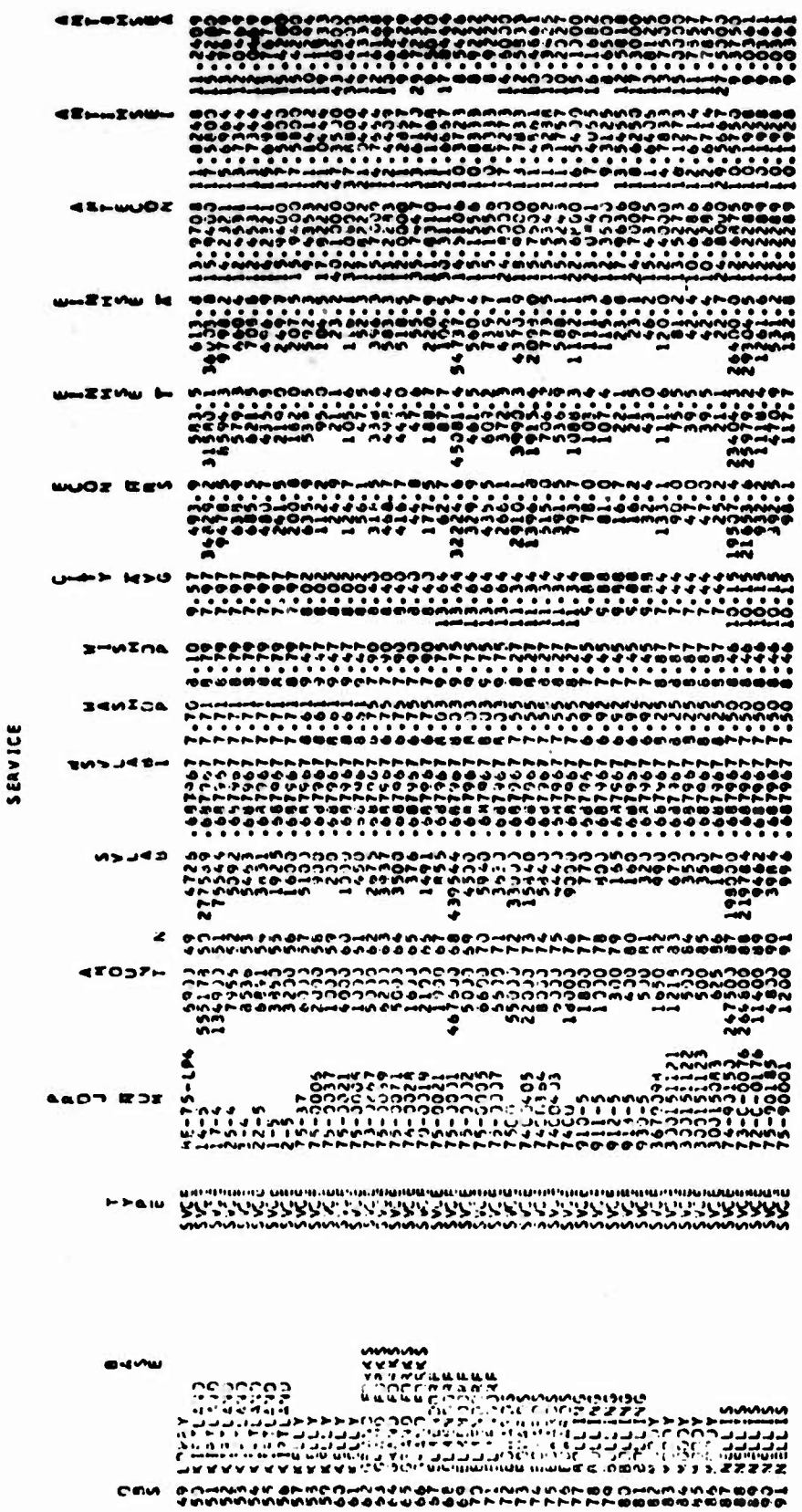

SERVICE

APPENDIX F

SUMMARY OF GOODNESS OF FIT TESTS ON CONTRACT DATA

This appendix contains the results of the goodness of fit tests when the unweighted percentages for supervision, overhead, and profit; labor; and material were tested, by contract category, against the normal distribution. Three tests were applied to each variable, namely: Kolmogorov-Smirnov goodness of fit test, Kurtosis, and Skewness tests; the latter two tests use the Fisher "g" statistic. In addition, a frequency distribution for the unweighted labor percentages is provided following the goodness of fit tests for each contract category. To assist in the interpretation of the results, the following explanation is provided for the terms used.

Explanation of Terms

VARIABLE NAME	EXPLANATION
A	Can not reject, at the 0.05 level of significance, the null hypothesis that the data comes from a normal population
LAB-PER	Variable name representing the percent of the contract dollar amount attributed to labor
MAT-PER	Variable name representing the percent of the contract dollar amount attributed to material
R	Reject the null hypothesis, at the 0.05 level of significance, and conclude that the data comes from other than a normal population

TABLE F.1

MAINTENANCE CONTRACT CATEGORY

Number of contracts analyzed = 102

Summary of Goodness of Fit Tests

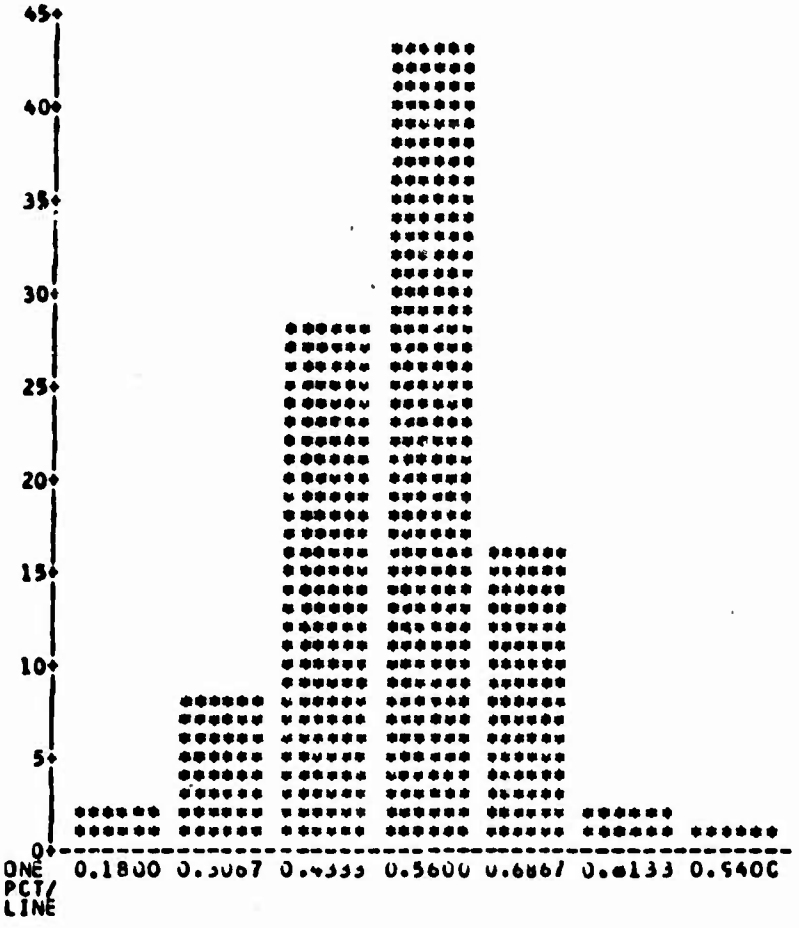
VARIABLE TESTED \ TESTS APPLIED	K-S	SKEWNESS	KURTOSIS	CONCLUSION
SOP-PER	R	R	R	R
LAB-PER	A	A	R	R
MAT-PER	A	A	A	A

The frequency distribution of the unweighted labor percentages is shown in the following figure.

FREQUENCY DISTRIBUTION OF LABOR PERCENT - MAINTENANCE CONTRACTS DATA X1

STATISTICS TABLE AND HISTOGRAM FOR LAB_PER

NO. OF VALUES=	102	NO. MISSING=	0
SUM=	52.59930000000	MEAN=	0.515679411765
UNCORRECTED SS=	28.66757175000	CORRECTED SS=	1.543195666765
VARIANCE=	0.015279165017	STANDARD DEVIATION=	0.123608919652
COEF. VARIANCE=	23.97010949656	STANDARD ERROR=	0.000149795735



FREQUENCY DISTRIBUTION OF THE UNWEIGHTED LABOR PERCENTAGES
ON MAINTENANCE CONTRACTS

TABLE F.2

REPAIR CONTRACT CATEGORY

Number of contracts analyzed = 104

Summary of Goodness of Fit Tests

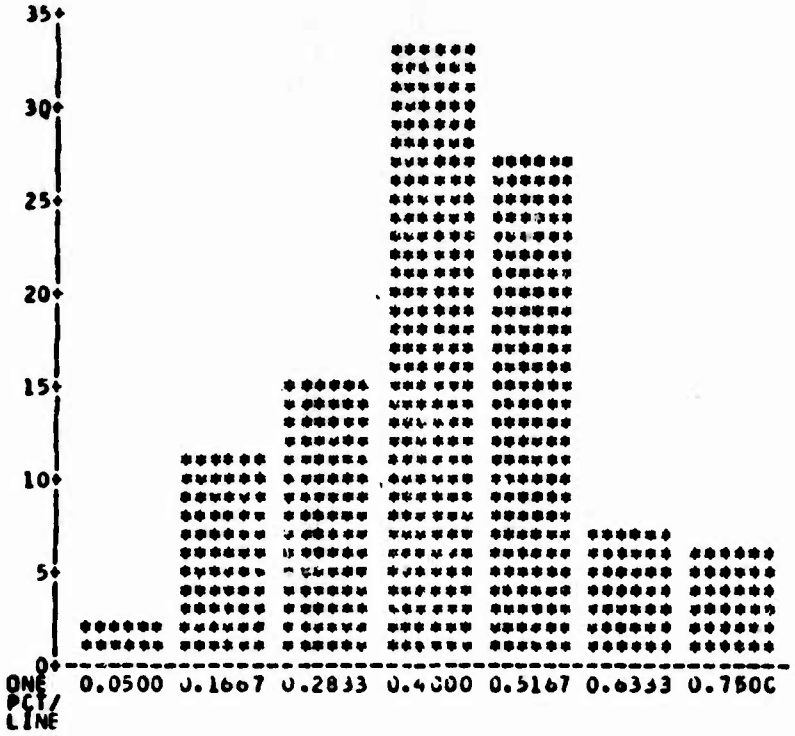
VARIABLE TESTED \ TESTS APPLIED	K-S	SKEWNESS	KURTOSIS	CONCLUSION
SOP-PER	R	R	R	R
LAB-PER	A	A	A	A
MAT-PER	A	R	A	R

The frequency distribution for the unweighted labor percentages is shown in the following figure.

FREQUENCY DISTRIBUTION FOR LABOR PERCENT - REPAIR CONTRACTS DATA X2

STATISTICS TABLE AND HISTOGRAM FOR LAB_PER

NO. OF VALUES=	104	NO. MISSING=	0
SUM=	43.39150000000	MEAN=	0.417225961538
UNCORRECTED SS=	20.60495647000	CORRECTED SS=	2.500908159904
VARIANCE=	0.024280661747	STANDARD DEVIATION=	0.155822532859
COEF. VARIANCE=	37.34727634986	STANDARD ERROR=	0.000233467901



FREQUENCY DISTRIBUTION OF THE UNWEIGHTED LABOR PERCENTAGES
ON REPAIR CONTRACTS

TABLE F.3

MINOR CONSTRUCTION CONTRACT CATEGORY

Number of contracts analyzed = 103

Summary of Goodness of Fit Tests

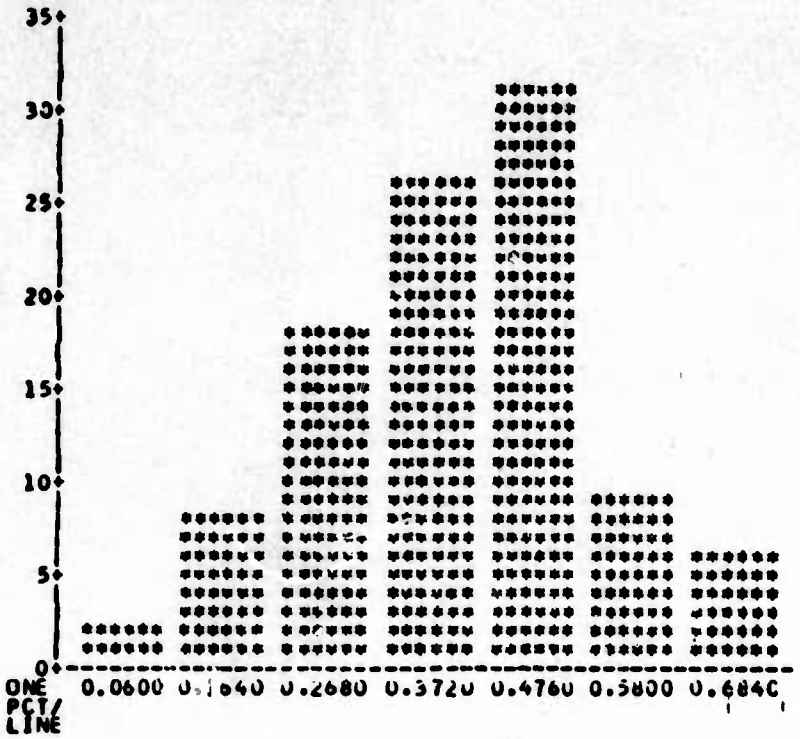
VARIABLE TESTED \ TESTS APPLIED	K-S	SKEWNESS	KURTOSIS	CONCLUSION
SOP-PER	R	R	R	R
LAB-PER	A	A	A	A
MAT-PER	A	R	A	R

The frequency distribution for the unweighted labor percentages is shown in the following figure.

FREQUENCY DISTRIBUTION FOR LABOR PERCENT - MC CONTRACTS DATA X3

STATISTICS TABLE AND HISTOGRAM FOR LAB_PER

NO. OF VALUES=	103	NO. MISSING=	0
SUM=	40.79870000000	MEAN=	0.396103883495
UNCORRECTED SS=	17.97115365000	CORRECTED SS=	1.810630138447
VARIANCE=	0.017751275667	STANDARD DEVIATION=	0.133233914103
COEF. VARIANCE=	33.63610397532	STANDARD ERROR=	0.000172342484



FREQUENCY DISTRIBUTION OF THE UNWEIGHTED LABOR PERCENTAGES
ON MINOR CONSTRUCTION CONTRACTS

TABLE F.4

SERVICE CONTRACT CATEGORY

Number of contracts analyzed = 91

Summary of Goodness of Fit Tests

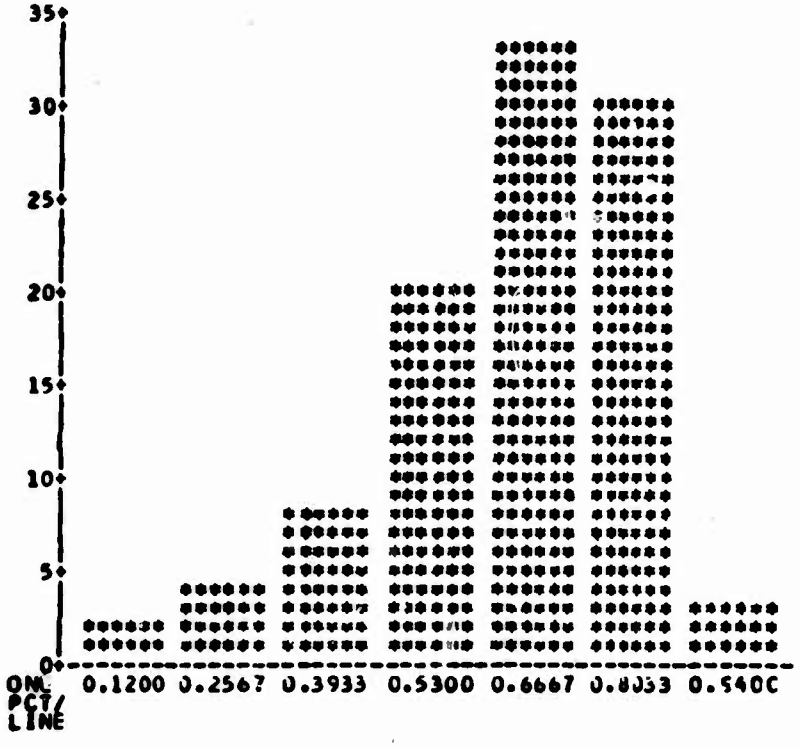
TESTS APPLIED / VARIABLE TESTED	K-S	SKEWNESS	KURTOSIS	CONCLUSION
SOP-PER	R	R	A	R
LAB-PER	R	R	A	R
MAT-PER	R	R	R	R

The frequency distribution for the unweighted means is shown in the following figure.

FREQUENCY DISTRIBUTION FOR LABOR PERCENT - SERVICE CONTRACTS DATA X4

STATISTICS TABLE AND HISTOGRAM FOR LAB_PER

NO. OF VALUES=	91	NO. MISSING=	0
SUM=	57.4600000000	MEAN=	0.6317142857
UNCORRECTED SS=	38.9600000000	CORRECTED SS=	2.6224571429
VARIANCE=	0.0291758.0571	STANDARD DEVIATION=	0.1708053339
COEF. VARIANCE=	27.0390171366	STANDARD ERROR=	0.0CC320613501



FREQUENCY DISTRIBUTION OF THE UNWEIGHTED LABOR PERCENTAGES ON SERVICE CONTRACTS

APPENDIX G

REGRESSION ANALYSIS AND PLOTS FOR NATIONAL DATA

This appendix contains the regression analysis results for the equivalent in-house hours, EINHSE-A, on a national basis. The data obtained from all 22 bases is used in the development of the manhour models by contract category. In addition, plots of the equivalent in-house manhours, EINHSE-A, versus the contract dollar amount, AMOUNT, are also included following the regression analysis results for each contract category. The title at the top of each page indicates the contract category under consideration. To assist the user in interpreting the regression and plot results the following explanation is provided for the terminology used (10).

Interpretation of Regression Analysis Results

1. REGSS (Regression Sum of Squares) - includes the drop in variability from a model $Y_i = B_o + \varepsilon_i$ containing only an intercept to the full model with all terms included which were specified in the MODEL statement.
2. REGMS (Regression Mean Square) - the mean square for regression is the average drop in variability per independent variable in the model (excluding the intercept).

3. ESS (Error Sum of Squares) - the variability about the full model is the error sum of squares which is the unresolved residue of variability not explained by the model.

4. EMS (Error Mean Square) - the ESS has (n-p) degrees of freedom associated with it and the "average" unexplained variability is EMS=ESS/(n-p) which is the error variance estimate.

5. TCSS (Total Corrected Sum of Squares) - the total corrected sum of squares is

$$TCSS = ESS + REGSS$$

and it represents all the variability in y about $\overline{Y}$. It has (n-1) degrees of freedom associated with it.

6. F-Value - the F value is the ratio of the average reduction in variability REGMS to the error variance.

$$F\ value = REGMS/EMS$$

It is hoped that this ratio will be greater than unity since this would indicate that the average reduction in variability due to introducing independent variables into the model is greater than the average unexplained variability EMS.

7. PROB > F - the area of the F-distribution to the right of F value is computed by the program and printed as PROB > F. This number is the significant level of F VALUE. The smaller PROB > F is, the more certain one can be that F VALUE is significantly greater than unity. Customarily, (PROB > F) < .05 would be considered significant.

8. R-SQUARE - this is a measure of the fraction of total variation about the mean which is accounted for by the model.

$$R^2 = 1 - \frac{ESS}{TCSS}$$

The ratio ESS/TCSS is the fraction of variability of TCSS remaining after the full model is fitted. This, 1 - ESS/TCSS, is the fraction of variability removed by the model.

9. SEQSS (Sequential Sums of Squares) - the sequential sums of squares are the reductions in variability attributable individually to each independent variable in the model as these variables are added one at a time in the order indicated by the MODEL statement.

10. PARSS (Partial Sums of Squares) - the partial sums of squares are the increases in variability which would result if the corresponding independent variable were individually removed from the full model. PARSS is usually different from SEQSS. PARSS is an increase in variability due to removal of an independent variable while SEQSS is the reduction in variability when the independent variable enters the model.

11. B VALUES - Regression coefficients.

12. PROB > |T| - this quantity is the tail area of the t-distribution. If PROB > |T| is smaller than .05, (say .049), then the alternate hypothesis, H_1: $B_j \neq 0$, can be accepted at a risk of less than .05 of being wrong. Small values of PROB > |T| indicate regression coefficients significantly different from zero.

Interpretation of Plots

All plots depict the equivalent in-house manhours, EINHSE-A, on the vertical axis and the contract dollar amount, AMOUNT, on the horizontal axis. The following legend is used on the plots:

LEGEND

A = 1 observation, B = 2 observation, etc (observed values)

Asterisk (*) - represents predicted values for the best line fitted to the data using the regression procedure

MAINTENANCE CONTRACT CATEGORY

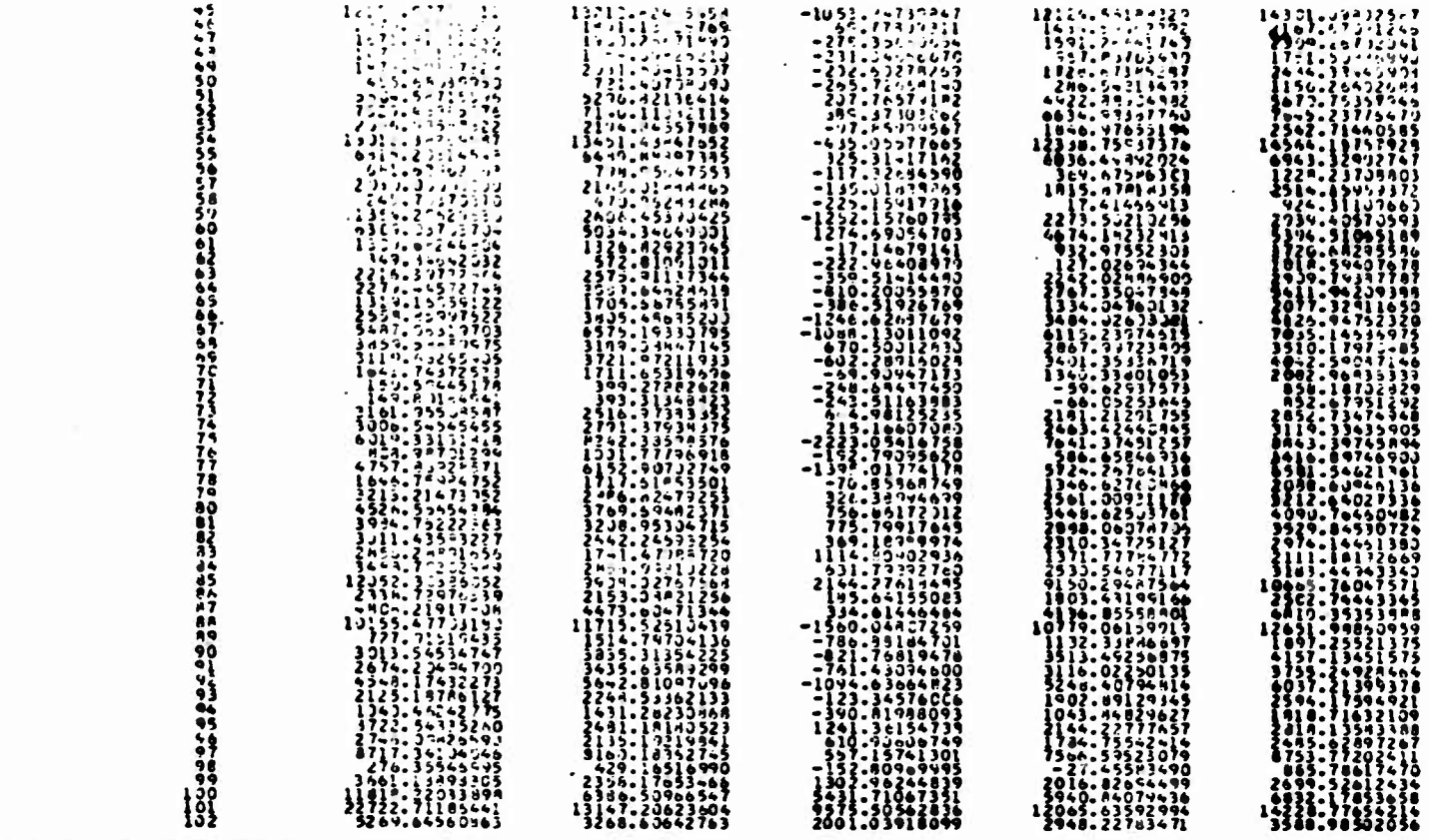
ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	911761339.16165	911761338.16165	344.51190	0.0001	0.77503414	46.74182 %
ERROR	100	264653075.21530	2646530.75215				
CORRECTED TOTAL	101	1176414413.37696				STD DEV	EINMSE_A MEAN
						1626.81613963	3480.42973

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	911761338.16162	344.51190	0.0001	911761338.16165	344.51190	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	285.93760336	1.21300	0.2280	235.72730655	0.0
AMOUNT	0.05965336	18.56103	0.0001	0.00321390	0.88036024

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	5642.00000000	5332.61339243	307.38660757	4956.68042324	5708.54636163
2	1466.66666667	1593.31177404	-131.64510737	1220.69395328	1975.93959480
3	544.00000000	739.32579444	-227.32579444	356.84267349	1219.15892838
4	1744.00000000	1910.20778419	167.79221181	1259.39557369	1892.62000248
5	3846.66666667	3539.87333206	319.79333460	3247.16225512	3886.97440501
6	1178.33333333	1672.69624641	-676.54635542	1510.65347643	2219.73902924
7	2281.66666667	2585.44960552	-304.35114398	2231.69533281	2920.03333122
8	2636.66666667	4340.13004792	-1615.96316981	4007.57443256	4672.62466518
9	2144.11111111	2491.62114661	-347.50877078	2155.01914629	2828.22312693
10	6220.55555757	5937.51513444	283.03574314	6074.44733233	6994.34225657
11	3193.23333333	3566.87333036	-371.63521482	3247.16225512	3886.58440531
12	2247.91666667	2451.33276624	-803.41371662	2524.45067677	3177.41485170
13	2790.72222222	2851.33276624	-60.30624741	2524.45067677	3177.41485170
14	4454.30493579	3686.18009103	768.12554473	3365.84671723	4006.51346286
15	5744.21133333	4143.40713482	1600.80419851	3835.59733261	4491.21693722
16	3337.72222222	2672.07252278	665.65972159	2341.02032588	3003.12491968
17	10269.57916667	7623.30320308	2646.27296358	7077.20010038	8169.40624578
18	5766.33562784	4637.46045905	1129.39516879	4328.44844010	4946.47232799
19	4401.22222461	3662.31873184	803.96533277	3342.15048328	3982.48711460
20	2433.30729333	2127.22636036	306.08016677	1774.52776604	2479.92575149
21	1873.13741333	1699.72232386	170.43529836	1327.75643116	2071.68865957
22	2541.22222333	2453.28579108	416.91504975	2125.72202725	2780.85105491
23	2598.00000667	2642.24593254	-146.57926587	2319.34725127	2974.14461380
24	779.33333333	1019.67399333	-240.67399333	605.77275579	1433.57523087
25	786.33333333	1174.77277259	-388.34338370	771.20398714	1578.34165804
26	1479.00000000	3299.64386470	-1920.64386470	3040.15027284	3719.13745657
27	122.22222222	399.79976555	-277.57653333	-156.02114948	775.61860959
28	4199.77999920	3713.57552355	459.20337155	3393.05514559	4031.10130271
29	243.33333333	546.56333270	-263.22999937	98.81562136	994.30712404
30	987.44479977	1135.82293780	-247.97420382	750.99267109	1560.61332413
31	7926.82226429	16571.31027591	-8644.49100762	15136.00055995	18006.61999188
32	966.31523661	1240.39149113	-274.07325652	841.06725464	1639.71572761
33	5023.34444774	4342.36727437	1580.97767136	4009.77422050	4674.96033225
34	1161.44518583	1777.27181550	-615.83172967	1409.47851000	2145.06532100
35	1735.77233772	2456.23005095	-720.45596323	1597.52184455	3314.94230536
36	1433.30303330	1479.30531307	-48.70198277	1094.43182722	1863.57819892
37	1127.27272727	2073.53881792	-946.26609065	1722.43781145	2428.63982440
38	473.49444545	1580.41375989	-1106.96121444	1201.76533408	1959.06612670
39	1583.93090909	2800.53635096	-1216.57544187	2472.76909301	3128.29360892
40	2054.61418182	1971.20535545	83.41312636	1615.21867259	2329.19123832
41	2483.79052369	3256.67575154	-772.88522785	2936.20450681	3577.14699627
42	3117.20069256	3268.50642763	-151.30944509	2948.22783571	3588.78501956
43	1446.34403890	2015.88543744	-569.50139854	1660.06588993	2371.71098496
44	3366.58354115	3865.14023249	-498.55669134	3542.92791221	4187.35255277



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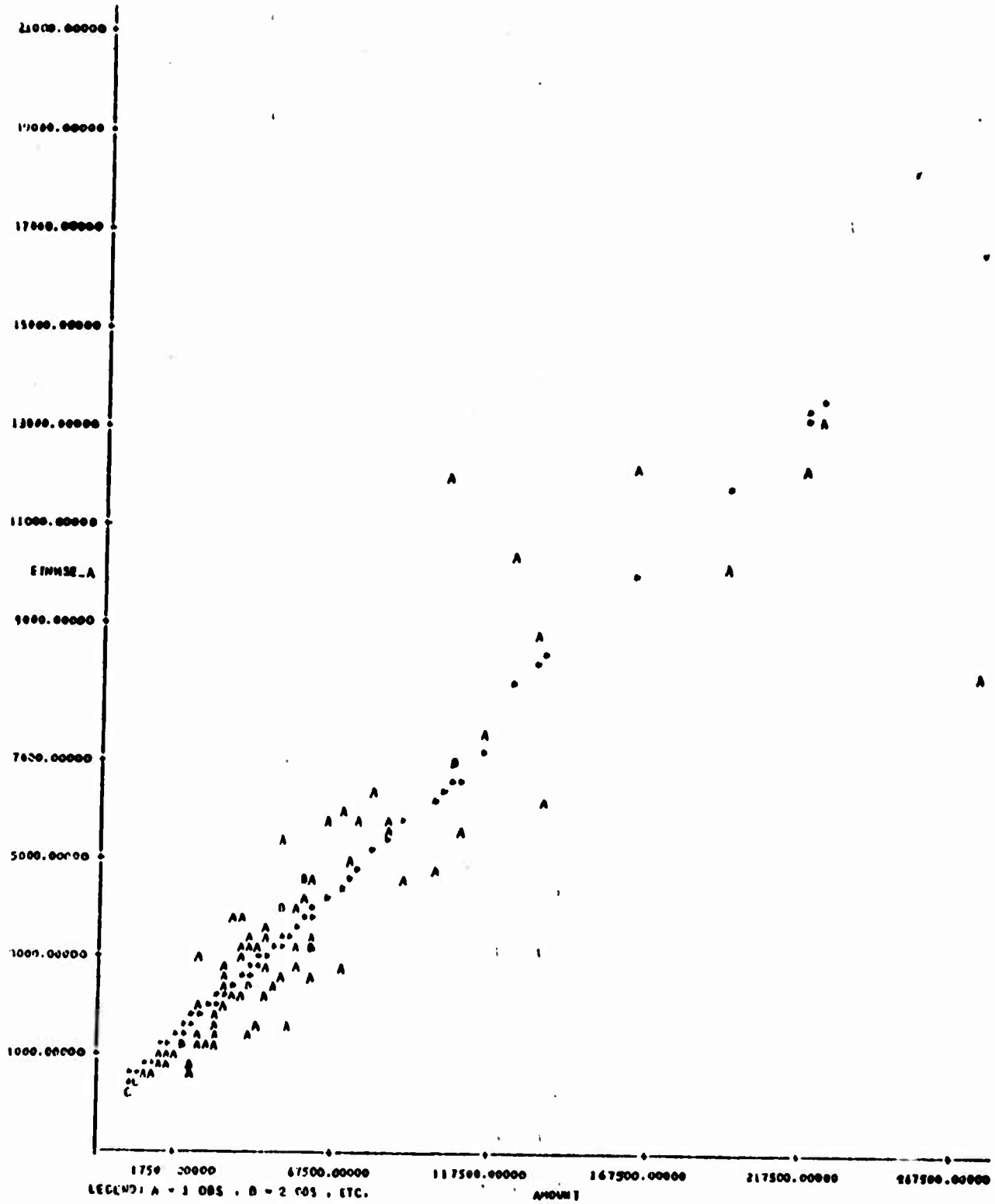
FIRST ORDER AUTOCORRELATION OF RESIDUALS =	0.39460344
DURBIN-WATSON D =	1.20143912

MAINTENANCE COVERAGE CATEGORY - CONTINUED

MAINTENANCE CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



REPAIR CONTRACT CATEGORY

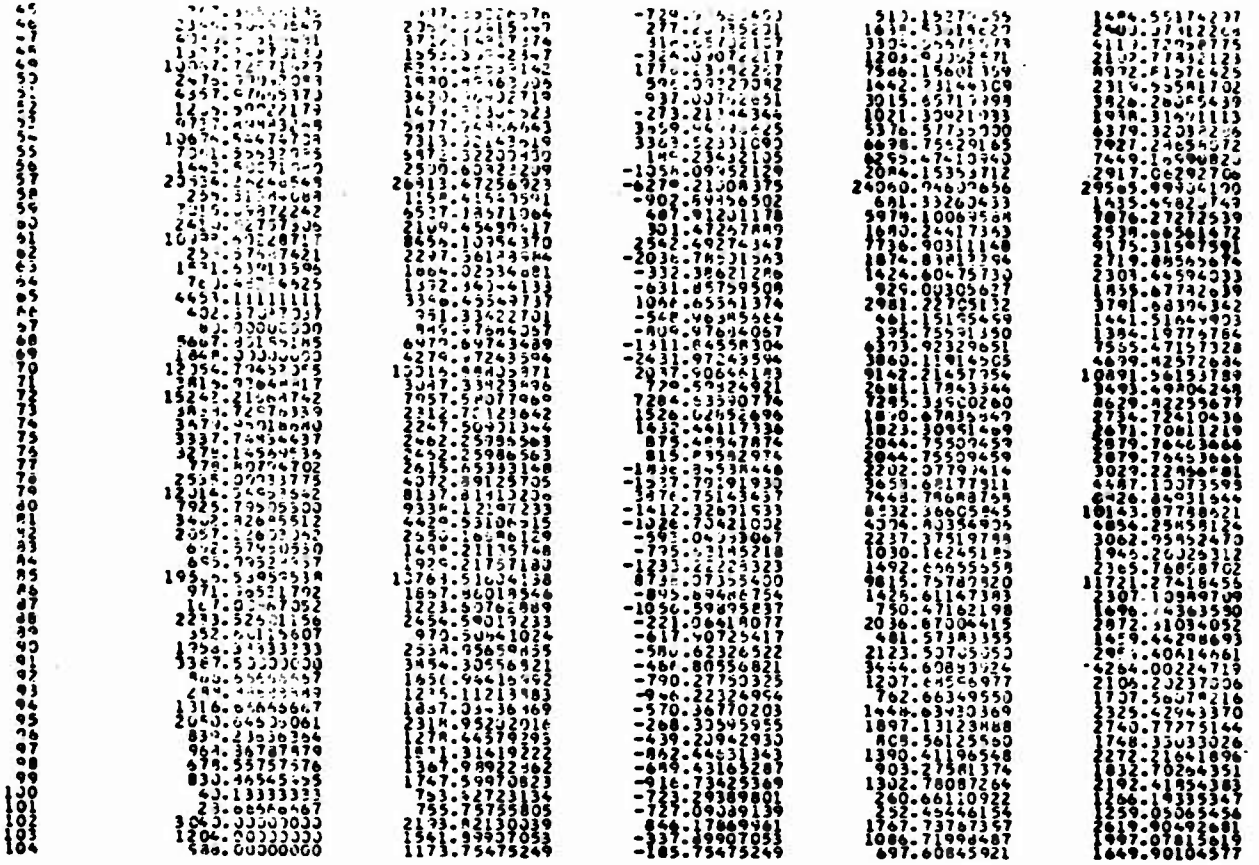
ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINHSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	1270183910.45222	1270183910.45222	292.69182	0.0001	0.74157053	62.54174 %
ERROR	102	442645638.76045	4339663.12510				
CORRECTED TOTAL	103	1712829549.21267				STD DEV	EINHSE_A MEAN
						2083.16581147	3330.87206

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	1270183910.45222	292.69182	0.0001	1270183910.45222	292.69182	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	736.58337482	2.89531	0.0046	254.40548812	0.0
AMOUNT	0.03834817	17.11524	0.0001	0.00224151	0.86114489

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	488.14437870	1059.39992370	-571.25554500	576.15813859	1542.64170882
2	1145.[illegible]757596	1797.49093300	-651.40335904	1355.02773217	2239.95413384
3	2168.[illegible]330769	2539.34309222	-369.64777452	2123.90035762	2954.78582681
4	1498.[illegible]721893	1769.95490588	-271.12958695	1326.20134685	2213.71226491
5	1151.[illegible]514793	1513.98641465	-362.49126672	1057.19720731	1970.53562199
6	2[illegible]6.[illegible]6[illegible]67	2415.65233148	231.01333519	2202.07776416	3029.22549881
7	479.142[illegible]716	1540.24743679	-708.10457445	1127.07700335	2033.41787023
8	3104.33333333	3420.96402719	-312.63069385	3015.65719098	3826.28086439
9	14560.[illegible]62[illegible]595	5913.61284724	8647.25031871	5409.75485798	6417.43083650
10	5342.91217257	2654.50169794	2736.41047463	2241.29480641	3066.70858947
11	4311.[illegible]1756549	2267.48262742	2041.93493606	1846.03086752	2692.93438532
12	5269.[illegible]550[illegible]3	2654.50169794	2615.64391069	2241.29480641	3066.70858947
13	1061.[illegible]4733[illegible]54	1088.56333058	-27.83572703	607.17676115	1569.94990001
14	703.241[illegible]526	1277.29534194	-574.05334668	807.34324425	1747.24743963
15	[illegible]7.5[illegible]7237	5376.73571577	1110.79549530	4937.23612429	5816.23530924
16	[illegible]471.[illegible]664	7593.27129929	878.54915059	6954.27564915	8232.31494844
17	2659.[illegible]3142[illegible]5	2638.66235135	20.66924959	2225.61360524	3051.71109747
18	[illegible]857.[illegible]5539[illegible]3	9007.64379340	849.37159820	5498.98132369	6519.78620311
19	1337.[illegible]4672[illegible]79	1693.52551152	-356.17978173	1246.04624336	2140.97077969
20	3542.01619928	9138.67211836	-5596.65595204	8352.81786265	9924.52637427
21	3191.[illegible]4757506	2272.81493533	919.02863975	1849.47942278	2696.15044782
22	11543.[illegible]2545335	12238.53921308	-1155.53335773	11129.26492457	13348.03111159
23	1566.[illegible]9[illegible]3[illegible]6[illegible]5	1650.59338618	-81.74533923	1201.12164766	2100.06512473
24	615.11771795	1213.48200262	-597.36428267	738.68352280	1688.24948233
25	1292.[illegible]2[illegible]8[illegible]147	1466.09802369	-228.84912222	988.91460397	1909.27754642
26	3359.[illegible]8[illegible]0[illegible]6[illegible]6[illegible]5	3707.23052293	-347.54317638	3299.71949783	4114.75956783
27	[illegible]44.56571[illegible]49	962.[illegible]7[illegible]5[illegible]5	-437.27202246	473.42561269	1452.27156193
28	1775.[illegible]6[illegible]2[illegible]7	1599.42152022	176.04466383	1147.26246445	2051.60077550
29	[illegible]49.33[illegible]7[illegible]0[illegible]0	824.[illegible]9[illegible]5[illegible]3	-838.23639403	330.29104935	1326.94785931
30	1[illegible]83.[illegible]2[illegible]5[illegible]3	1265.79283200	-176.83617777	795.16158508	1736.42407892
31	[illegible]57.[illegible]1922525	913.24310775	-655.46044249	313.91427817	1512.64659732
32	5[illegible]5.[illegible]7[illegible]3[illegible]5[illegible]4	11274.71447868	-5826.53514315	10268.53015526	12285.89880110
33	[illegible]75.[illegible]3[illegible]1[illegible]7[illegible]4[illegible]0	[illegible]90[illegible].2[illegible]6[illegible]5[illegible]2	-1150.97737623	1468.65750451	2543.75759934
34	1397.79382338	1389.33143145	-61.53749407	904.69419132	1833.96865159
35	1022.[illegible]4[illegible]5[illegible]7[illegible]7[illegible]7	1375.17227797	-373.71821060	933.03339454	1859.29716140
36	1136.[illegible]4[illegible]4[illegible]0[illegible]1[illegible]9	1396.17227797	-260.11196678	933.03339454	1859.29716140
37	1323.[illegible]3[illegible]4[illegible]5[illegible]8[illegible]1[illegible]7[illegible]3	1752.91506[illegible]37	-429.46926835	1308.24543494	2197.38473220
38	456.67915[illegible]0[illegible]6	1189.03[illegible]09908	-732.41494802	713.87953413	1664.38074403
39	1842.[illegible]2[illegible]1[illegible]4[illegible]7[illegible]3[illegible]1[illegible]6	2688.51522776	-845.69375460	2276.55067509	3100.47978042
40	943.[illegible]1[illegible]9[illegible]7[illegible]5[illegible]3[illegible]3[illegible]1	2435.41[illegible]00910	-1491.21625879	2017.14963261	2852.68288560
41	[illegible]44[illegible].[illegible]4[illegible]3[illegible]4[illegible]5[illegible]3[illegible]6[illegible]9	1143.07[illegible]05932	-494.61[illegible]00864	605.05194777	1681.10015087
42	2[illegible]76.[illegible]4[illegible]9[illegible]0[illegible]3[illegible]4[illegible]1	2554.88443953	-280.83443613	1934.30335146	3175.46552761
43	[illegible]169.[illegible]5[illegible]6[illegible]8[illegible]4[illegible]8[illegible]4	1342.48756493	-173.[illegible]5006[illegible]7[illegible]08	878.[illegible]1[illegible]1[illegible]5[illegible]6[illegible]8	1806.[illegible]6[illegible]4[illegible]7[illegible]4[illegible]9
44	1[illegible]80.37352[illegible]56	1745.14941278	-64.77188722	1300.20907786	2190.08974771



SUM OF RESIDUALS	=	0.00000000			
SUM OF SQUARED RESIDUALS	=	442445638.76044510			
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000256			
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.15206556			
DURBIN-WATSON D	=	1.69517767			

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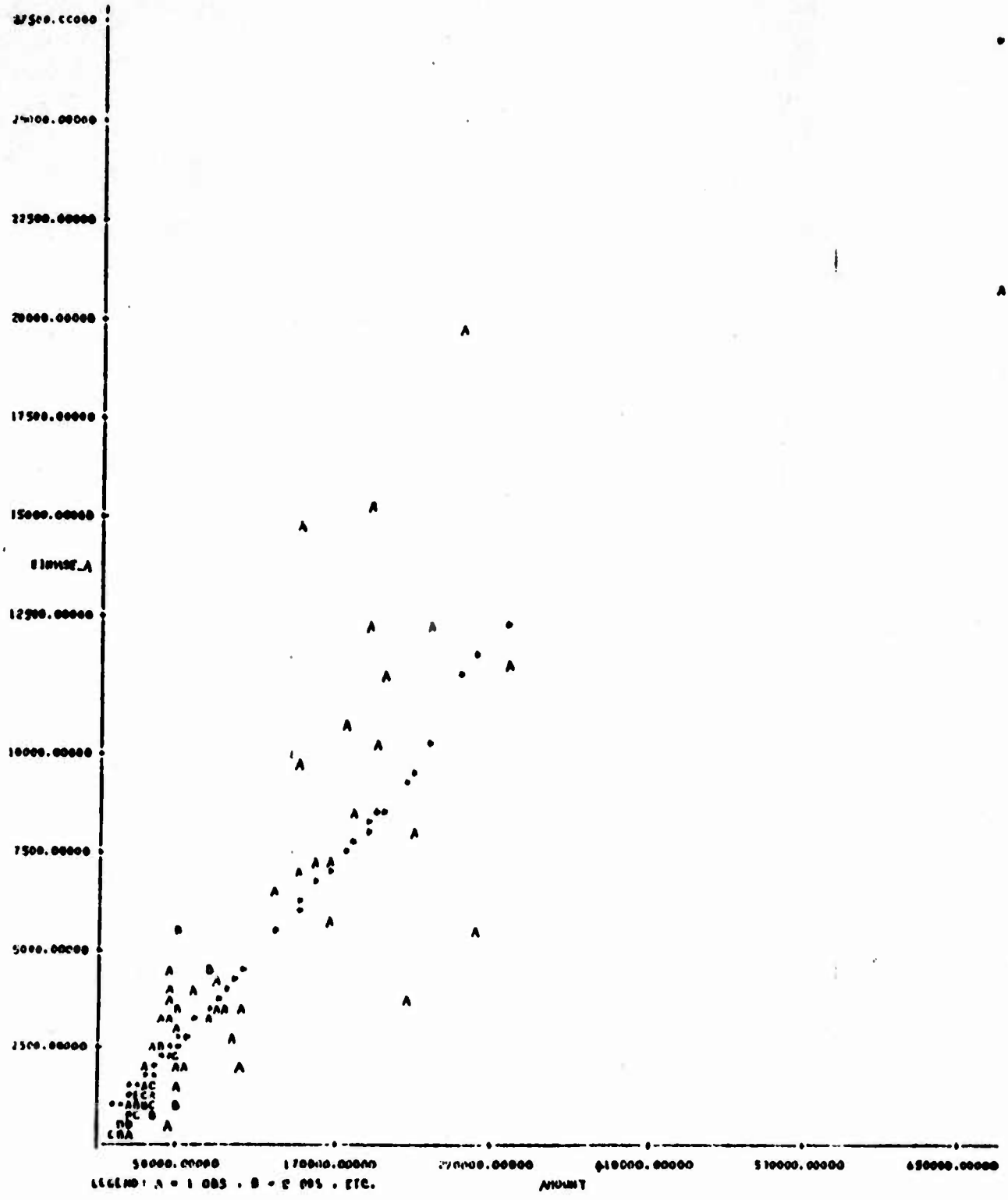
REPAIR COVERAGE CATEGORY - CONTINUED

REPAIR CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



MINOR CONSTRUCTION CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	227835342.48741400	227835342.48741400	1278.22374	0.0001	0.92677040	30.70588 %
ERROR	101	18002614.80219074	178243.71091278				
CORRECTED TOTAL	102	24583795? 28960480				STD DEV	EINMSE_A MEAN
						422.18918853	1374.94556

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	227835342.48741400	1278.22374	0.0001	227835342.48741410	1278.22374	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > ITI	STD ERR B	STD B VALUES
INTERCEPT	48.73822974	0.87445	0.3839	55.73610732	0.0
AMOUNT	0.04665835	35.75226	0.0001	0.00130505	0.96268915

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	256.07361420	264.29979110	-7.32937690	141.33632721	387.29325500
2	530.41420118	823.20679355	-292.65256237	735.24575346	911.28331514
3	418.27819335	461.01134241	-42.73917168	364.16297758	557.86776328
4	2184.03307602	2206.26443553	-17.34375563	2111.72763245	2300.40024066
5	413.09370959	1213.37721959	-799.82219001	1130.39545402	1296.35548519
6	1671.75571429	1495.14577480	176.63873948	1412.35514369	1577.93640592
7	2959.52330252	2055.34713418	504.47057535	1964.30567230	2145.78859600
8	140.11404762	855.29673574	-505.17768812	503.62104012	746.97243135
9	1272.14245714	1864.41374772	-596.27089056	1781.64723643	1925.36025901
10	522.45714286	463.66334928	54.19379358	372.02657961	565.30012194
11	2102.16706619	979.38561132	1122.78141447	893.99405267	1064.77717000
12	370.41428382	216.73627756	142.70522626	112.11340465	321.30315047
13	1295.79352451	617.97035344	667.82247006	525.37359412	710.56661277
14	971.07241911	434.36966451	436.70225459	330.92601946	532.03990957
15	1389.95087242	2060.34463816	-175.39376534	1977.97747223	2169.11180409
16	823.82204544	1233.22934331	-112.40640067	944.55643119	1117.40225544
17	1614.70324130	1272.44865134	-153.74545004	1588.23114117	1956.66024373
18	1732.54344370	1901.07459035	-156.53096445	1813.54049199	1988.60868833
19	794.26433915	897.92213413	-103.65579694	811.25540737	984.58852089
20	1349.23718245	1819.23585039	21.10133206	1733.10961334	1905.36208743
21	953.14318707	1193.69731252	-241.55412545	1016.78331523	1484.61130981
22	907.23586951	1755.49543539	-958.22917459	1690.16504488	1850.80582529
23	429.99581270	389.39081338	40.57506432	290.39396683	488.38765993
24	2078.25792257	1676.97455156	398.48344101	1592.76734630	1761.18175682
25	1564.64671023	215.17633511	535.74992112	1132.19947269	1298.15391724
26	820.46014470	541.62220243	239.21636227	488.05459644	675.15191343
27	1343.41449524	1747.91149676	-394.11290248	1662.83552750	1833.02227152
28	377.61585121	493.36555650	-115.44980334	397.12944081	589.05948852
29	673.82264638	450.00031063	228.42265795	352.82035868	547.17796438
30	197.87322525	142.59492797	55.27830228	34.85514033	249.33471561
31	544.47627112	370.89082139	173.79550973	271.10675784	470.67488493
32	173.50114774	151.34659230	22.21455544	44.52451330	258.16867129
33	402.41302439	246.69579768	155.74322671	184.44101466	308.95057633
34	1651.25495176	2381.59555244	-730.49060672	2282.05555748	2481.13551343
35	561.81592965	503.99302657	63.02688228	410.41460361	597.56944952
36	424.83497450	361.34915206	61.44857244	261.48441561	461.21388852
37	475.58142648	468.66334928	6.89857741	372.02657961	565.30012194
38	1131.43815551	1030.49850068	131.26769482	915.47145783	1145.52554354
39	1035.81797753	883.42263415	121.69534338	797.01875399	970.82651432
40	824.22471410	1070.53602061	-250.33130151	986.32269143	1154.74934978
41	379.53104365	921.24931144	-547.71622779	834.97231314	1007.52630973
42	2044.26966292	1770.76288015	304.50677377	1634.23786708	1907.28789322
43	1835.20594251	2334.09721387	-499.79122136	2214.77403529	2453.42039244
44	293.03373526	450.00001063	-156.96627537	332.82035868	567.17966438

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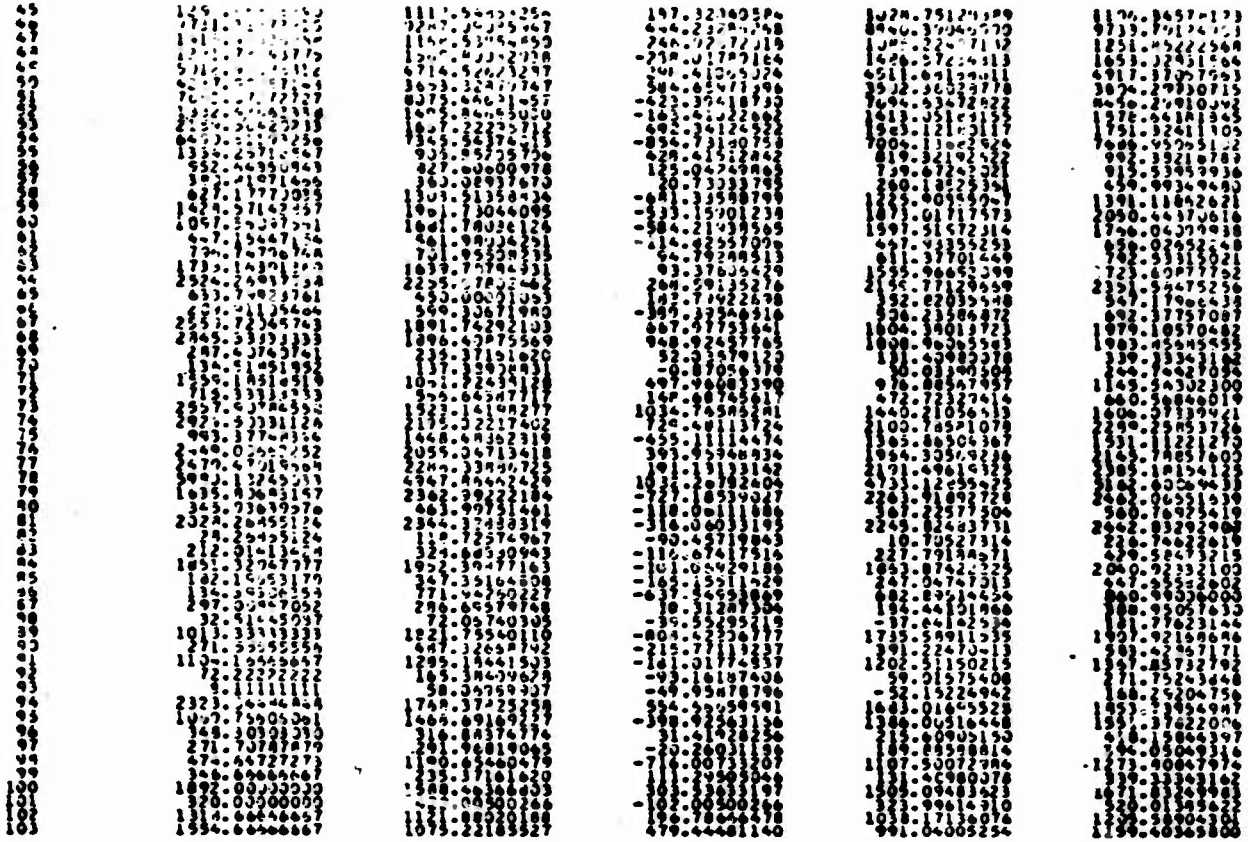
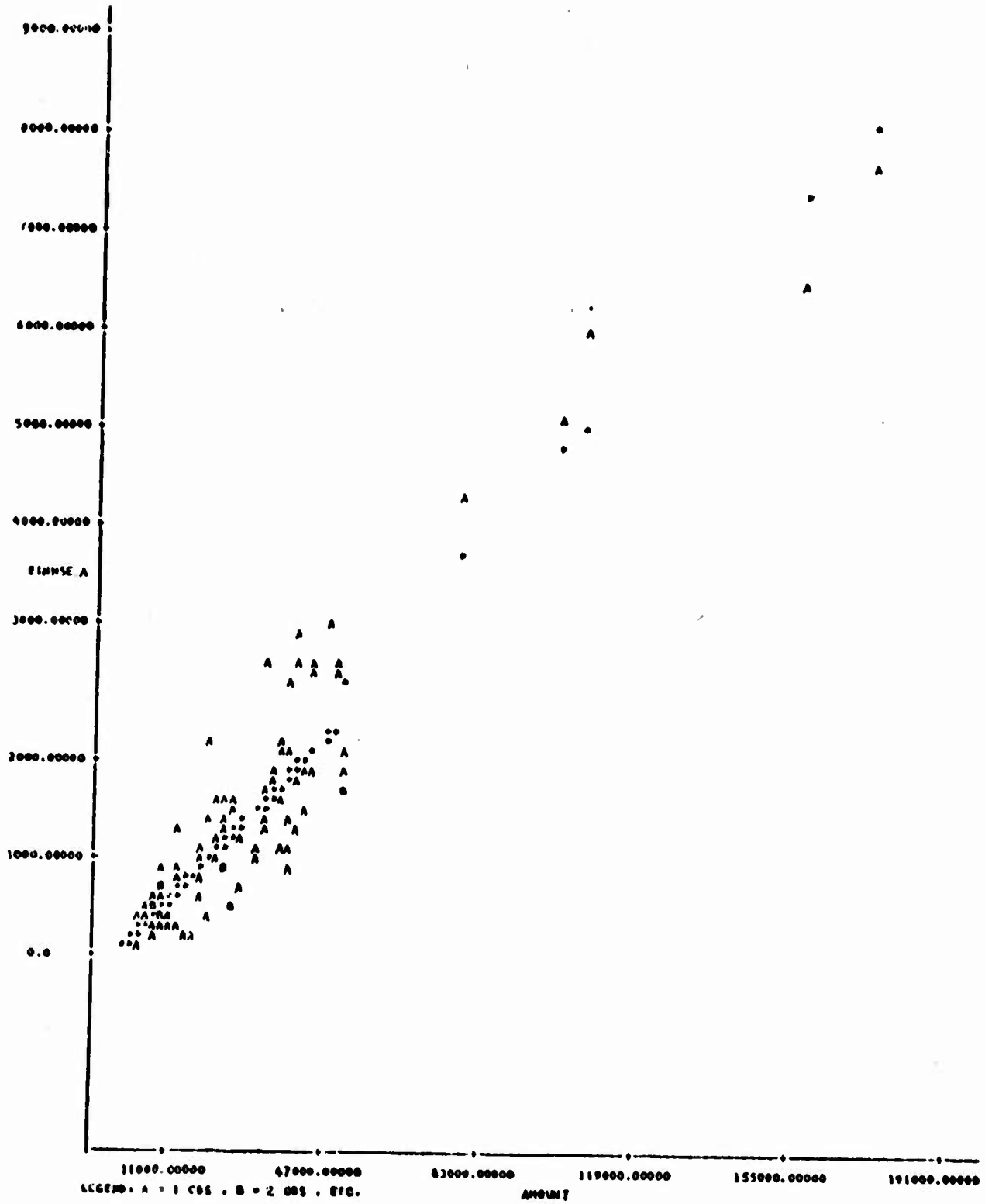


SUM OF RESIDUALS	0.00000000
SUM OF SQUARED RESIDUALS	18002614.80218995
SUM OF SQUARED RESIDUALS - ERROR SS	-0.00000082
FIRST ORDER AUTOCORRELATION OF RESIDUALS	0.07757620
DURBIN-WATSON D	1.83307008

[illegible] CONSTRUCTION CONTRACT AGENCY - CONTINUED

MINOR CONSTRUCTION CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



SERVICE CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	7771291448.71891	7771291448.71891	1613.81614	0.0001	0.94773364	59.98986 8
ERROR	89	428577284.69597	4815475.11119				
CORRECTED TOTAL	90	8199868733.61488				STD DEV	EINMSE_A MEAN
						2194.41908285	3657.98348

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	7771291448.71891	1613.81614	0.0001	7771291448.71891	1613.81614	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	9.78462873	0.03552	0.9717	247.32359939	0.0
AMOUNT	0.09311487	40.17233	0.0001	0.00224321	0.97351612

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	29652.03431353	25086.58254692	3565.45177261	23932.33123522	26240.83385862
2	5419.45153146	6835.45055746	-1456.92911923	6431.26432243	7240.86979394
3	333.37953722	432.61235354	-98.23365532	-53.54241642	814.76871351
4	1360.22958729	1773.23346006	-382.93300207	1305.74238279	2239.72453733
5	2504.61534662	2586.07002290	-81.45463819	2135.92364517	3036.21640063
6	493.33333333	634.48746616	-181.25541283	168.71293703	1100.26199529
7	101.13647419	94.47.2.2265	2.24937354	-160.93942786	359.70742514
8	1.2.2.71439	98.699.0265	-94.61378816	-359.70742514	368.70742514
9	125.00000000	279.12925049	-154.12925049	-207.54731538	765.80581639
10	17.457142 6	98.699.0265	-81.54235979	-390.60982246	588.70742814
11	326.25115562	229.11549546	97.13566016	-258.41605922	716.64708014
12	499.2845 149	346.17471468	153.11377681	-139.31372702	831.72250538
13	48.03697397	41.22598334	6.81099663	-449.61579562	532.06773330
14	280.54842443	278.12925049	1.41937794	-207.54731538	765.80581639
15	148.32017705	170.99140178	-2.66222473	-317.54771121	659.53051478
16	1347.38156413	1318.27121662	29.31032952	542.70456697	1493.83746627
17	9.39162005	17.79611612	-8.44449517	-473.46921018	509.06144263
18	9.39162005	17.79611612	-8.44449517	-473.46921018	509.06144263
19	441.90531178	501.44244444	-56.53733256	10.31650041	994.45231793
20	16.13602771	180.72360817	-19.88776045	-307.64155765	669.09178399
21	203.43644951	214.05746026	-11.53077065	-272.83769512	702.74261963
22	5847.73211142	5935.45955661	-87.72755499	5464.70144369	6405.21767955
23	491.92134753	212.72.2.01	-20.82509143	435.90273274	1389.55112527
24	25319.05571747	27066.23159017	-1757.22788170	25840.54402046	28331.91915773
25	213.35525430	252.39478831	-39.03853422	-235.04257821	739.83215292
26	252.51076040	297.15222527	-44.64144487	-188.84184125	783.63591179
27	275.14344419	324.18668744	-48.03304326	-161.72903567	810.10240146
28	884.51342394	792.76433142	106.27040198	314.23563227	1271.31431137
29	370.87517034	432.32453615	-61.44693641	-51.80231914	916.45139143
30	2113.60034392	1811.04210710	301.52423372	1344.98113430	2277.20307993
31	27127.47598243	27628.99368478	-501.51770235	26358.24441085	28898.49255872
32	32384.80245643	32981.81699525	-596.01453882	31401.99548568	34502.53850544
33	9426.94848345	10381.20641674	-954.25793329	9818.72246118	10943.67037235
34	1139.44122532	1261.30137620	-122.85015087	780.11857100	1743.58417930
35	439.45058864	555.57482101	-116.06423237	103.83660088	1007.20257674
36	134.93144057	170.99140178	-36.05996121	-317.54771121	659.53051478
37	112.35955456	143.05693961	-30.69738505	-345.09584274	632.09671196
38	171.66042447	234.07181353	-62.41138906	-253.67464810	721.81811316
39	149.81273638	189.31437657	-39.50163948	-298.43208713	677.05083028
40	78.63485937	98.89955265	-20.26469328	-390.60982284	588.70742814
41	1876.14086501	1991.31185494	-115.17098993	1526.07561119	2456.54809869
42	4435.12450852	5091.26351776	-655.13900923	4028.01187641	6155.51515911
43	542.18831346	630.97728877	-87.98897531	148.70456697	1113.25001057
44	58.97771933	98.89950265	-39.92178332	-390.60982284	588.70742814

45	[illegible]	[illegible]	[illegible]	-445.94625113	535.[illegible]740772
46	[illegible]	[illegible]	[illegible]	433.[illegible]	[illegible]
47	[illegible]	[illegible]	[illegible]	-297.21[illegible]	677.[illegible]
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52	[illegible]	725.[illegible]	-45.31833216	246.19[illegible]	1205.[illegible]
53	70[illegible]	778.00519250	-69.[illegible]	299.[illegible]	1[illegible]
54	[illegible]	625.[illegible]	-128.[illegible]	144.[illegible]	1106.[illegible]
55	24[illegible]	35[illegible]	-106.05114753	-129.[illegible]	861.[illegible]
56	207.[illegible]	297.[illegible]	-[illegible]	-189.21[illegible]	783.[illegible]
57	592.[illegible]	549.[illegible]	42.[illegible]	57.[illegible]	1031.[illegible]
58	1[illegible]	1[illegible]	-84.[illegible]	-299.21[illegible]	677.[illegible]
59	23.[illegible]	98.[illegible]	-75.[illegible]	-390.[illegible]	58[illegible]
60	115.[illegible]	359.[illegible]	-25[illegible]	-115.[illegible]	854.[illegible]
61	[illegible]	96.[illegible]	-[illegible]	-390.[illegible]	58[illegible]
62	3[illegible]	457.[illegible]	-[illegible]	-24.[illegible]	943.[illegible]
63	58[illegible]	567.[illegible]	15.[illegible]	85.[illegible]	1049.[illegible]
64	51[illegible]	45[illegible]	59.[illegible]	-24.[illegible]	943.[illegible]
65	53.[illegible]	152.[illegible]	-97.[illegible]	-335.[illegible]	641.[illegible]
66	220.[illegible]	198.[illegible]	22.[illegible]	-290.[illegible]	686.[illegible]
67	1[illegible]	180.[illegible]	-73.[illegible]	-308.[illegible]	668.[illegible]
68	54737.[illegible]	42146.[illegible]	12591.[illegible]	40188.[illegible]	44104.[illegible]
69	560.[illegible]	459.[illegible]	101.[illegible]	-24.[illegible]	943.[illegible]
70	739.[illegible]	603.[illegible]	136.[illegible]	122.[illegible]	1084.[illegible]
71	452.[illegible]	603.[illegible]	-151.[illegible]	122.[illegible]	1084.[illegible]
72	4370.[illegible]	4[illegible]	-594.[illegible]	4503.[illegible]	5426.[illegible]
73	2095.[illegible]	1931.[illegible]	106.[illegible]	1526.[illegible]	2455.[illegible]
74	774.[illegible]	729.[illegible]	43.[illegible]	250.[illegible]	1209.[illegible]
75	5[illegible]	540.[illegible]	36.[illegible]	67.[illegible]	1031.[illegible]
76	1192.[illegible]	1630.[illegible]	-438.[illegible]	1162.[illegible]	2098.[illegible]
77	111.[illegible]	170.[illegible]	-5[illegible]	-317.[illegible]	659.[illegible]
78	1[illegible]	98.[illegible]	16.[illegible]	-390.[illegible]	5[illegible]
79	23.[illegible]	35.[illegible]	-11.[illegible]	-455.[illegible]	526.[illegible]
80	23.[illegible]	44.[illegible]	-21.[illegible]	-445.[illegible]	535.[illegible]
81	46.[illegible]	53.[illegible]	-7.[illegible]	-436.[illegible]	544.[illegible]
82	120.[illegible]	157.[illegible]	-37.[illegible]	-331.[illegible]	648.[illegible]
83	81.[illegible]	118.[illegible]	-37.[illegible]	-370.[illegible]	6[illegible]
84	42.[illegible]	53.[illegible]	-11.[illegible]	-436.[illegible]	544.[illegible]
85	42.[illegible]	53.[illegible]	-11.[illegible]	-436.[illegible]	544.[illegible]
86	22.[illegible]	65.[illegible]	-42.[illegible]	-425.[illegible]	555.[illegible]
87	26[illegible]	22312.[illegible]	4087.[illegible]	21282.[illegible]	23[illegible]
88	29304.[illegible]	23871.[illegible]	5433.[illegible]	22771.[illegible]	24[illegible]
89	1261.[illegible]	1036.[illegible]	225.[illegible]	560.[illegible]	1511.[illegible]
90	531.[illegible]	441.[illegible]	89.[illegible]	-42.[illegible]	925.[illegible]
91	132.[illegible]	116.[illegible]	15.[illegible]	-372.[illegible]	686.[illegible]

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	428577284.89593880
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00003350
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.12668003
DURBIN-WATSON D	=	1.72076332

SERVICE CONTRACT CATEGORY - CONTINUED

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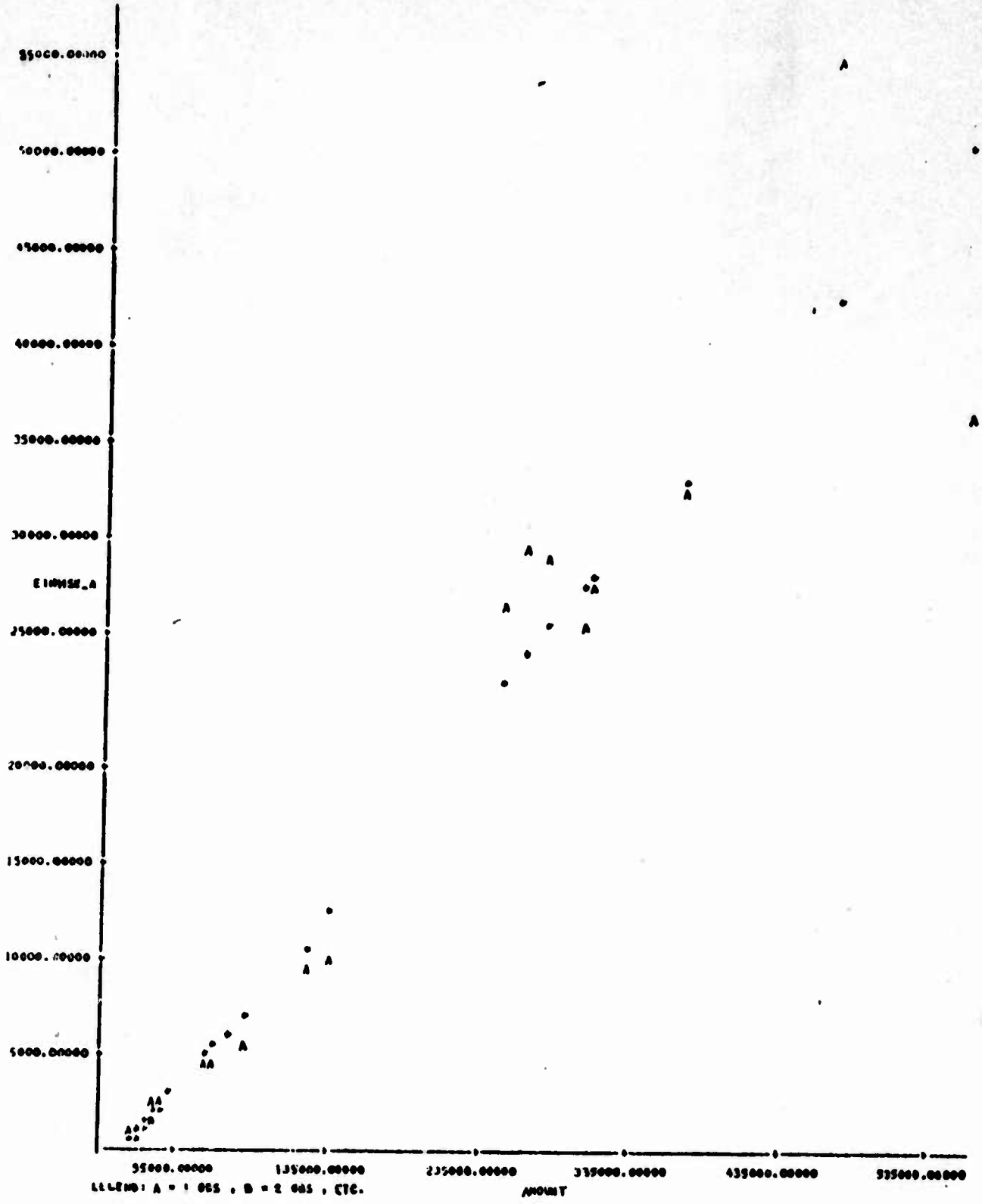
SERVICE CONTRACT CATEGORY
PLOT OF ETHNIC_A Y*. AMOUNT



APPENDIX H

REGRESSION ANALYSIS AND PLOTS FOR RATE GROUPINGS

This appendix contains the regression analysis results for the equivalent in-house hours, EINHSE-A, on a Rate Grouping basis. Due to the limited sample size, only two (2) Rate Groupings could be analyzed, namely: Rate Groupings 3 and 5. This appendix is divided into two parts for the respective Rate Groupings. In addition to the regression results, plots of the equivalent in-house manhours, EINHSE-A, versus the contract dollar amount, AMOUNT, which show both predicted and observed values, are also included following the regression analysis results for each contract category. The title at the top of each page indicates the contract category under consideration. To assist the user in interpreting the regression and plot results, the introductory portion of appendix G contains detailed explanations for the terminology used.

APPENDIX H - PART 1

REGRESSION ANALYSIS AND PLOTS OF EQUIVALENT IN-HOUSE MANHOURS FOR RATE GROUPING 3

MAINTENANCE CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	542180628.73245470	542180628.73245470	79.73131	0.0001	0.72004304	60.84354 %
ERROR	31	210803013.19196480	6800097.19974080				
CORRECTED TOTAL	32	752983641.92441950				STD DEV	EINMSE_A MEAN
						2607.69959921	4285.91017

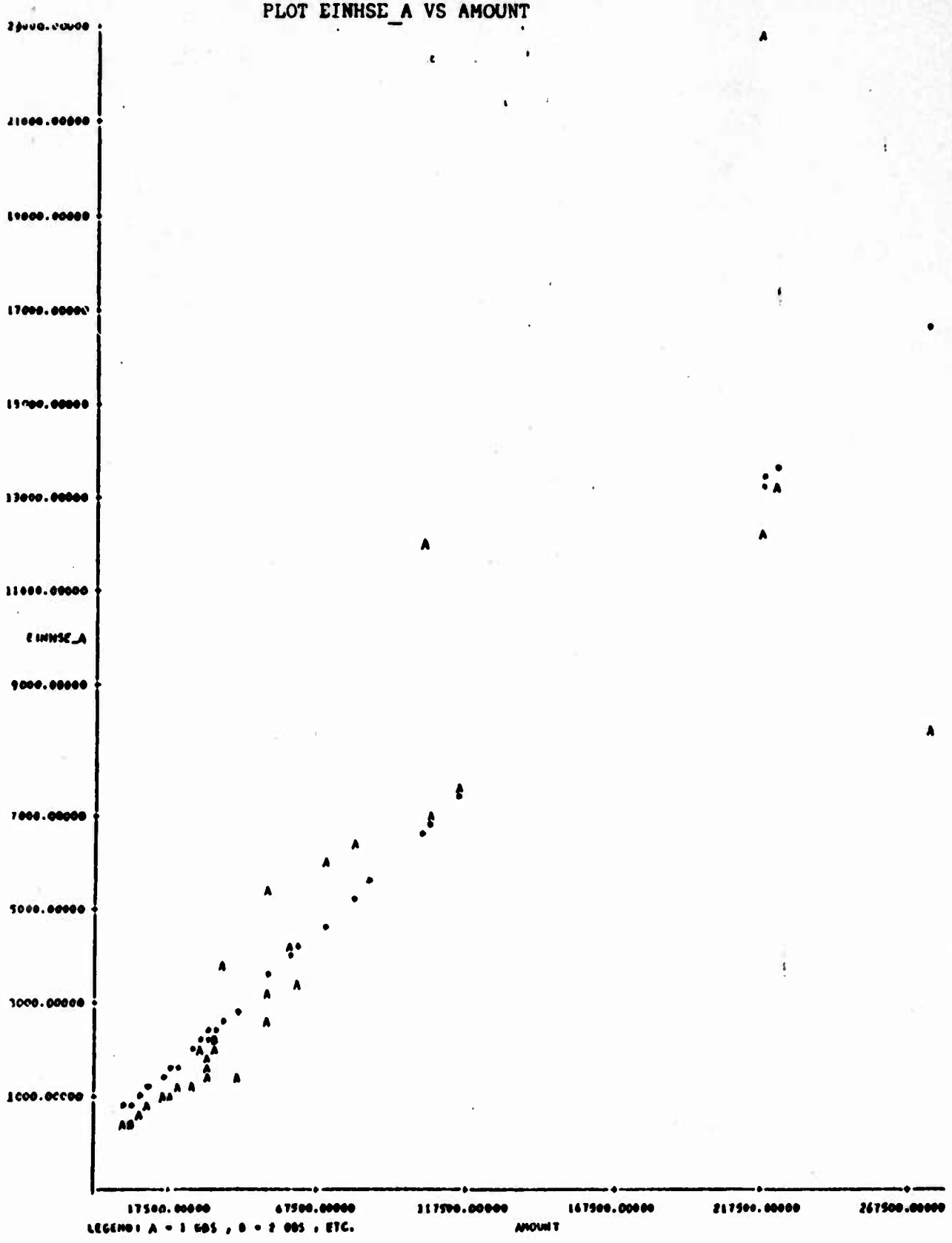
SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	542180628.73245460	79.73131	0.0001	542180628.73245460	79.73131	0.0001

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	508.64856361	0.81975	0.4186	620.49246065	0.0
AMOUNT	0.05871762	8.92924	0.0001	0.00657588	0.84855350

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	4169.78469520	3879.56824980	290.21644540	2949.11338624	4810.02311336
2	283.33333333	765.18583318	-481.85249985	-461.10553367	1991.48153033
3	907.84379277	1364.26085771	-457.94693363	223.69651412	2506.69520130
4	7926.82926329	16538.55806092	-8611.72879263	13560.60523087	19486.30691758
5	696.31823461	1448.13043891	-441.81220430	317.97378589	2578.28713792
6	5923.34464774	4501.44653363	1421.89841410	3574.32414665	5428.56893062
7	1161.44018563	1976.58699376	-815.14880793	911.06241528	3042.11156225
8	1235.77235772	2152.74184538	-916.96948766	1106.54615725	3198.93753352
9	2483.79062369	3432.78500048	-948.99537679	2486.66733541	4378.88443155
10	3117.20698254	3444.52942332	-327.32244138	2499.97966866	4389.07917798
11	1446.33402690	2241.45946259	-795.07942269	1171.44203309	3251.47469204
12	3366.58354115	4031.70559598	-665.12205484	3104.07230182	4959.33889014
13	12156.97755511	13232.75821221	-1073.77865610	10989.29773369	15476.21869072
14	1870.91136030	2000.07604065	-129.16467585	937.19266270	3062.95941860
15	1671.91011255	2146.47003366	-474.55997130	1100.04512783	3192.89493949
16	1078.85158339	1565.56567332	-486.91398793	480.57609549	2650.55525115
17	1674.90137328	2276.04884151	-397.14746823	1242.66504591	3309.42263712
18	455.69339950	737.24716921	-431.60676571	-263.55789630	2138.17225676
19	5504.59715596	5440.92840993	63.65874703	4478.26017627	6403.59664359
20	7529.49885376	7255.30270061	274.18907516	6107.64112367	8402.46427754
21	2096.98556222	2397.61231431	-290.62673098	1365.24197262	3429.98265599
22	13010.38166937	13467.62668105	-451.24398116	11175.15927530	15760.09408679
23	6815.20814548	6615.20879306	199.99935242	5547.47783376	7683.94357236
24	661.62962903	1913.62007154	-331.99044155	-176.23650472	2203.47649588
25	203.[illegible]	2358.25350560	-328.25350560	1333.07673581	3383.43027540
26	245.70370370	599.67317595	-444.96947324	-546.84572293	1924.19457699
27	1356.29429430	2792.74387293	-1438.44757663	1806.13121817	3779.35652769
28	6359.03703704	5132.57089323	1129.46614381	4234.37432088	6130.76746557
29	276.35546995	649.62956252	-373.27409256	-364.13378881	1693.39291354
30	3661.13896305	2548.38115012	1112.75783263	1541.65130376	3555.67299647
31	11810.22033898	6513.52312244	5304.69721654	5457.10861845	7569.93762643
32	22722.71180441	13168.16683328	9554.54503113	10938.13762753	15398.19573903
33	5209.64560863	3444.52942392	1825.11618471	2498.97566866	4390.07917918

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	210803013.19196400
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000078
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.35640824
DURBIN-WATSON D	=	1.19742827

MAINTENANCE CONTRACT CATEGORY
PLOT EINHSE_A VS AMOUNT



REPAIR CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	517517157.04690520	517517157.04690520	101.10318	0.0001	0.75958501	53.64448 %
ERROR	32	163798499.73292750	5118703.11665399				
CORRECTED TOTAL	33	681315656.77983270				STD DEV	EINMSE_A MEAN
						2262.45510821	4217.49837

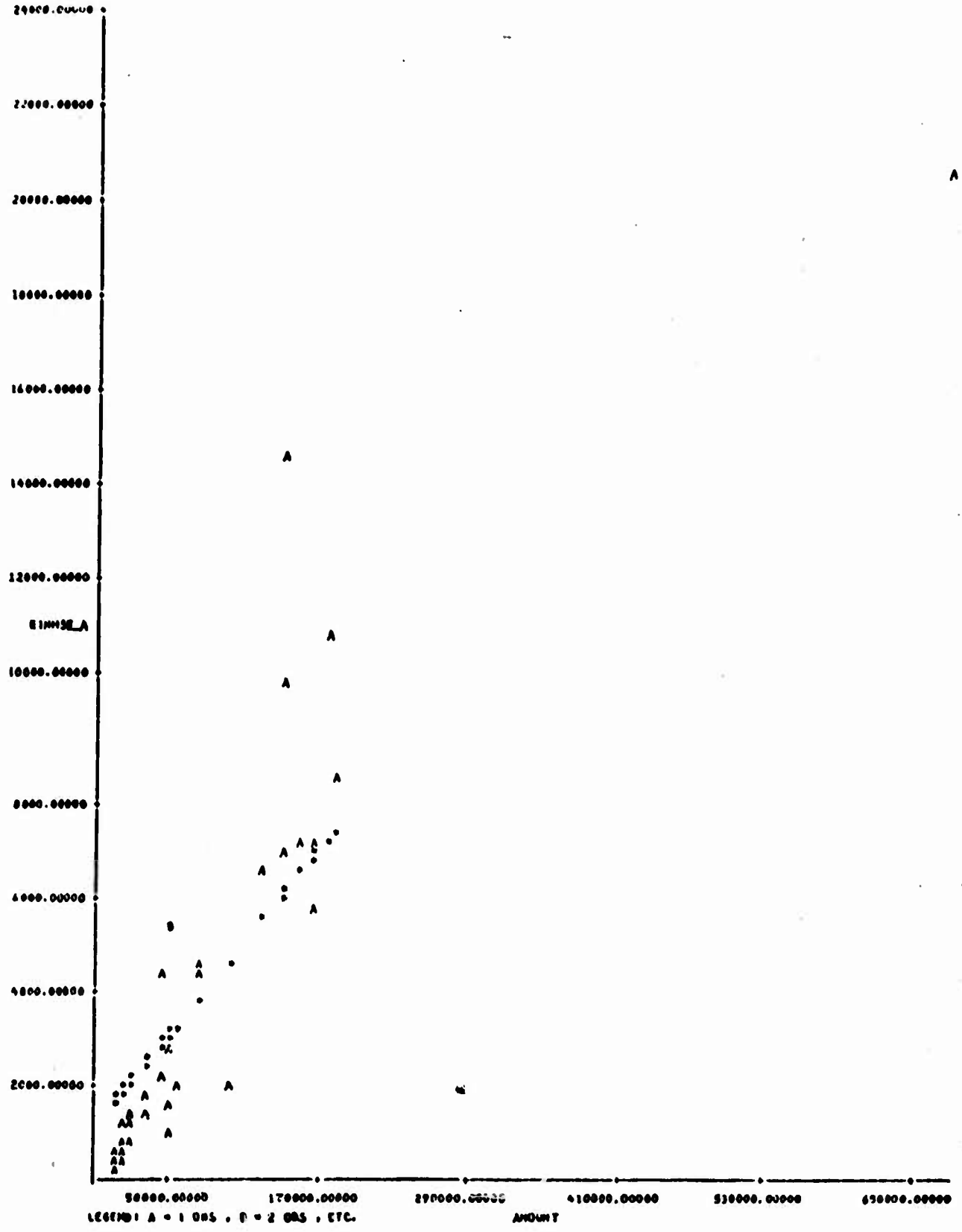
SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	517517157.04690520	101.10318	0.0001	517517157.04690520	101.10318	0.0001

SOURCE	B VALUES	T FOR HO: B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	1466.43532699	3.08873	0.0041	474.77102050	0.0
AMOUNT	0.03308625	10.05501	0.0001	0.00329052	0.87154174

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	14560.6[illegible]6595	5933.08357626	8627.77928969	5069.70564788	6796.46150464
2	4392.91317257	3120.75201160	2272.16116648	2299.77652674	3941.72752705
3	4311.41796549	2769.99214606	1522.42141542	1947.34288691	3591.64745521
4	5269.66[illegible]363	3120.75201190	2148.[illegible]9359673	2299.77652674	3941.72752705
5	1760.74730354	1770.13836967	-709.39074613	837.16645005	2703.11028930
6	709.24185526	1932.95550412	-1229.71360886	1017.[illegible]4e2454	2848.[illegible]261337[illegible]
7	4487.53117237	5469.87502448	1017.[illegible]5514759	4639.81363720	6299.[illegible]3[illegible]1176
8	5471.82044888	7382.26146825	1059.55896063	6364.56764301	8399.93532749
9	2655.35162095	3107.51751042	-448.16588947	2285.81272372	3929.22229711
10	6857.85536160	6015.79921051	842.05615109	5145.54109680	6886.05732221
11	1323.34581773	2343.22504998	-1019.87923226	1466.41310038	3220.03699958
12	456.47915106	1856.[illegible]5712052	-1400.17796556	933.1CC[illegible]463	2780.0[illegible]3[illegible]31
13	1242.82147316	3250.52964023	-1307.70916707	2331.10625507	3969.[illegible]2221[illegible]38
14	540.19[illegible]0231	2532.16036562	-1991.96[illegible]1850	2100.[illegible]2[illegible]655	3764.2[illegible]7[illegible]4[illegible]3
15	541.[illegible]3[illegible]3049	1817.15561018	-1168.71416549	889.2C[illegible]14[illegible]58	2745.[illegible]0[illegible]4[illegible]78
16	2074.[illegible]940341	2802.67923305	-788.[illegible]2942964	2026.04[illegible]9107	3699.31777503
17	1169.[illegible]89[illegible]534	1990.20213541	-819.21524157	1379.03597514	2879.30629168
18	1680.37352556	2336.60779924	-656.23427369	1459.21453856	3214.[illegible]0[illegible]5993
19	267.36566186	1691.42935213	-1424.06019027	749.894[illegible]2655	2632.96[illegible]67770
20	2479.[illegible]9[illegible]2088	2453.73313734	23.25778354	1586.[illegible]E043[illegible]62	3321.0[illegible]554375
21	4357.37655370	3782.47795586	575.49956763	2961.23667669	4577.71549443
22	1206.56922179	2107.[illegible]9[illegible]0991	-901.08478812	1209.17962427	3004.1[illegible]8[illegible]555
23	5737.[illegible]9[illegible]2[illegible]38	5902.31336032	3835.58547237	4041.42[illegible]5[illegible]3	6752.[illegible]0[illegible]3[illegible]86
24	10675.[illegible]4[illegible]4[illegible]7[illegible]4	7140.46714622	3556.07760[illegible]6	6152.[illegible]1[illegible]2785	8[illegible]2[illegible].[illegible]1[illegible]4[illegible]59
25	7061.[illegible]3[illegible]2385	6760.21961872	301.31[illegible]1113	5[illegible]1[illegible].[illegible]5[illegible]0[illegible]97	7[illegible].[illegible]2[illegible]3[illegible]47
26	1442.5[illegible]71050	2989.[illegible][illegible]9710	-1545.[illegible]5[illegible]28[illegible]30	2159.[illegible]7[illegible]23132	3[illegible]17.[illegible]3[illegible]71239
27	20534.25[illegible]2548	23965.09[illegible]4158	-3430.[illegible]2935[illegible]40	19[illegible]7.34[illegible]C[illegible]5[illegible]5	28[illegible]2.[illegible]3[illegible]507[illegible]75
28	255.51[illegible]4088	1830.38511766	-1574.87127478	903.[illegible]4471[illegible]94	2758.[illegible]3151837
29	7015.06372242	6462.46303543	552.63508698	5550.[illegible]1797253	7374.[illegible]30[illegible]29834
30	4459.11111111	3752.69945754	706.41165358	2936.76[illegible]9[illegible]4[illegible]3	4568.62[illegible]92104
31	402.37037037	1651.72234749	-1249.35197732	705.78505842	2597.[illegible]5[illegible]3[illegible]6[illegible]
32	8[illegible].CC[illegible]0[illegible]0[illegible]0	1598.78436177	-1518.78436177	646.[illegible]122[illegible]8[illegible]1	2550.65[illegible]39673
33	5667.85185185	6852.[illegible]8142907	-1185.02657722	5[illegible]59.12225547	7806.63[illegible]59[illegible]68
34	1848.CC[illegible]3[illegible]0[illegible]0	4523.60916871	-2675.[illegible]0916871	3730.63970642	5316.37863100

SUM OF RESIDUALS	=	0.CCCCCCC0
SUM OF SQUARED RESIDUALS	=	163798499.73292720
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000048
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.51[illegible]24223

REPAIR CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



MINOR CONSTRUCTION CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINHSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	103523821.86814280	103523821.86814280	516.08987	0.0001	0.94161541	28.78929 %
ERROR	32	6418964.06325165	200592.62697661				
CORRECTED TOTAL	33	109942785.93139440				STD DEV	EINHSE_A MEAN
						447.87568250	1555.70235

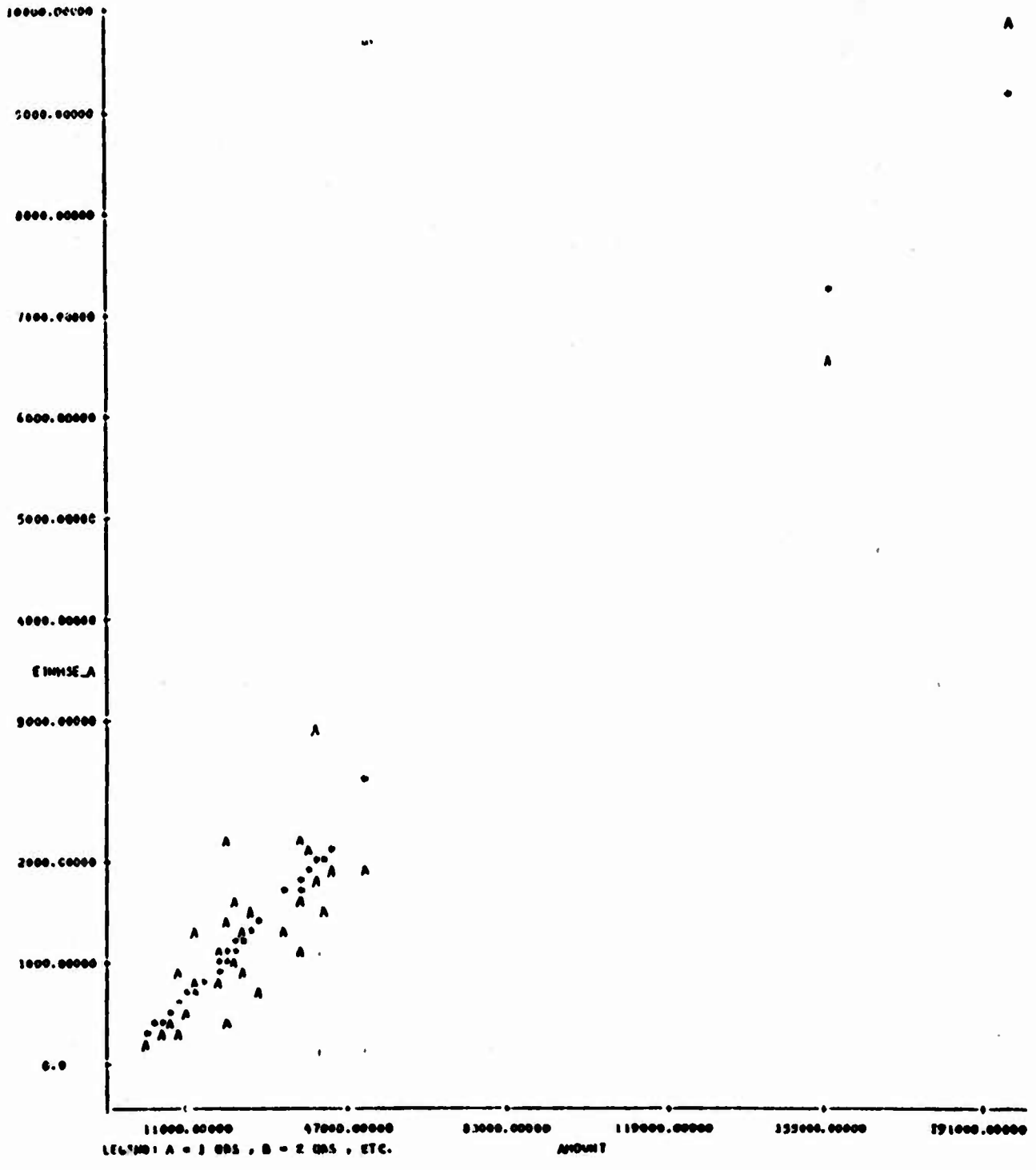
SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	103523821.86814270	516.08987	0.0001	103523821.86814270	516.08987	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	138.54718360	1.40437	0.1698	98.93647120	0.0
AMOUNT	0.04458379	22.71761	0.0001	0.00198013	0.97035870

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	2102.1670261	1036.1938362	1065.9731399	872.95118345	1199.4364940
2	379.41448382	303.88282711	78.52565671	108.17853555	493.5911197
3	1285.7935285	687.74940944	598.04411907	513.00725156	862.4915673
4	871.07241911	510.73520113	360.33421798	328.37314101	693.1032612
5	1889.4552873	2086.7452362	-197.09436341	1923.2044306	2250.2857918
6	929.35294264	1095.1051233	-167.75218572	926.12517567	1250.0851103
7	1519.7092419	1704.3803277	-185.67679067	1547.3602910	1861.4003744
8	1737.5436409	1924.8033971	-192.25995622	1764.8856899	2084.7213037
9	794.26433915	957.65214130	-163.38780214	792.22224551	1123.0820366
10	1005.6179775	944.15700470	61.46097263	776.37684258	1109.9431068
11	821.22471910	1124.5921592	-303.86744017	962.92126649	1285.2635520
12	373.53108365	980.14403562	-606.61095197	815.39694216	1144.8911290
13	2084.2666292	1807.6457460	276.62391628	1649.7849542	1965.5069043
14	1835.2054925	2343.1528314	-507.94683959	2171.5035844	2514.8023457
15	263.05373526	525.80777032	-232.75403507	344.13320877	707.4823318
16	1269.4663840	1164.5775690	135.29136635	1004.2356612	1324.9156768
17	9731.3237221	9045.7373923	685.58638287	8356.1777232	9735.2970614
18	1415.4555636	1218.5551542	196.90715325	1059.2027240	1377.9075844
19	1241.7824377	1605.4184977	-323.63626001	1448.8553724	1761.9816231
20	2159.5642023	1699.3446844	460.21935390	1542.3598344	1856.3294343
21	6460.8119326	7173.9071926	-693.05999372	6646.3551450	7701.3447374
22	1334.2671854	965.29936535	368.96780011	800.13052466	1130.4654607
23	952.64450643	839.86157181	62.78693662	722.40223374	1057.3209098
24	340.81971466	430.12400961	-58.30429495	253.37825167	624.5697675
25	627.17773035	1353.5034135	-726.33178100	1156.0068872	1511.0121398
26	1423.5714285	1978.2262235	-554.71109378	1822.1680105	2134.2843419
27	1047.5409756	1713.3797950	-615.81881489	1556.2850662	1870.4730717
28	447.15447154	633.76896307	-186.61449152	456.81908433	810.7196180
29	796.74796748	768.72022900	28.02773848	597.08225529	940.3522027
30	2845.3333333	1920.3052825	925.02811508	1760.4754324	2080.1399326
31	287.40740741	318.68234257	-31.47493516	127.11699908	510.6547206
32	136.91851852	224.41638642	-87.89786790	27.62517735	421.2075954
33	1599.1851852	1155.0954015	444.08978364	953.72951406	1276.4618870
34	715.33333333	638.26724193	77.06609140	481.50452267	815.0299611

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	6418964.06325159
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000005
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.12027531

MINOR CONSTRUCTION CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



SERVICE CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	1311377676.75374	1311377676.75374	24229.67559	0.0001	0.99863989	13.31026 %
ERROR	33	1786052.11481	54122.79136				
CORRECTED TOTAL	34	1313163728.86855				STD DEV	EINMSE_A MEAN
						232.64305568	1747.84731

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	1311377676.75374	24229.67559	0.0001	1311377676.75374	24229.67559	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > ITI	STD ERR B	STD B VALUES
INTERCEPT	111.57637145	2.74112	0.0098	40.70461360	0.0
AMOUNT	0.06518190	155.65884	0.0001	0.00041877	0.99931971

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	329.25115562	270.34612577	55.30502985	188.64586711	353.24638443
2	459.[illegible]	355.61741856	143.96717212	273.58667670	437.64816037
3	43[illegible]	130.[illegible]	-87.00438678	52.3C694571	217.77676778
4	280.56462463	307.42208228	-26.57345385	224.93144614	389.91272441
5	168.32917706	228.90379794	-60.57462089	146.47492262	311.33467326
6	1047.[illegible]	941.61369188	205.76785426	766.73725944	922.49317431
7	9[illegible]	118.[illegible]	-108.74294086	35.3C293697	200.[illegible]
8	8[illegible]	118.[illegible]	-108.74294086	35.3C293697	200.[illegible]
9	434.45[illegible]	328.74055455	-89.28966791	447.16481115	610.31629795
10	1[illegible]	224.90379794	-94.07233727	146.47292262	311.33467326
11	112.33[illegible]	209.34822686	-96.98967630	126.85642288	291.84203094
12	171.66[illegible]	274.51113047	-102.87073600	152.24185647	350.82041147
13	149.81[illegible]	241.94017867	-92.12744458	159.55017451	324.33018283
14	74.63[illegible]	176.75227506	-98.12131269	94.16C6C236	259.33594775
15	1874.18[illegible]	1545.57825086	328.60261414	1465.53C15534	1625.62634639
16	4435.12[illegible]	3787.83573504	647.28877348	3703.50523343	3872.16623666
17	542.5[illegible]	561.33150035	-18.73644670	476.83786647	642.52511424
18	58.97771953	176.75227506	-117.78055553	94.16C6C236	259.33594775
19	36003.76[illegible]	36299.13525376	-295.37390486	35840.5C497375	36757.76153677
20	9793.16417639	8904.61516842	893.36900798	6781.52[illegible]	9027.[illegible]
21	660.42023346	630.16356657	30.25663550	566.63635550	693.68691763
22	708.55549935	667.[illegible]	40.59639869	586.72620040	747.20479832
23	496.[illegible]	557.48377404	-60.60380258	475.5E2585[illegible]	639.[illegible]
24	249.67574578	362.52673034	-112.85095456	280.4[illegible]	444.55[illegible]
25	207.92269780	320.15846300	-112.63576520	238.00669112	402.31[illegible]
26	592.33[illegible]	502.06779311	89.66670167	421.C2480217	584.[illegible]
27	104.52961672	241.94017867	-137.41056194	139.55017451	324.33[illegible]
28	23.22880372	176.75227506	-153.52947134	94.16C60236	259.35[illegible]
29	116.14401958	372.30398589	-256.15996732	290.3C433759	454.30363423
30	52.26483316	176.75227506	-124.49346669	94.16C62236	259.35594775
31	3[illegible]	437.68588950	-41.18959320	355.66E81154	519.30296747
32	583.[illegible]	515.70417183	67.55508543	434.C5497761	547.31337004
33	519.51851852	437.68588950	81.03262902	355.66E81154	519.30296747
34	356.70170370	215.86741722	-160.16771352	133.39533897	298.33949547
35	220.88888889	248.45836903	-27.56948014	166.CE167588	330.82806218

SUM OF RESIDUALS	=	0.CCC00C00
SUM OF SQUARED RESIDUALS	=	1786052.11480855
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.CCC00C77
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.04930377

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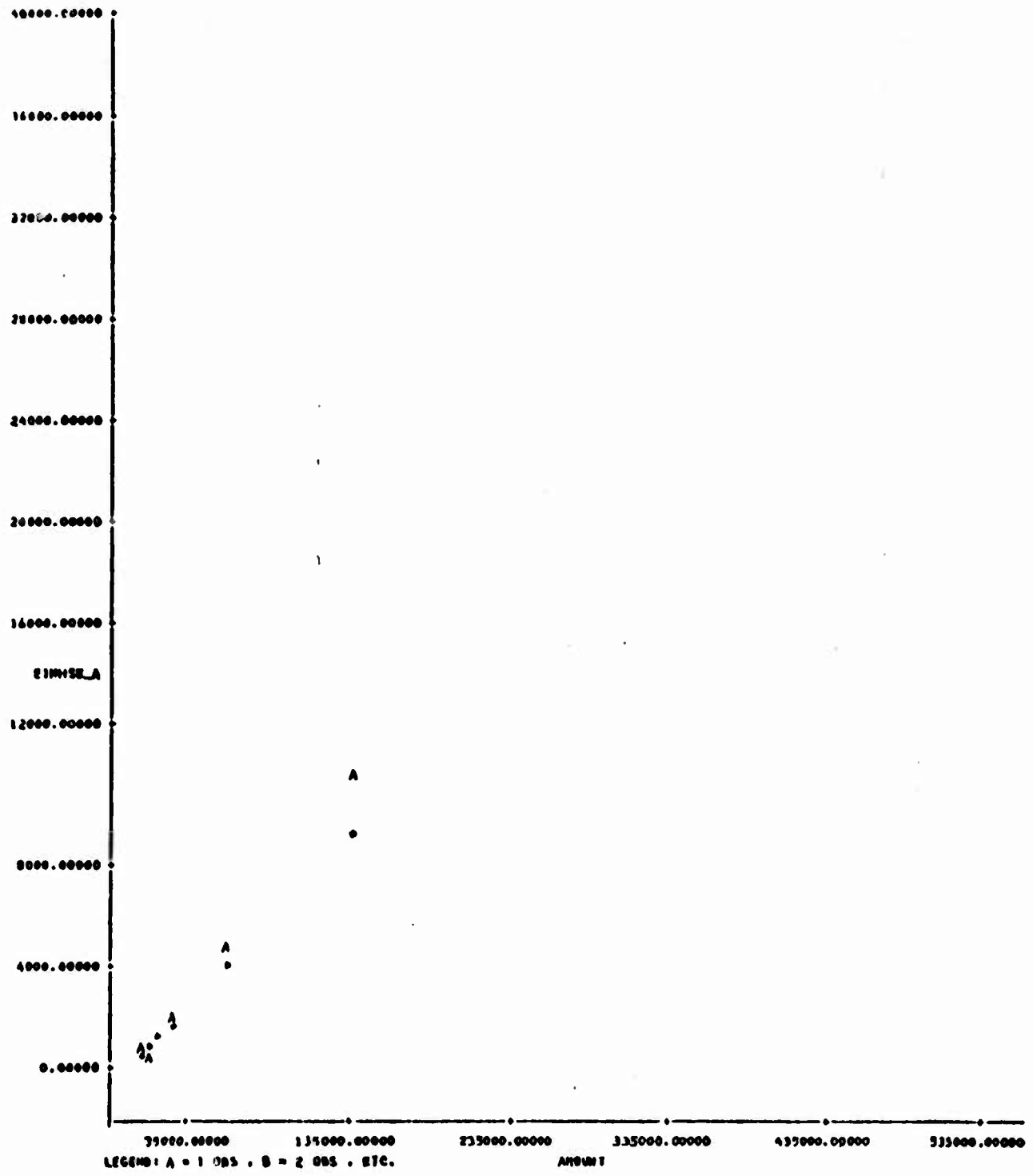
SERVICE CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT


20000.00000
16000.00000
12000.00000
8000.00000
4000.00000
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EINHSE_A
A
A

APPENDIX H -- PART 2

REGRESSION ANALYSIS AND PLOTS OF EQUIVALENT IN-HOUSE MANHOURS FOR RATE GROUPING 5

MAINTENANCE CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	99160405.54088993	99160405.54088993	172.90583	0.0001	0.86063122	29.12943 E
ERROR	28	16057823.79983827	573493.70713708				
CORRECTED TOTAL	29	115218229.34072820				STD DEV	EINMSE_A MEAN
						757.29367298	2598.24021

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	99160405.54088987	172.90583	0.0001	99160405.54088988	172.90583	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	125.76683158	0.49882	0.6218	252.13455724	0.0
AMOUNT	0.06069568	13.14937	0.0001	0.00461586	0.92770212

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	5640.00000000	5260.62325556	379.37674444	4796.25126775	5724.99524337
2	1460.66666667	1451.07376433	9.59290234	1100.05712725	1802.08840140
3	522.00000000	676.61253361	-154.61253361	189.48626691	1163.73880032
4	1785.00000000	1479.28046846	305.71953154	1120.01757569	1838.54336123
5	3866.06666667	3466.03116409	422.63550257	3167.41835080	3764.64397739
6	1165.34799999	1743.45227419	-577.10427419	1404.68641210	2081.81813628
7	2261.53946154	2445.55757441	-184.01811287	2153.69529377	2737.41985504
8	2654.13727811	4250.74855225	-1596.61127415	3857.77673217	4643.73837234
9	2144.11242604	2369.99155434	-225.87912831	2075.05369416	2664.91441452
10	6826.33333737	6491.06900984	334.58197774	5859.55055264	7112.68746703
11	3199.23809523	3466.03116409	-268.79306886	3167.41835080	3760.64396739
12	2467.01404762	2735.68301891	-688.06897129	2431.33031148	3020.06572633
13	5799.85652793	4586.90122126	1212.95530672	4200.36553932	4973.43710379
14	4465.25407491	3561.14425012	904.11382449	3255.08695934	3867.20154090
15	2434.30703013	2001.26530584	437.04172429	1685.45655535	2317.07405633
16	1673.15781923	1564.25641473	305.90140050	1212.98125659	1915.53156045
17	2880.20046043	2341.16110693	539.03935350	2044.64873616	2637.37347772
18	2501.66666667	2523.24814323	-21.58147656	2234.07134322	2812.42494325
19	779.00000000	872.32568080	-93.32568080	648.28494026	1096.36642134
20	786.38888889	1030.13444559	-243.74555670	824.05781685	1436.21107433
21	1479.00000000	3294.08836355	-1815.08836355	3004.23285680	3583.94387029
22	32.22222222	150.04710349	-117.82488127	-303.26454820	603.35875517
23	2554.85897922	3706.01347916	-1147.95390394	3396.35159486	4015.77579346
24	5467.06319703	6524.91424525	-1057.85104722	5852.64206711	7196.18642338
25	3859.58539975	3079.64543047	779.94316928	2795.02393599	3364.26692495
26	2125.18786127	2122.65465337	2.53119790	1814.74735963	2430.56195711
27	1640.40242775	1291.12586428	-250.66343654	913.12056760	1669.13116097
28	3722.94355260	2359.38981056	1363.17354204	2063.57600405	2654.76361706
29	2746.05826590	2007.33487372	738.76339218	1691.64332382	2322.72642361
30	8717.34104046	8137.59842905	579.74261141	7273.67659709	9001.52026101

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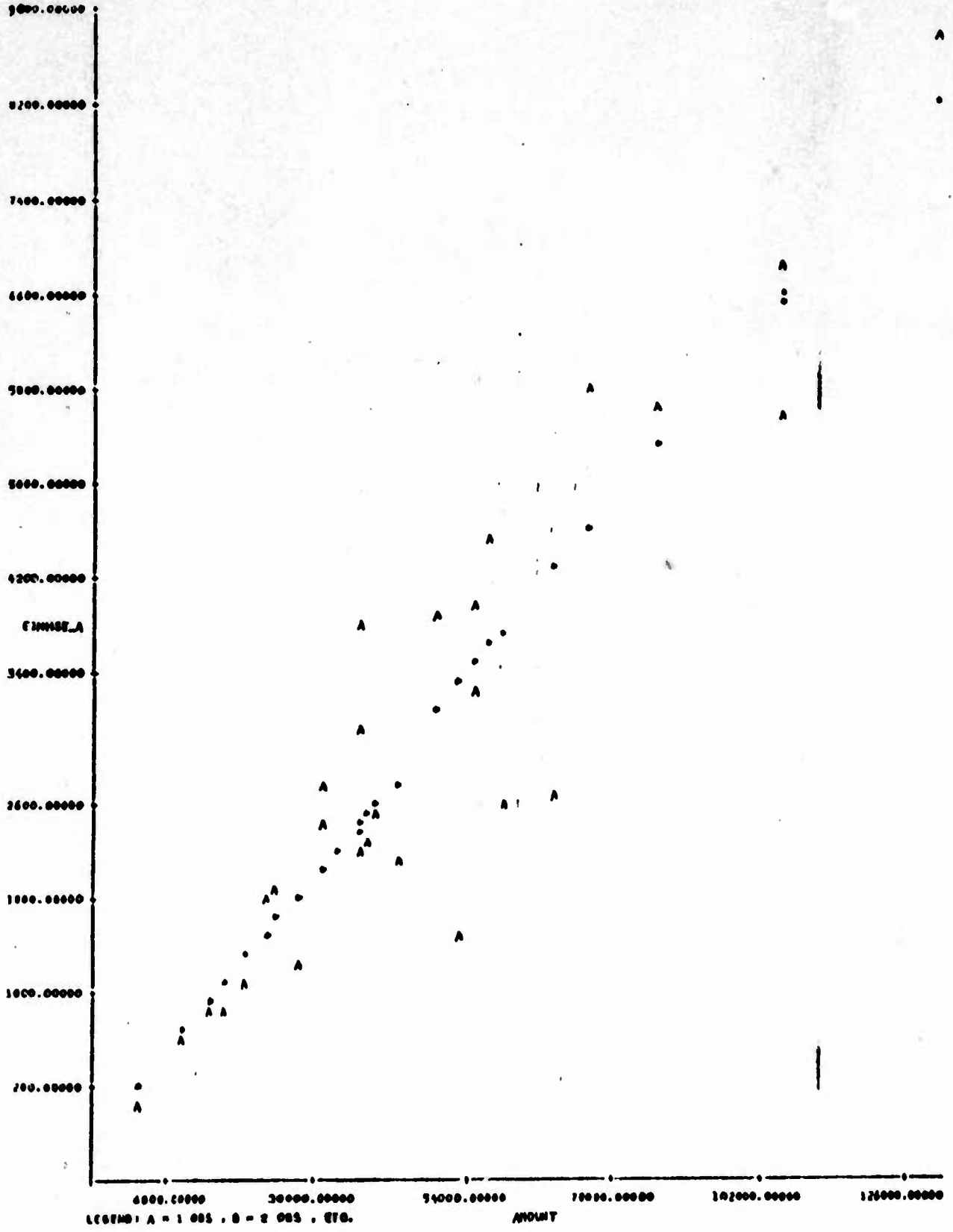
SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	16057823.79983822
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000005
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.24596659
DURBIN-WATSON D	=	1.48553490

MAINTENANCE CONTRACT CATEGORY
PLOT OF EINUSE_A VS AMOUNT



REPAIR CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	335534760.50935080	335534760.50935080	596.09363	0.0001	0.95360695	39.75472 %
ERROR	29	16323791.41228646	562889.35904436				
CORRECTED TOTAL	30	351858551.92163730				STD DEV	EINMSE_A MEAN
						750.25952779	1887.22147

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	335534760.50935090	596.09363	0.0001	335534760.50935080	596.09363	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-461.46815187	-2.95529	0.0061	156.28083442	0.0
AMOUNT	0.07036265	24.41503	0.0001	0.00288194	0.97652801

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	448.14437870	100.80455969	347.23981901	-212.69266556	414.53180394
2	1145.83757396	1455.17440161	-309.26682765	1177.21439719	1733.13440603
3	2169.69230769	2816.33976281	-646.64745512	2529.98866240	3102.71085322
4	1498.82721893	1404.66402199	94.17319694	1126.11137756	1683.19666642
5	1151.37514793	934.77227396	216.60287397	647.64162935	1221.90291857
6	2853.66666667	2958.36144777	-104.69478110	2666.84866136	3249.87423417
7	872.14349714	1056.57001358	-184.42715644	772.37750519	1340.76251197
8	3105.33333333	4433.97703701	-1328.64367423	4229.45855941	4638.49551461
9	615.11771995	381.79226135	233.32545860	76.71622124	686.86830145
10	1220.24783147	815.92674336	404.31908811	526.05311084	1105.80037588
11	3359.69640644	4959.29457781	-1599.59775137	4582.17337453	5336.29578110
12	468.36271449	-70.26938220	541.83529669	-357.21282532	244.67565572
13	1775.46224407	1091.75133853	683.71444754	809.21617775	1375.28649932
14	199.34307010	-322.53744217	511.92091248	-654.52739850	-9.45171421
15	1685.93255423	479.59631888	609.33623535	179.83672531	779.35590246
16	557.41922529	-350.68200246	908.50212571	-663.99277859	-17.37322232
17	19304.54958533	17915.45902506	1591.12967042	16544.80405160	19286.11599851
18	571.96531792	1584.28933648	-612.32453855	1307.53029725	1861.04941572
19	167.00847052	402.23740561	-235.18873509	99.82963703	706.58851419
20	2233.52401156	2660.83333550	-427.31232424	2377.72761158	2943.93905942
21	352.50115507	-62.19405306	414.79720613	-382.53779536	258.14564929
22	1958.33333333	2815.63615635	-857.30282302	2529.27905043	3101.99326209
23	3527.51000000	5229.07490410	-1841.57490410	4836.23544154	5621.91436626
24	865.66666667	1197.29535509	-330.62868843	915.70642883	1478.88428136
25	288.83488889	423.30620232	-134.47131343	121.66060911	724.95179553
26	1316.66666667	1619.47117934	-302.80451267	1342.56629579	1895.97605284
27	40.13333333	-442.15433996	482.28767321	-779.83330517	-104.47537653
28	20.66666667	-456.22636902	484.89353568	-794.58439571	-117.86534232
29	3040.00000000	2182.37234499	857.62765501	1905.67178669	2459.07290329
30	1204.00000000	986.20736797	217.79263203	700.46510657	1271.94962738
31	588.00000000	310.72596919	677.27403081	5.12495611	616.32697926

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	16323791.41228579
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000067
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.15930232
DURBIN-WATSON D		1.65006333

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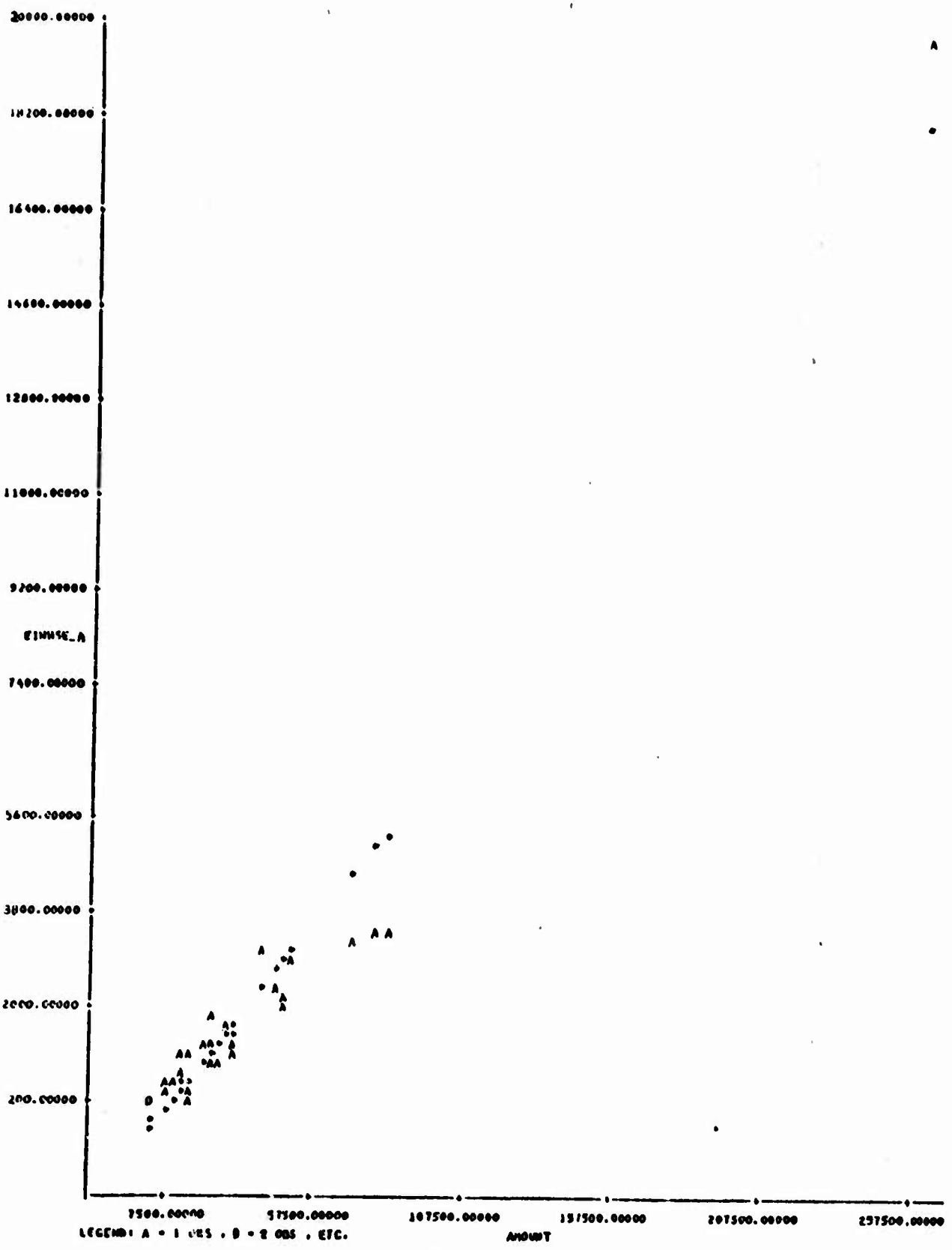
REPAIR CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



MINOR CONSTRUCTION CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	14010010.15771543	14010010.15771543	125.57515	0.0001	0.79189677	40.99472 %
ERROR	33	3691702.46714275	111566.74142857				
CORRECTED TOTAL	34	17691712.62485818				STD DEV	EINMSE_A MEAN
						334.01607960	814.77836

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	14010010.15771542	125.57515	0.0001	14010010.15771542	125.57515	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > ITI	STD ERR B	STD B VALUES
INTERCEPT	26.15733213	0.28992	0.7737	90.22315874	0.0
AMOUNT	0.04501137	11.20603	0.0001	0.00401671	0.88948582

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	256.97041420	234.10985229	22.86056191	76.19315980	390.02654479
2	530.41420118	773.34604595	-242.93184477	658.23453321	888.45755869
3	418.27218935	423.27777979	-5.00559044	288.85673483	557.69882475
4	2188.92307692	2107.52799499	81.39507704	1846.22329942	2368.83269056
5	413.25562959	1149.66605891	-736.13105923	1019.71654436	1279.61557346
6	1671.78571429	1421.50974017	250.27597411	1262.30132704	1580.71815331
7	2559.52380952	1961.64615619	597.87765333	1723.84549957	2199.44681285
8	150.11904762	611.30511615	-461.18606853	450.64520164	771.96503065
9	1272.14285714	1781.60268419	-509.45982704	1571.62569544	1991.57967293
10	522.85714286	431.23984414	91.59729872	256.59769514	605.88199314
11	2075.66666667	1596.91904128	478.73395129	1414.27813737	1779.56174499
12	1546.74671923	1151.44153216	397.50518707	1021.32565766	1281.55746667
13	820.23214286	540.23216607	280.00297679	415.01791306	665.44641908
14	1363.22619048	1665.39133201	-311.55223772	1472.91556418	1857.86709984
15	377.61586121	454.99058960	-77.18472839	322.64639868	588.93478053
16	678.82299556	413.25509694	265.36789862	277.20975930	549.30043458
17	157.91422555	115.18006813	42.73415712	-24.69654828	287.29969645
18	544.47632712	336.75577134	207.74055578	192.76773869	480.74380379
19	173.66114778	129.19234173	48.41880605	-44.72634293	265.06106695
20	402.63902439	255.71530893	146.72371546	102.42672469	409.00389294
21	1851.32447977	1862.62114659	-11.29666682	1640.39266112	2084.84963206
22	182.19453176	314.23088734	-132.03355554	167.76253984	460.69923483
23	134.39306358	723.53353615	-589.44047257	607.78493913	839.28213318
24	257.00447052	255.71530093	41.29316959	102.42672469	409.00387294
25	32.51445087	48.66311613	-16.14866526	-131.72712260	229.05315485
26	1013.33333333	1736.58031618	-723.25598285	1533.60350270	1939.57712967
27	271.55555556	449.22419134	-177.70863578	316.60725571	581.92112697
28	1104.16666667	1218.95833417	-114.79191750	1042.65415954	1395.26250879
29	72.22222222	138.69375213	-66.46352991	-29.42465524	305.79951950
30	8.11111111	35.15960573	-27.04849461	-147.12734567	217.44655552
31	346.66666667	206.20283413	140.46386254	40.82246317	385.58314509
32	1892.00000000	1511.53247618	380.46752382	1340.66388285	1662.40106950
33	320.00000000	386.24827614	-66.24827614	247.51393779	524.98271449
34	1318.66666667	1061.41679616	257.24787051	938.13332311	1184.70026922
35	1554.66666667	1016.40742816	538.25923851	855.84944085	1136.96541547

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	3691702.46714270
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000005
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.13601858

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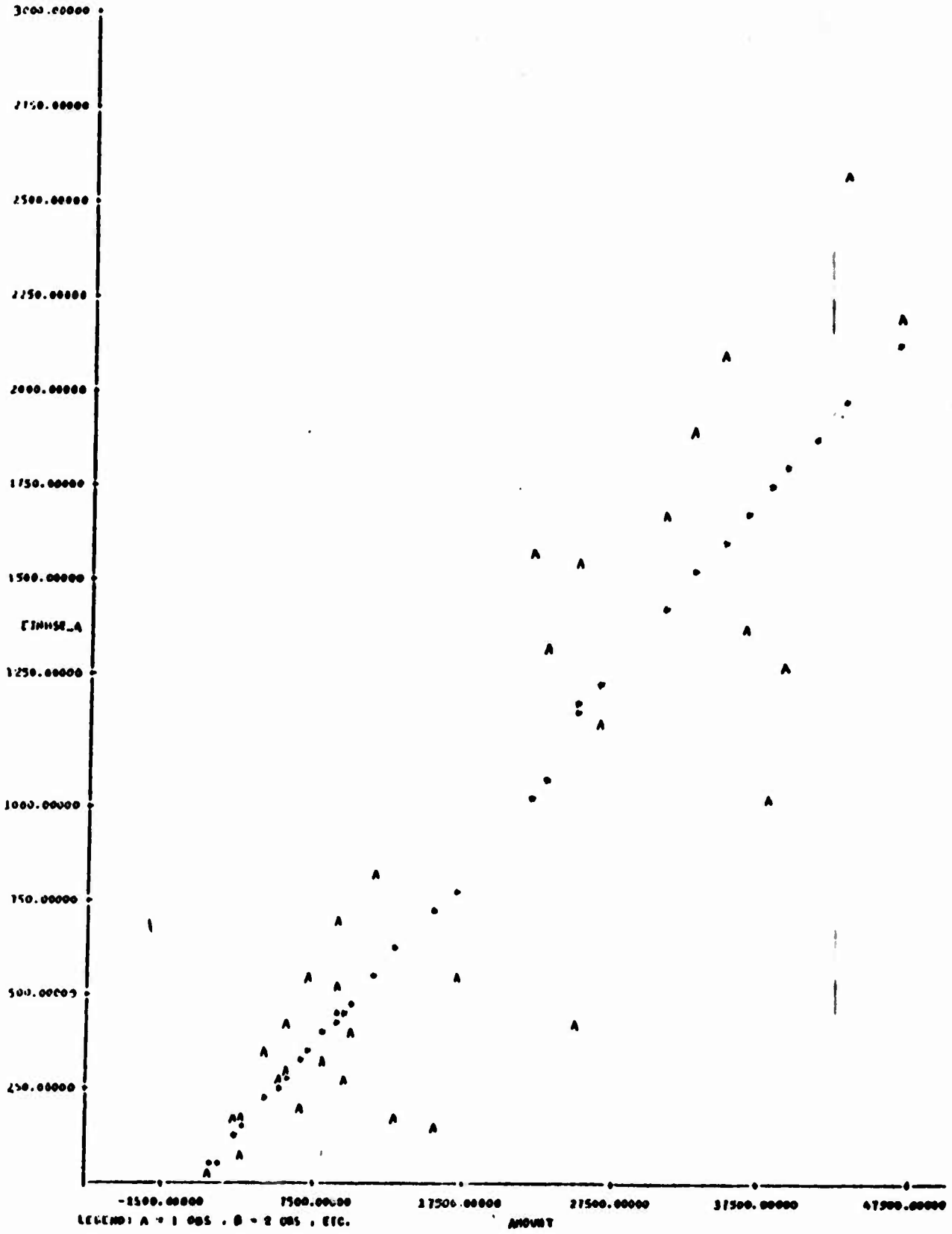
MINOR CONSTRUCTION CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



SERVICE CONTRACT CATEGORY

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE EINMSE_A

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	2427400333.10434	2427400333.10434	1503.09619	0.0001	0.98428390	26.62602 %
ERROR	24	38758403.00407	1614933.45850				
CORRECTED TOTAL	25	2466158736.10841				STD DEV	EINMSE_A MEAN
						1270.83032204	4772.41820

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
AMOUNT	1	2427400333.10434	1503.09619	0.0001	2427400333.10434	1503.09619	0.0001

SOURCE	B VALUES	T FOR HO:B=0	PROB > ITI	STD ERR B	STD B VALUES
INTERCEPT	-130.73686286	-0.46780	0.6441	279.47655463	0.0
AMOUNT	0.05579538	38.76978	0.0001	0.00143405	0.99211083

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	28652.23431753	27641.01640845	1011.01791107	26319.41819075	28962.61462616
2	5418.44153548	7484.64545369	-2066.19391522	6550.39558222	8418.39532815
3	332.37769322	336.40036106	-4.02266784	-229.88522431	902.38377843
4	1350.29585769	1823.22348095	-432.65781166	1295.45847229	2351.04960761
5	2504.61538462	2723.40799471	-218.79261009	2167.88024967	3279.21574175
6	458.33333333	567.82794141	-109.46460808	6.66867831	1128.78720451
7	101.19047619	-30.94442340	132.13489959	-605.36817963	543.47733204
8	14.28571429	-30.94442340	45.23013768	-605.36817963	543.47733204
9	129.00000000	168.64633154	-39.64633154	-401.12512511	738.41779119
10	17.85714286	-30.94442340	48.80156625	-605.36817963	543.47733204
11	25319.00371747	29855.47583446	-4536.47211699	28424.55172907	31286.39993985
12	213.06979409	138.70771430	74.34223579	-431.78108412	709.16652372
13	242.51470040	198.66540703	43.90555337	-380.79663676	757.62260082
14	276.19364419	218.54402027	57.62762392	-359.02594243	787.17712288
15	666.51342944	737.47998310	-50.96655326	189.06288313	1286.89708303
16	370.87517934	338.29547323	32.57970611	-227.64753697	904.24348343
17	111.32947477	48.59197858	62.43760119	-523.65062941	621.43411657
18	115.64493642	-30.94442340	146.58935981	-605.36817963	543.47733244
19	23.80393364	-100.60118762	124.64511826	-676.89797793	475.28563269
20	23.12138728	-90.32164988	113.94303716	-666.66540259	485.02610244
21	46.26277457	-80.84211213	127.08488670	-656.48121831	494.76699404
22	26400.00000000	24568.61612236	1831.38387764	23395.94971594	25741.28252878
23	29304.53333333	26295.07615255	3009.45718079	25039.16657839	27550.98332670
24	1261.60000000	1306.92750227	-45.32750227	454.87500615	2158.97999838
25	331.20000000	348.27801098	-17.07801098	-217.44612772	914.00214968
26	132.80000000	-10.98534790	143.78534790	-584.93491854	562.96422273

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	38758403.00406279
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00000260
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.10760207
DURBIN-WATSON D	=	1.76080326

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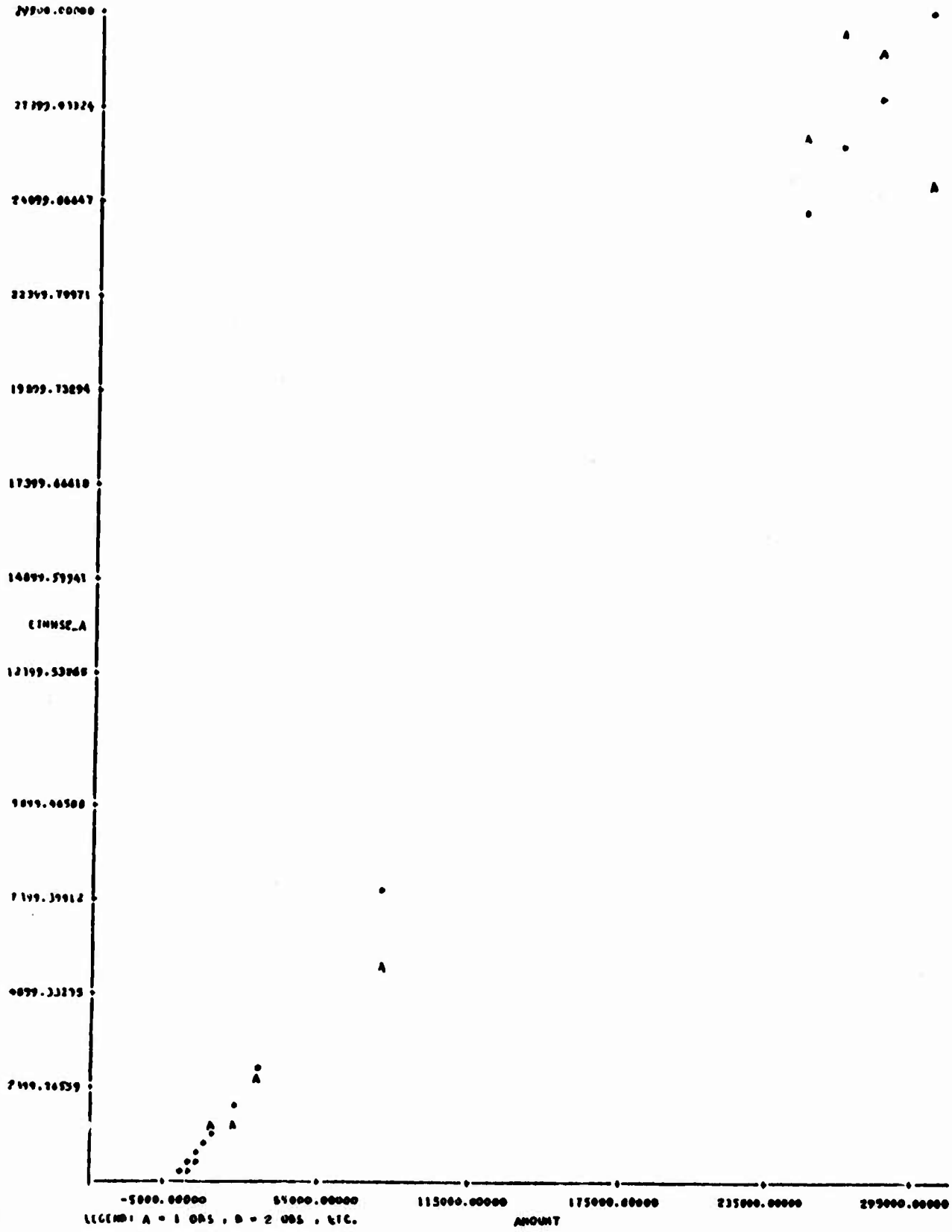
SERVICE CONTRACT CATEGORY
PLOT OF EINHSE_A VS AMOUNT



ABSTRACT

The objective of this research effort was to develop the methodology that will permit the Department of the Air Force to accurately assess, in the most objective manner, the impact of contract services on the manpower deficit.

Detailed data was gathered in the areas of contracts, in-house hourly rates, and the skilled hourly construction rates prevailing in an area. The research was concentrated only on those contract categories that are within the in-house capability to accomplish namely: Maintenance, Repair, Minor Construction, and Service contracts. Labor dollars are then identified, from the information provided, for each contract at a base and divided by the weighted in-house hourly rate prevailing at that base to yield equivalent in-house manhours per contract. To reduce the subjectivity at the local level, a "Rate Grouping" technique was used to group bases based on the average skilled hourly rates at the respective bases. Regression analysis was then used to determine models that could predict equivalent in-house manhours for a given total contract dollar amount within a rate grouping. In addition, equivalent in-house manhour models were also developed on a national basis to be used by commands that are well dispersed throughout the CONUS.

Statistically, a significant difference exists between contract categories which necessitated calculation of different equivalent manhour models for each contract category by Rate Grouping and on a national basis. Due to the limited data, only two out of eight Rate Groupings could be completely analyzed; however, the models developed were highly correlated in all cases and accurate predictors of equivalent in-house manhours could be determined. The end result was a procedure capable of determining how many in-house manhours could be obtained from a given contract dollar amount. The "Rate Grouping" technique represents a viable means for combining bases and conducting objective evaluations. This study was considered highly successful; however, additional bases must be sampled to complete the other six Rate Groupings.

VITA

Robert Eugene Corsi, Jr., was born [redacted] PII Redacted

[redacted] He attended [redacted]

[redacted] and graduated from [redacted]

[redacted]

The author attended Manhattan College in Bronx, New York, and in 1970 received a Bachelor's Degree in Mechanical Engineering. While attending Manhattan College, the author participated in the Air Force ROTC program and was commissioned a 2nd Lieutenant upon graduation. As a member of the Air Force, the author served as a Mechanical Design Engineer for 2 years and as Chief of the Engineering Design Branch at Laughlin AFB, Texas, before being selected to pursue a Master of Science in Industrial Engineering degree at West Virginia University. He is presently serving as a Captain in the Air Force and will enter the Management Engineering Career Field upon completion of degree requirements.

The author is married to [redacted]

PII Redacted

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Cooper N. Redwine
Dr. C. N. Redwine (Chairman)

DATE

August 11, 1975