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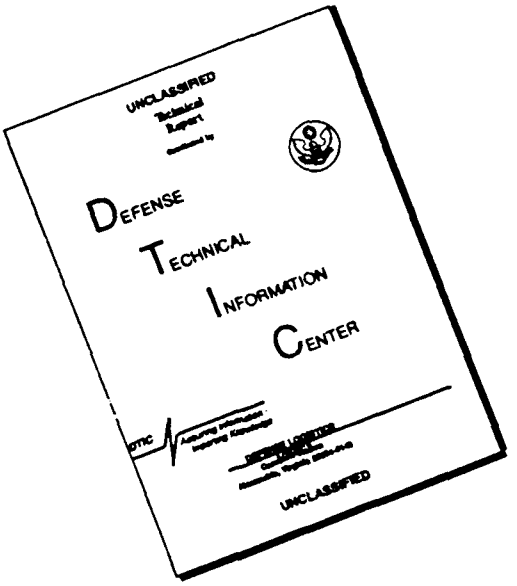

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CONSTRUCTION PROJECT MANAGEMENT FOR RED HORSE TROOP TRAINING PROJECTS

By

TILGHMAN H. KEIPER, III

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN BUILDING CONSTRUCTION

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1989

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

AFB: Air Force Base

AFR: Air Force Regulation

AFSC: Air Force Specialty Code

BCE: Base Civil Engineer

CERHS: Civil Engineering RED HORSE Squadron

DD: Department of Defense

GOE: Government Owned Equipment

HR: Heavy Repair

RED HORSE: Rapid Engineer Depolyable, Heavy Operational Repair Squadron, Engineer

RHPCS: RED HORSE Project Control System

TAC: Tactical Air Command

TACR: Tactical Air Command Regulation

TDY: Temporary Duty

Abstract of Thesis Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Master of Science in Building Construction

CONSTRUCTION PROJECT MANAGEMENT FOR RED HORSE TROOP TRAINING PROJECTS

by

Tilghman H. Keiper, III

December 1989

Chairman: George S. Birrell
Major Department: Building Construction

This master's thesis is a study in construction project management for United States Air Force RED HORSE squadrons. The objective of the study is to design a construction project control system for troop training projects based on successful control practices of the civilian construction industry that can be adapted for military use.

RED HORSE is military acronym for Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineer. These 400-man units provide the Air Force with a heavy construction and repair capability that is highly mobile, rapidly deployable, and self-sufficient in a combat environment. RED HORSE squadrons accomplish a number of small road, building, and utility construction projects in peacetime as part of their war skills training program.

This thesis contains a cost and schedule control system with specific procedures and recommendations based on information learned in the classroom, from literature, from

the governing military regulations, and from interviews of successful construction contractors in the state of Florida. The results from these interviews include the use of computers with cost-coding systems known as Work Breakdown Structure, performing cost and schedule analysis in the home office through centralized cost accounting, and retaining historical project data to better plan and control future projects.

The detailed subsystems and procedures of the proposed RED HORSE Project Control System (RHPCS) are described. Instructions for assembling a definitive cost estimate and control schedule based on progress values are included. It also describes the flow of cost and schedule data during the construction phase through the collection, analysis, reporting, and system maintenance steps. Finally, a discussion on the capture, format and use of historical data to improve the entire project process is included.

This thesis provides specific recommendations to the Air Force such as necessary regulation changes and required training programs. The adoption of these recommendations, as well as the use of the project control system contained herein, will result in better quality construction project management, more effective troop training, and a higher level of service to this country.

CHAPTER 1

INTRODUCTION

The Purpose of This Study

In most cases, Air Force and Tactical Air Command regulations do not define the specific estimating, budgeting, and scheduling requirements that will result in effective project control in RED HORSE troop training construction projects. This task has been left to the individual unit commanders.

The goal of this thesis is to describe a construction project management system which has been researched and designed especially for RED HORSE squadrons. The proposed project control system will provide the basic framework of standardized estimating, scheduling, and cost control required for project management decision making in RED HORSE construction projects. The expected benefits of this new project control system include increasing the quality of troop training construction project management and increasing the ability, confidence, and skill of personnel assigned to manage RED HORSE projects.

What Is RED HORSE?

Imagine a construction company whose entire workforce stays only a few years and then moves on. Imagine a construction company that does not compete for the work it has to do; it is automatically assigned to it. This company also assigns recent college graduates, all with engineering degrees and little construction management knowledge, to manage its construction projects with superintendents that are skilled craftsmen pressed into management roles. Imagine this same company with a highly bureaucratic contracting and financial system, and regulations covering everything from alcohol abuse to assigned parking places, but only sketchy treatment of what should be done in managing its construction projects. What if this company had to face a three-year lead time prior to purchasing new construction equipment? Finally, throw in 410 semi-skilled but highly motivated, salaried, and nonunion employees who can work under austere and even hostile conditions. This is RED HORSE.

The description above is based on the four active-duty U.S. Air Force combat civil engineering units known as RED HORSE squadrons. RED HORSE is a military acronym for Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineer. The following sections will briefly describe the history of RED HORSE, its current mission, and the peacetime

construction projects undertaken to maintain skill proficiency.

The RED HORSE Concept

Until the Vietnam War, the U.S. Army was designated as the primary construction agent for both the Army and the Air Force during peace and wartime. As both services became firmly entrenched in Southeast Asia, the Air Force began to realize the need for its own construction and heavy repair capabilities because Army priorities took up more and more of the Army troop efforts in that theater. The RED HORSE concept was born and Congress authorized the formation of heavy repair civil engineering squadrons with strict guidelines so as not to infringe upon the Army's claim as chief construction agent.

Air Force Regulation 93-9, "CIVIL ENGINEERING RED HORSE SQUADRONS," is the governing regulatory document for RED HORSE. It describes the mission and objectives as they are today. According to paragraph 1-2 of this regulation,

> RED HORSE squadrons provide a highly mobile, rapidly deployable civil engineering response force for limited periods of time. . . . A RED HORSE Squadron:
>
> a. Performs heavy damage repair required for recovery of critical Air Force facilities and utility systems required for aircraft launch and recovery that have been subjected to enemy attack or natural disaster.
>
> b. Accomplishes required engineering support necessary for the beddown of weapon systems, and the installation of critical utility and support

> systems required to initiate and sustain operations, especially in austere, bare base environments. (p. 1)

The RED HORSE Unit

Each of the four active-duty RED HORSE squadrons is comprised of 400 personnel and a fleet of equipment valued at approximately $9 million. As military units, these squadrons are organized and equipped to meet their wartime missions described above. Figure 1-1 shows the RED HORSE squadron organizational chart. Most of the personnel assigned to RED HORSE squadrons have construction-related Air Force Specialty Codes, however, logistical support personnel and equipment are also assigned to give RED HORSE its self-sustaining nature.

The Troop Training Project Process

To develop and maintain the construction-related skills required by the primary wartime missions, RED HORSE units accomplish a number of exercises and training projects. Although the principles of construction management apply to a certain degree in military mobility and deployment exercises, the emphasis of this thesis is on troop training construction projects since they consume a great deal of RED HORSE managerial time and effort.

Tactical Air Command Regulation 85-3, "MANAGEMENT OF TRAINING PROJECTS: CIVIL ENGINEERING RED HORSE SQUADRONS,"

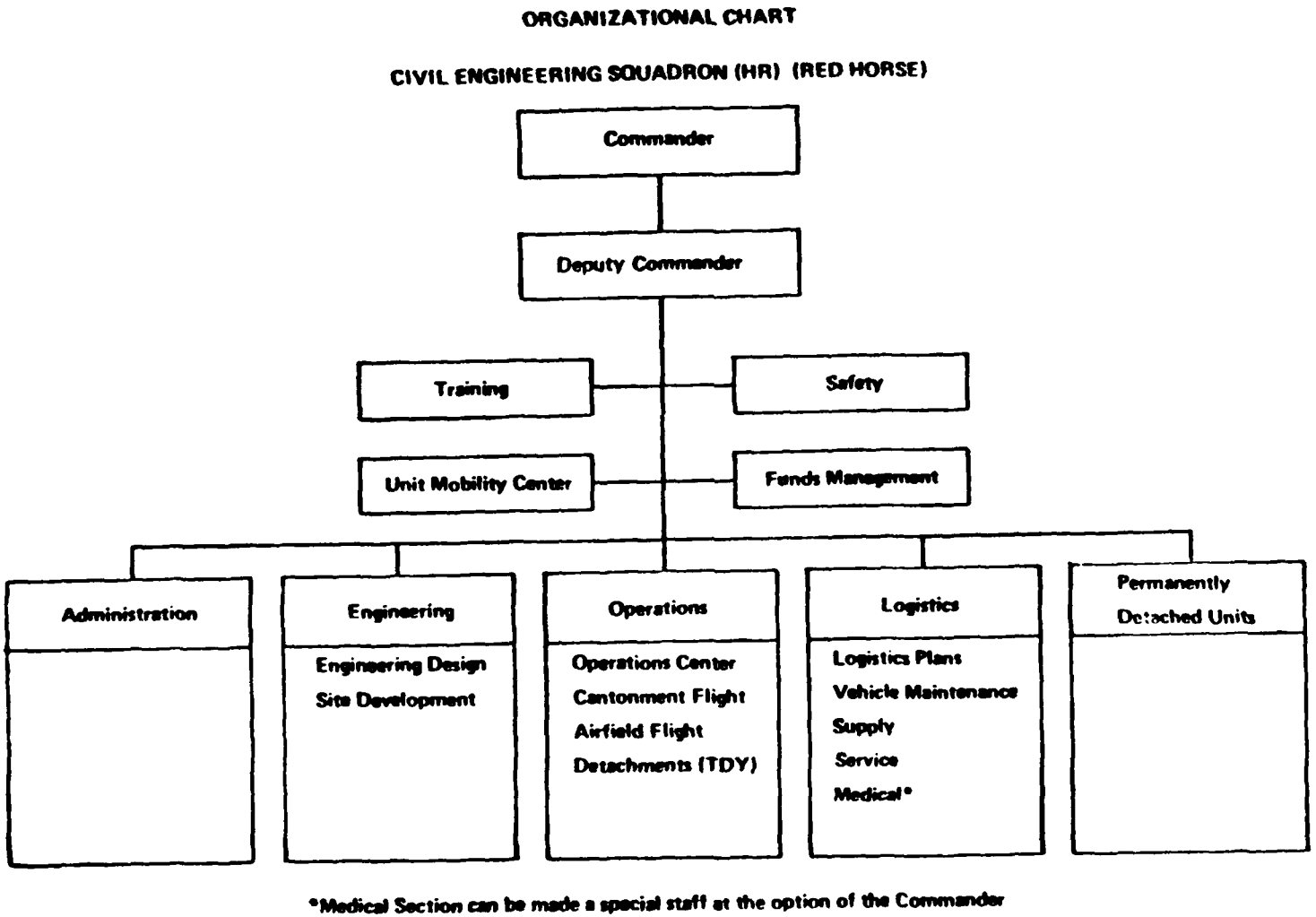


Figure 1-1 Organizational Chart (Department of the Air Force, AF Regulation 93-9, p. 17)

is the governing regulatory publication for all RED HORSE troop training construction projects in Tactical Air Command. It outlines the phases of the project cycle including procedures for selection of projects, design, management, funding, and cost accounting. The following paragraphs and Figure 1-2 describe the current project process as outlined in TACR 85-3. For the purpose of clarity, the steps of the project process have been arranged using the phase headings as shown below.

Feasibility phase. The project cycle is initiated in this phase by Headquarters, Tactical Air Command (TAC) with the Project Call which is notification to Air Force bases to submit potential projects. Air Force bases requesting RED HORSE construction support submit an initial DD Form 1391, Military Construction Project Data, for review by RED HORSE and Headquarters, TAC. RED HORSE sends personnel to review more carefully the projects that appear to fit the project selection criteria. This review is called the RED HORSE evaluation and the contents of the RED HORSE evaluation are specified in paragraph 3g of TACR 85-3 (see Appendix b). Headquarters, TAC ends the feasibility phase by notifying the requesting bases of projects that then have their tentative approval.

Design phase. After receiving tentative approval for a project, either the benefiting base engineering section or the appropriate RED HORSE squadron executes the technical

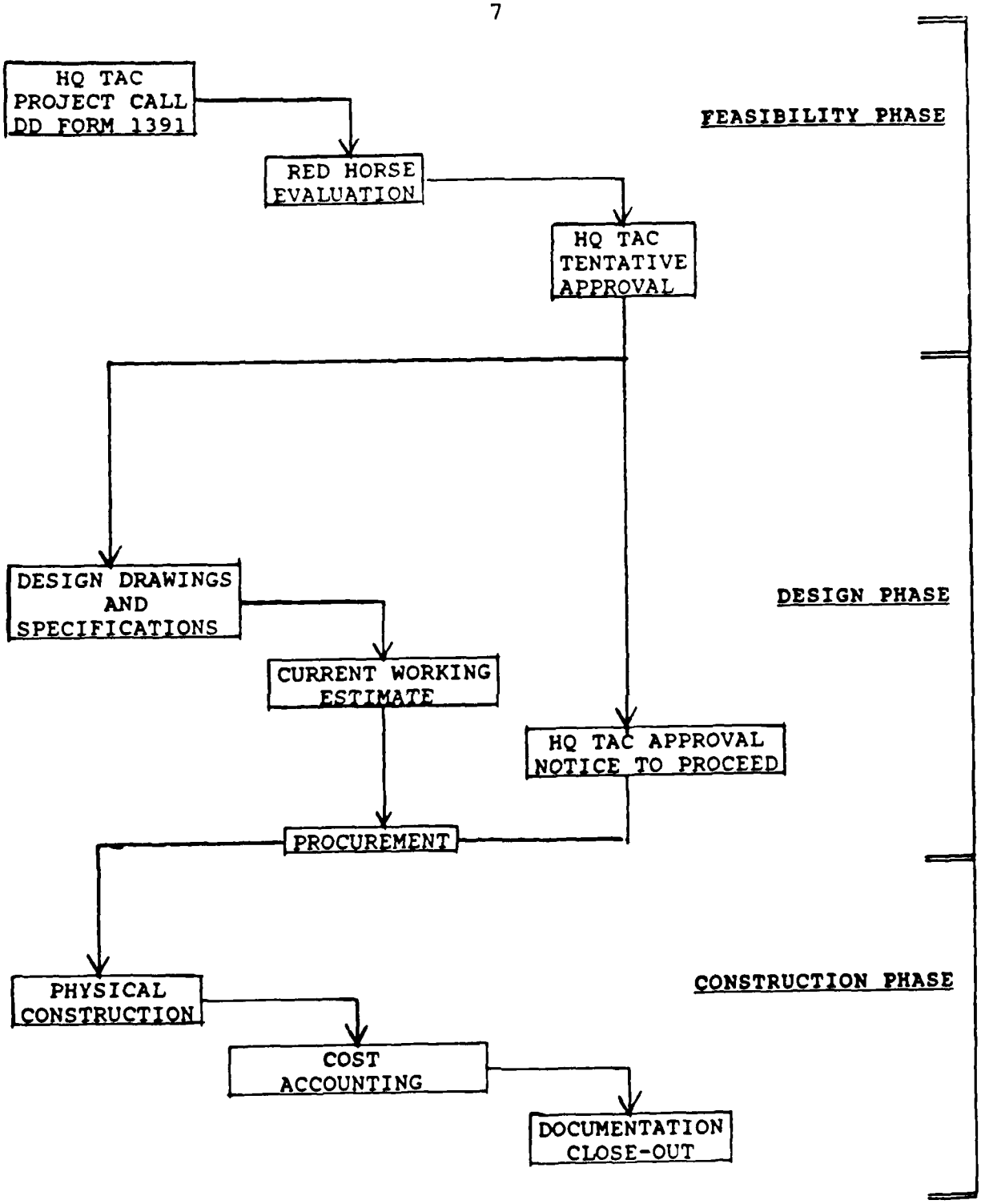


Figure 1-2 Current RED HORSE Project Process

design by preparing the working drawings and specifications. The drawings and specifications are approved by the benefiting base commander and forwarded to RED HORSE for review. Once the design has started, the benefiting base reports to Headquarters, TAC monthly using paragraph 2 of the RED HORSE Project Status Report shown in Attachment 6 of TACR 85-3 (see Appendix B). The design phase is complete when the design documents have been reviewed and approved, when the bill of materials and procurement documents are complete, and a current working estimate has been developed.

Construction phase. Physical construction of the project occurs during the construction phase of the project cycle. Generally, RED HORSE provides most of the labor, equipment, and on-site construction supervision. The benefiting base provides an inspector from its Contract Management Branch to act as liasion between RED HORSE and benefiting base, and to check the quality of construction.

Project cost accounting during the construction phase is divided between the benefiting base and the RED HORSE squadrons in accordance with paragraph 8 of TACR 85-3. RED HORSE is required to submit a weekly cost report (see Attachment 7 of TACR 85-3) to the benefiting base and Headquarters TAC. The benefiting base is required to submit the RED HORSE Project Status Report monthly to Headquarters TAC. The construction phase and the project cycle end when the benefiting base and RED HORSE squadron agree that the

project is physically complete and when all documentation has been finalized in accordance with paragraph 8 of TACR 85-3.

Research and Design

The data used to design the project management system in Chapter 3 of this thesis came from a two-faceted research effort. The first aspect of the research effort involved determining the cost control requirements in the troop training process. Much of this information is already enumerated in various Air Force regulatory publications. The basic concepts of estimating, scheduling, and cost control are contained in a variety of textbooks and journal articles.

The second aspect of the research effort involved contacting civilian general contractors in Florida and interviewing their project management specialists to identify successful features of their constuction project management systems, especially those relating to estimating, scheduling, and cost control. It is obvious that differences exist between military construction units and civilian contractors, however these private industry procedures serve as valuable input for the system design.

As mentioned on page 1, the goal of this thesis is to design a construction project control system that executes the required processes to enhance management of the project

process. There are inherent constraints, however, that must be factored into the design of the system. This control system must be simple to use by RED HORSE personnel likely to be assigned project control duties and at the same time provide enough information for decision making by project management personnel. Also, the cost of operating any new system must be less than the expected benefit from the system. Another way to state this is that the information gained by using a cost control system over a series of projects should be of sufficient value to warrant the expenditure of time and capital to produce it. The cost control system must produce data that have actual value to the decision-makers in the project process.

What Is Project Control?

This section is a brief discussion of control theory as it relates to construction. The purpose of this section is to introduce the reader to the concept of control and how it is used to improve the construction process.

Control Theory

The easiest way to introduce control theory is through a graphic representation of the control cycle (Figure 1-3).

The cycle begins with the establishment of a set of firm objectives which usually remain constant through the life of the process. During implementation, data are

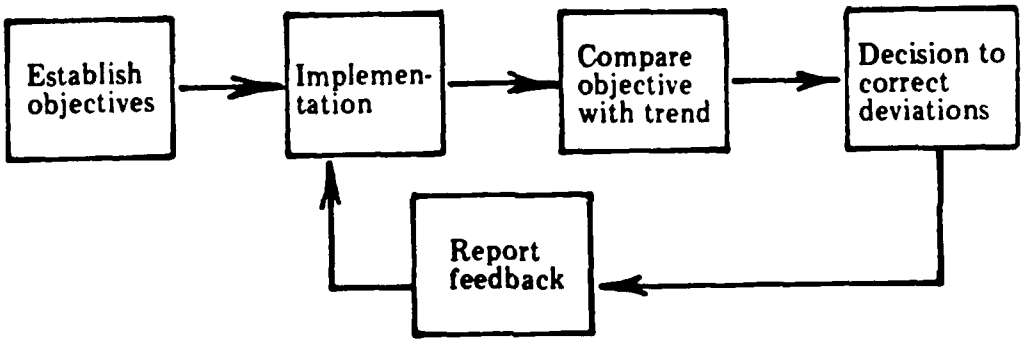


Figure 1-3 Control Cycle

collected that reflect actual performance and results. In the third step, trends projecting performance to the end of the process are developed and then compared against the objectives. If the forecast does not compare favorably with the objectives, corrective action can be incorporated into the implementation as feedback. By constantly comparing actual to expected performance during implementation, established objectives can be achieved as planned (9, p. 142).

For a construction project to achieve its established objectives, time, cost, and quality must be controlled. The scope of this thesis has been narrowed to only time and cost as quality is a very broad topic of its own and is usually specified in the drawings and specifications for the project. Time relates to progress of construction according to the calendar. Cost relates to the sum of dollars required to obtain and utilize all of the resources required to construct a project.

Time is controlled in construction by first establishing progress objectives or goals that are determined by estimated production rates and the sequencing of construction activities. The construction schedule serves this purpose. When the schedule has been finalized and accepted as the best estimate of the actual construction process, it becomes the control schedule and should remain unchanged during the construction phase of the project as

the datum for time control. During the construction phase, the progess of the work is analyzed periodically and forecast to the end of the project. If the forecast completion date or production goals do not match those of the control schedule, then corrective action such as employing more workers or extending work hours may have to occur.

Construction costs are controlled in the same manner as time, except the definitive datum is the detailed cost estimate and budget. When the detailed cost estimate that identifies the costs of all required construction work items and resources has been completed and approved, it becomes the control cost estimate. The control cost estimate can be reformed into a meaningful manner to form the control budget, and it remains constant throughout the project unless a change order is approved. As costs are incurred during the construction of the project, they are accumulated through cost accounting procedures and the actual amounts can be used to forcast the actual, final cost of each item in the estimate. The forecast cost is then compared to the estimated amount to provide the manager with an expected variance between the control budget and forecast cost. Corrective action can and should be applied to the construction process (9, p. 141).

The previous two paragraphs describe cost and schedule control as a function of the construction phase. Although

this is clearly important, the same concepts of construction project control can be applied with great success to the entire construction project process creating a project cycle through which all projects pass. The elements of scheduling, estimating, and feedback can be used if the project process is treated as a cyclic system from feasibility study through design, construction, and historical feedback to future projects. This approach is very common in firms that offer Construction Management services (6, p. 23). While this thesis is directed more towards control in the construction phase, historical cost and duration data will improve the entire process if they are fed forward to future projects.

The Need for Control

The execution of RED HORSE training projects requires the expenditure of time and money. Like any other aspect of the peacetime Air Force, the RED HORSE program is constrained by the fiscal decisions of our civilian government and the competetive requirements within the service. When RED HORSE was first started during the Vietnam War, this was not the case. According to Colonel Robert Bell, USAF (Ret), RED HORSE units in Southeast Asia had vast amounts of construction materials and equipment available to them. Their primary management concern in the war zone was

to meet the strict time demands dictated by combat operations.

This is clearly not the case for peacetime construction projects in 1989 and in the future. Managers at all levels of the RED HORSE program must make strong efforts to minimize costs and maximize training value while providing a construction product. Although part of the "product" in RED HORSE projects is training through actual experience, there still is a duty to the Air Force and the people of this nation to maximize output and make the best use of scarce resources such as time and money.

CHAPTER 2

CONTROL IN THE PROJECT PROCESS

In this chapter, the RED HORSE troop training project process outlined in Chapter 1 and in the current regulations will be analyzed to determine where there are weaknesses and gaps from a construction project control standpoint. The first section is a survey of the cost and time control requirements as outlined in the regulations. Then this chapter explores practices and procedures currently in use by high-quality construction companies in the state of Florida to show how they meet the requirements of project cost control systems. The final sections of this chapter compare the regulations and civilian construction practices to determine what actions should be changed or added to the project process to form a more complete RED HORSE project management system.

Current Requirements by Military Regulations

The governing regulations for RED HORSE construction projects are Air Force Regulation 93-9, "CIVIL ENGINEERING RED HORSE SQUADRONS" (AFR 93-9) and Tactical Air Command Regulation 85-3, "MANAGEMENT OF TRAINING PROJECTS" (TACR

85-3). These regulations contain a great deal of information about RED HORSE and the selection of RED HORSE projects that are not applicable to this thesis. The portion of AFR 93-9 relevant to this study is Section C of Chapter 6 (see Appendix A). The applicable paragraphs of TACR 85-3 are paragraphs 3, 6, 7, 8, 9, and 10 (see Appendix B).

Regulation Cost Control Requirements

Since the total cost of each project is limited to the approved funded cost, the objective of cost control for RED HORSE construction projects is to simply stay under the approved amount. Paragraph 6-9 b of AFR 93-9 states that the project engineer is to ensure that the current working estimate is not greater than the approved cost at the time of construction. Paragraph 6-14 c states that the Base Civil Engineer benefiting from the construction work is to ensure that the cost is limited to the approved amount. Paragraph 8 of TACR 85-3 also splits the responsibilty for construction cost control between RED HORSE and the benefiting base.

The term "Current Working Estimate" is used in both regulations although it is not defined in either. The current working estimate is really the projected final cost at the time it is made. Paragraph 6-10 of AFR 93-9 specifies that the current working estimate will be prepared

as part of the design documents. Paragraph 6c. of TACR 85-3 also includes the current working estimate in the design but is unclear in defining who is to accomplish it. TACR 85-3 requires an updated current working estimate every month after design commences from the benefiting Base Civil Engineer as part of the RED HORSE Project Status Report shown in Attachment 6 of TACR 85-3.

Regulation Time Control Requirements

Both regulations briefly address project scheduling. Paragraph 6-12b. of AFR 93-9 requires that RED HORSE will develop a project schedule for scheduling the construction effort and for monitoring its progress over time. In paragraph 7b., TACR 85-3 requires RED HORSE to provide a construction schedule to the benefiting base before work begins. TACR 85-3 requires the progress status be reported weekly by RED HORSE to the benefiting base and monthly by the benefiting base to Tactical Air Command Headquarters in the form of percentage scheduled vs. percentage completed. The format for reporting progress data is shown in paragraph 3 of the RED HORSE Project Status Report which is Attachment 6 of TACR 85-3 (see Appendix B).

How Some Private Construction Firms Handle Project Control

In addition to consulting material that has been written on construction project control, several major construction companies in Florida were contacted to see what practices and procedures are actually being used in the civilian construction industry. Appendix C is a list of the companies that were interviewed for the purpose of identifying these practices and procedures as input to this study. Although the sample was small (five companies), there are clear similarities between the civilian company practices that may be applicable to the RED HORSE situation.

A personal interview was conducted at the home office of each of the companies. Each individual was asked to describe his company's organizational structure, types of work performed, and his company's general attitude toward construction cost and time control. Additionally, each was asked to describe the flow of construction cost and schedule data during the various phases of a typical project, beginning with initial estimates all the way through the completion of monthly reports. The following paragraphs describe significant similarities that may be useful in improving RED HORSE construction project control.

Work Breakdown Structure

The four companies who use their computer systems to control projects in great detail employ some type of work breakdown structure to codify the various pieces of data by class of work. Three of the four followed the Construction Specification Institute's Uniform System of cost code classification. The other firm devised its own code of accounts based on a systems approach focusing on independent subparts of the job that may require several different trades. Only one company refrained from employing a cost code system because it performed a narrow range of specialized construction tasks.

Centralized Accounting

All of the firms performed centralized financial accounting and project cost control as a routine practice. Personnel in the field relayed data and documents to the company office for processing and analysis. Office-based project managers then prepared cost and progress status reports for management action at the jobsite and for updating the corporate officers. One firm performed cost control on-site for very large projects ($90+ million).

Historical Cost Database

Three of the four firms that employed a work breakdown structure also maintained actual cost data from previous

projects as a historical database. The database was most commonly used to make a preliminary estimate and to assist in construction budget preparation. These three companies expressed the importance of having accurate historical data so they could practice cost control in the early stages of construction process planning and design as well as ensuring that their bids or guaranteed prices were as competetive as possible.

Specialized Functions

Each of the companies performed project cost control through a project manager who was supported by specialized branches in the home office. Examples of the specialized functions include accounting, estimating, data processing, and scheduling. Four of the five firms used an estimating department to help establish the bid price and the construction budget. The fifth did not have an estimating department because it works only on negotiated contracts and has excellent historical data to help establish a guaranteed maximum price. All of the firms had separate accounting departments to process financial information as well as input cost control data into the computer. One firm established a controls office as a central point of contact for the cost control system and the project schedules.

Project Manager-Superintendent Roles and Relationships

All of the companies that participated in this study assign a project manager and superintendent to each project. In every case, the project manager has the primary responsibility for the successful completion of the project. In this capacity, their scope of involvement includes sales, estimating, scheduling, cost and schedule analysis, invoice approval, quality control, and facility startup. Project managers work out of the company home office with periodic visits to the client or jobsite and often handle more than one project. In four of the companies, the project managers are organized into their own office in the corporate structure independent of the engineering or operations branches. On very large or complex projects, or at the request of the client, the project manager works full-time at the jobsite.

Project superintendents are assigned to only one project at a time and are the primary on-site managers of materials, machines, and men on the jobsite. The superintendents are selected from individuals in the operations sections of most companies but answer to the project manager during construction of a project. In four of the companies, the project managers approve or participate in superintendent selection. Cost control actions usually carried out on the jobsite include invoice coding, payroll distributions, quantity surveys of completed

construction work, and data transmittal. All of the companies stressed that the project manager-project superintendent relationship should be based on a team approach to project management.

Personnel Experience

All of the companies that were visited stated that the key to effective cost control was the experience and knowledge of the project management personnel assigned in the field and in the home office. Project managers are expected to possess enough experience to accurately break down a project into its fundamental parts for estimating and scheduling. Project managers and superintendents are also expected to be able to forecast costs and progress accurately during the construction of the project and take quick action to resolve discrepancies. The senior managers were very clear in saying that no amount of hardware and software can take the place of qualified people.

Computers

All of the companies used mainframe or minicomputers to assist in cost control. Four of the companies used their computers to perform financial accounting functions and to calculate cost control data at elemental levels of each project. The computer accepts raw data and computes the actual cost, projected final cost, and projected variance

from the budget for each cost center or code. The project managers then control the entire job by monitoring and controlling each elemental part. The fifth firm is tracking financial accounting data at the project level but is planning on refining their system to incorporate greater depth.

What Else Is Required?

Both AFR 93-9 and TACR 85-3 provide general guidelines and are purposely vague. This allows the RED HORSE commanders the latitude to develop procedures that best suit their own needs as long as the basic requirements of the regulations are met. The regulations touch on the surface of cost control by discussing schedules and estimates. They require estimates, schedules, and cost reports, but do not define specific formats or procedures. Based on the definition of project control and the practices of civilian construction firms, the following additional items are required for RED HORSE construction cost and schedule control.

Definitive Estimate

Construction project control requires definitive standards for cost and time against which actual performance can be compared. In terms of cost, some form of definitive cost estimate is required before the expenditure of funds

begins. This estimate must be prepared when information is available concerning the expected actual cost of the project. The definitive estimate becomes the control budget in the construction phase and actual cost data is compared to it (9, p. 35).

Both sets of governing regulations mention the current working estimate in the design phase but not in terms of a definitive estimate or budget. In fact, the final approved funding limit for projects is currently being established during the RED HORSE evaluation, which occurs before the design is started. A detailed cost control estimate including labor costs, equipment costs, material costs, and any other costs is needed and would be greatly facilitated by a standardized format. The control cost estimate cannot be completed until after the project design has been completed.

Cost Forecast

Although both regulations call for a current working estimate, neither defines it or describes how to use it in control. The current working estimate is really a forecast of the final cost based on past performance and future requirements. It includes the actual costs to date and takes into account the actual conditions on the site. The control cost estimate, on the other hand, is management's best guess of the final cost before construction begins.

The current working estimate is critical in control because it is compared to the original estimate and any variance in the two values can be projected to the end of the project and appropriate managerial action can be taken. Procedures for preparation and use of the current working estimate are required for effective RED HORSE cost control.

Cost Accounting Procedures

Paragraph 8 of TACR 85-3 requires RED HORSE to provide actual cost data to the host Base Civil Engineer, and it requires the host Base Civil Engineer to transmit cost data to higher headquarters. For effective construction cost control, the logical flow of cost data must be clearly defined. The regulations leave it to the local commanders to develop procedures for capturing, assimilating, and analyzing the cost data during the construction process. Key decisions must be made as to what level of detail the information should be, whether the accounting functions should take place at the jobsite or home office, and what standardized format should be used to organize and process raw data.

Historical Cost Data

There is no mention in the regulations of retaining or using historical cost data. Although historical cost data from previous projects is of little use once the

construction of a project has begun, it is beneficial in the early stages of project planning. Historical cost data that is organized in a useful format could be a valuable addition to the RED HORSE project process.

Standarized Schedule

Since TACR 85-3 requires the preparation of a construction schedule, a decision must be made as to what type of schedule should be used and what procedures are required. The control schedule, like the control cost estimate, needs to be established to provide objective perfomance standards before the work is commenced. Clearly, a standardized scheduling technique that provides progress goals that can be compared to actual performance is needed to control the time element of the construction process.

Additions and Changes to the RED HORSE Project Process

Chapter 1 explained the RED HORSE troop training project process as it is currently specified by Air Force Regulations. The following paragraphs explain, by phase, several additions and changes that will create a better and more complete RED HORSE construction cost and schedule control system. A major difference in the proposed project process is that it is a cycle which constantly updates itself through feedback and historical data that are fed forward to future projects. The entire proposed project

cycle is depicted in Figure 2-1, showing which components are existing features and which have been added from research of the industry. A detailed description of the new items is contained in Chapters 3 and 4.

Feasibility Phase

From a cost control standpoint, the new recommendation is that the preliminary cost estimate of the RED HORSE evaluation be organized in the budget format that will be explained in Chapter 3. This will help the budget preparer to quickly see if the tentative project is within established funding limitations. Another advantage of using the standardized budget format is that it serves as a checklist for the preliminary cost estimate and can be used in conjunction with historical data in the same format.

Design Phase

The only modification proposed in this phase is to remove the preparation of the estimate and construction schedule and make it a separate management function of the preconstruction phase. The designers and project managers need to keep cost factors in mind during design, but the preparation of the detailed estimate and schedule deserves special attention after the technical design is completed.

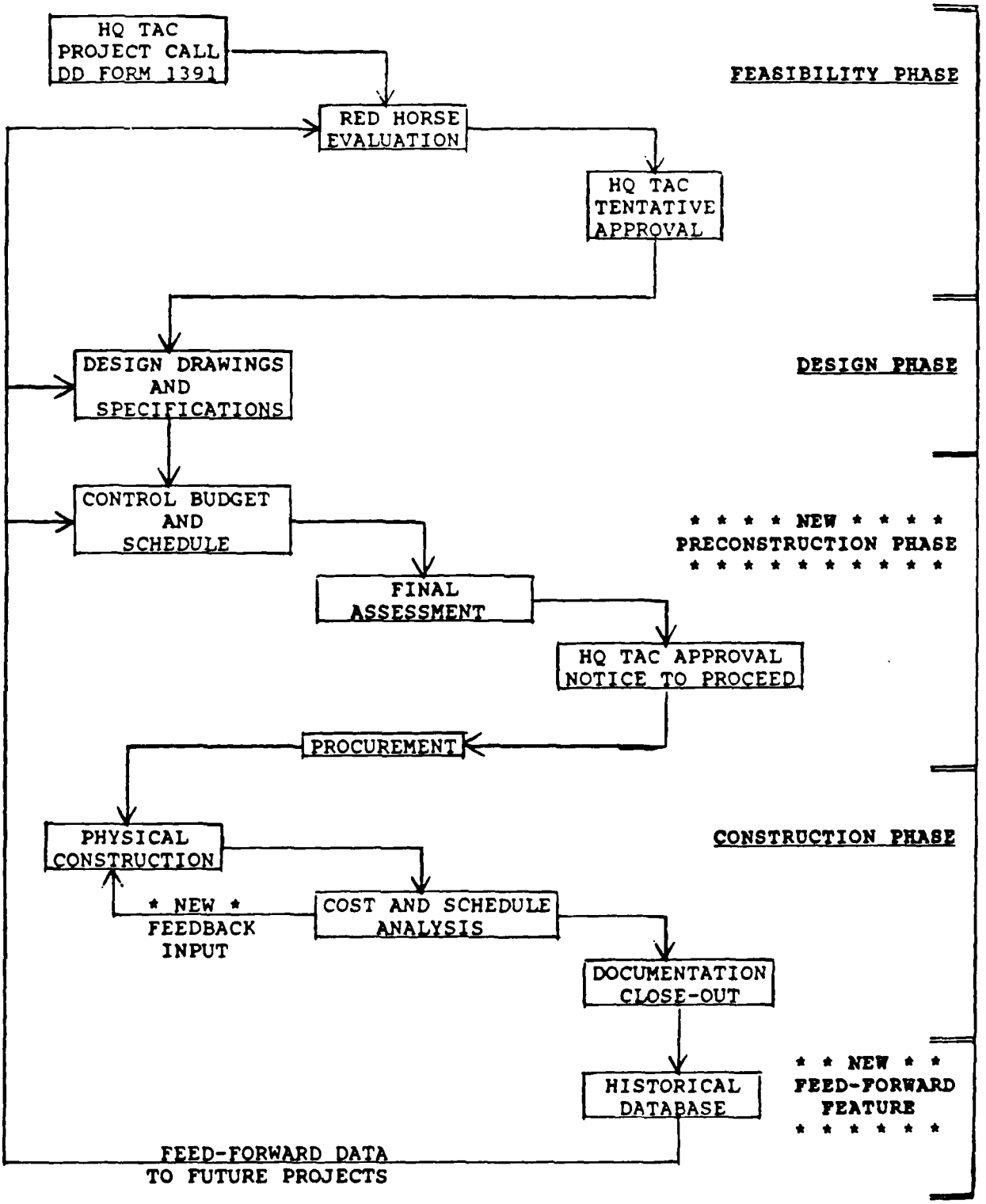


Figure 2-1 Proposed RED HORSE Project Cycle

Preconstruction Phase

Following completion of the design documents, it is proposed that this new phase be added to the project cycle. In it, RED HORSE will perform a detailed review of the entire project with several objectives. These objectives are to perform the definitive estimate and establish the control budget for cost control, to prepare a construction schedule for time control, and to reassess the feasibility of the project in light of the control cost estimate and schedule before obtaining final approval from higher headquarters. Detailed procedures for the preparation and format of the control schedule and budget are found in Chapter 3.

Construction Phase

During the construction or project accomplishment phase, RED HORSE is to perform many of the same cost accounting activities as before. The only difference is that the data will be collected, processed, and evaluated in a format that allows actual cost and progress performance to be compared to previously established standards. This applies to both cost and schedule. When significant variances appear, managers have timely information to guide them in taking corrective actions. Chapter 3 will show that reports issued by RED HORSE are a secondary product of cost control and not the primary purpose.

Feed-Forward Feature

A new portion of the construction process will occur when the project is completed. The highly organized data that reflects the final actual costs of the project will be converted into a historical database so that it is available as an aid in the planning stages of future projects. This feature is what transforms the RED HORSE project process into a project cycle which continually improves itself.

CHAPTER 3

THE PROPOSED RED HORSE PROJECT CONTROL SYSTEM

The control system that has been designed for RED HORSE is a construction project management information system based on the requirements of the regulations and on proven practices of the construction industry. There are no great revelations or amazing innovations for the management of construction to be found in the following pages, just common-sense cost accounting and documentation that have been standardized for this specific military situation. Of course, an information system is only as good as the information that passes through it, which is the old "garbage in-garbage out" axiom, but the system itself should be a viable tool for the job it has to do. Finally, it should be reiterated that there should be no substitute for human thinking in the construction decision-making process. A management information system is only a tool to provide the decision maker with the best and most appropriate information he/she can have on which to base decisions.

The Information System

Before the in-depth discussion of the mechanics of the RED HORSE Project Control System (RHPCS), it is first necessary to describe the information system that should be used to organize, collect, and process data. This section describes the process of data flow, hardware and software requirements for assisting in the processing of data, the format in which the data are organized, and the format for the construction schedule.

Data Flow

The flow of cost and schedule data for the RED HORSE Project Control System revolves around three elements: the field operation, the office-based project manager, and the squadron Operations Center. During the preconstruction phase of a project, which is described later in this chapter, the project manager and superintendent will develop the cost and schedule targets for comparison during construction. Once funds are provided and the construction schedule is activated, the three elements noted above will begin to transmit, process, and analyze the data using the procedures described in the last section of this chapter.

Field operations. At the jobsite, the superintendent simply records personnel and equipment hours expended as well as units of in-place work. The superintendent relates these data to the proper cost codes that have been

previously established in the budget process. The coded information is forwarded along with copies of material delivery tickets to the project manager at the home squadron office.

Project manager. The project manager and superintendent establish the cost and time objectives in the preconstruction phase. Once construction begins, the project manager refines the field data to determine the dollar costs expended on each cost code and checks to see if the results are realistic. Once the project manager has approved and formatted the source data, he submits them to the squadron Operations Center for input.

Operations Center. Personnel assigned to the squadron Operations Center establish the project control file by entering the intial approved cost and budget data into the computerized cost accounting system. During construction. they enter the actual cost and progress data provided by the project manager into the appropriate computer file. Computer products showing budgeted, actual, and forecast costs are printed and distributed to the appropriate project manager. The project manager and superintendent review the computer products for possible management action and to assist in report generation. Upon completion of construction, the Operations Center will close out the project by converting the final cost and schedule data to a

historical database. All of this activity occurs within the RED HORSE squadron.

The cost and schedule data are transmitted from the jobsite to the home office for further processing and report generation. Centralized accounting is advantageous in construction because it allows the superintendent to concentrate on men and machines on site, not on paperwork. It also moves the accounting function away from the noise, dirt, and distractions of the jobsite. Finally, it allows well trained and impartial personnel in the home office to objectively process the data (1, p. 40).

The obvious drawback to centralized accounting is the time factor. Time is consumed gathering, transmitting, receiving, and processing the data. Also, jobsite personnel might not have enough information at their fingertips to make immediate decisions. Fortunately, modern technology has provided devices such as the modem, the facsimile machine, and high speed computers that can rapidly transmit and process data. In Chapter 2 it was mentioned that all of the firms interviewed practiced centralized accounting through the use of computers. Based on this and the advantages listed in the previous paragraph, centralized accounting has been incorporated into the proposed RED HORSE Project Control System.

Data Organization

Chapter 2 described the use of Work Breakdown Structure by the civilian companies that were surveyed. With the rapid data processing capability of computers, it is easy to see how a project can be divided into elemental cost or schedule increments and then controlled increment by increment. An elemental cost or schedule increment is a small segment of a large project that is unique and identifiable such as relating to one trade, one deliverable product, or one geographic location on the jobsite. When all of the elemental cost or schedule increments are codified into a standard chart of accounts, the utilization of Work Breakdown Structure forces the project mangager to consider all aspects of the job and it becomes a checklist for those less experienced in construction.

In Air Force civil engineering terms, the project, which is assigned as one large work order by the base civil engineer, can be broken down into a series of smaller interrelated "job orders" so that each can be estimated, measured, and controlled. Work orders and job orders are the classifications given to maintenance and repair tasks that occur as part of routine Air Force Base upkeep. Because of the growing popularity of Work Breakdown Structure in the civilian construction industry and its ability to help inexperienced managers, Work Breakdown Structure has been incorporated into the proposed RED HORSE

Project Control System for the purpose of establishing and controlling the budget.

There are several different ways in the industry to break down work into subdivisions or categories. Architects and construction executives are familiar with the Construction Systems Institute, Inc. format and its 16 divisions. Means Assemblies Cost Data orgainizes the elements of a building into deliverable products that include all labor and materials associated with a particular system or assembly. MEANS uses a 12- division "Uniformat" beginning with Foundations and detailing the functional systems of the entire project (7, p. iii).

One of the basic requirements of any code of accounts is that it must be usable by all persons assigned to operate the accounting system (8, p. 75). Also, very little of the work in a RED HORSE project is subcontracted so there are no jurisdictional problems outside of the jobsite crew. With these ideas in mind, an assemblies-type code of accounts has been designed for use in the RED HORSE Project Control System rather than one based on craft distinctions. Since field personnel and junior officers will be correlating and assembling cost code data, each cost code in an assemblies-type of work breakdown structure should reflect a recognizable package of work that is easy to visualize and quantify. The Chart of Job Cost Codes shown in Appendix D has been developed from Means Assemblies Cost Data, the

chart of job cost codes from the Opus South Corporation and Gulf Contructors International Inc., and from the expected scope of work of typical RED HORSE projects.

Construction Schedule

The control schedule for this project management system is based on a Critical Path Method scheduling technique known as Activity-On-Arrow. This scheduling technique was chosen for the RED HORSE Project Control System because of the general familiarity RED HORSE members have towards it through Army Technical Manual 5-333, Construction Management, and its use during mobility missions. The Activity-On-Arrow technique is also suited for RED HORSE because the time-scaled network provides a visual relationship to the logic as well as the duration. This is apparent even to those who are not familiar with the technical workings of the network (2, p. 61). There are many commercially available scheduling programs for the microcomputer that can help project personnel perform the scheduling tasks.

Hardware and Software

Obviously, the computer is a prime vehicle because of its ability to rapidly process data. The computer is used in this control system to store the budgeted cost and schedule data, to calculate actual cost and schedule data,

and to calculate projected final costs. In accordance with centralized accounting, the computerized aspects will take place in the home office. Since AFR 93-9 requires the squadron Operations Center to track the ongoing construction projects, the Operations Center is the logical office to handle these control duties.

As of this writing, the 820th CERHS at Nellis AFB, Nevada has installed a Wang minicomputer system while the 823rd CERHS at Hurlburt Field, Florida is still operating soley with microcomputers. With this in mind, the procedures described in this thesis have been tailored towards microcomputer application. When full minicomputer capacity has been reached by either unit, the RED HORSE Project Control System could be easily adapted to a commercially available project management software package, or one can be developed.

Preconstruction Phase

When the design drawings and specifications have been approved and are 100% complete, the project moves into the Preconstruction Phase. It is at this time that the RED HORSE project manager begins a detailed review of the entire project to establish the control budget and the control schedule. The accuracy and detail of these two items are essential because they provide the benchmarks against which all actual costs and time progress are compared.

Control Budget Development

During the design phase, the project manager should periodically ensure that the design is staying within the orginal scope of work and has not expanded. If the project manager has monitored the scope and the design is roughly reflects the intended project, then the detailed estimate can be assembled. The detailed estimate and control budget are assembled using the following procedures.

Division of work. The project manager and superintendent must thoroughly review the design drawings and specifications so that the project can be divided into elemental increments of work known as cost codes. The project manager obtains a blank copy of the Chart of Job Cost Codes from the Operations Center and together with the superintendent, determines the cost codes that apply to the project. The Chart of Job Cost Codes serves as an initial checklist for the project manager and also serves as the estimate summary sheet that will be submitted to the Operations Center for initial input. If the project manager cannot find a cost code that is applicable to an item of work for the project, he should contact the Operations Center so a new code can be added to the system.

Cost code refinement. Once the project manager and superintendent have surveyed the Chart of Cost Codes, they will begin the detailed estimate by assigning a Job Cost Collection Sheet (Figure 3-1) for each cost code (8, p.

JOB COST COLLECTION SHEET

Cost Code No.	Description	Project No.	Date

PRODUCTIVITY CALCULATIONS

Base Quantity: _____
and Unit of Measure

Crew Hrs.: _____

Work Days: _____

MILITARY LABOR

Position	No.	Shop	Calculations				
			Total # Pers.	Work Days			Man-Days
			_____	X _____			= _____
			# Pers.	X Crew Hrs		Rate	Cost
			(RH) _____	X _____	X	_____	= _____
			(BCE) _____	X _____	X	_____	= _____
						Total	$ _____

EQUIPMENT OPERATION, RENTAL, & DEPRECIATION

Type	No.	Gal. D/M	Op. Cost	Ren. Rate	Ren. Cost	Dep. Rate	Dep. Cost
Totals			$	********	$	********	$

OTHER FUNDED COSTS (MISC. CONTRACTS, CIV. LABOR)

Description	Cost
Total	$

COST SUMMARY

MATERIALS (FROM REVERSE)	$_____	MILITARY LABOR	$_____
EQUIPMENT OP. & RENTAL	$_____	EQUIPMENT DEPRECIATION	$_____
OTHER FUNDED COSTS	$_____		

Figure 3-1 Job Cost Collection Sheet

PERMANENT MATERIALS

Source Number	Description	U/M	Quant.	Unit Cost	Extension
				SUBTOTAL	

OTHER MATERIALS & SUPPLIES

				SUBTOTAL	

INSTALLED EQUIPMENT

				SUBTOTAL	
				MATERIALS TOTAL	

Figure 3-1 continued

220). If a cost code needs further subdivision into more logical and manageable work packages, the project manager should add a decimal place to the primary cost code number and start a Job Cost Collection Sheet for each subcost code. A good example of the need for subdivision would be a large (10,000 sf) slab on grade:

311 - Slab On Grade, 5"

Divided into:

311.1 - Fine Grade

311.2 - Set Forms

311.3 - Place Reinforcement

311.4 - Place & Finish Concrete, West End

311.5 - Place & Finish Concrete, East End

The project manager and superintendent should use their judgement when dividing up job cost codes into work task subcost codes, but some general guidelines can be used:

1) If some key element of a cost code is to be accomplished at a different time than the bulk of the cost code, then it probably should be subdivided.

2) If the total time to complete the work required by the cost is longer than 14 calendar days, then the item should be divided up. Dividing up the work by geographic zones may apply in this case. A two-mile roadbuilding project could be subdivided into 1/2 mile segments for example.

3) Whenever the project manager and superintendent feel that a cost code is too broad to control, they should subdivide it into manageable parts. Although these subdivisions will not show up in the computer-generated cost reports, the budget data will still be available for comparison.

Detailed estimate. Each cost code (or subcost code) shall be thoroughly estimated using the Job Cost Collection Sheet. The Job Cost Collection Sheet serves as an estimating checklist much like the chart of job cost codes is a checklist for dividing work (8, p. 221). The Job Cost Collection Sheet is organized so the estimator will determine the duration, the cost of military labor, the costs of equipment operation, rental, depreciation, the cost of materials, and any other costs such as subcontracts or Base Civil Engineer civilian labor. Appendix E gives detailed instructions on how to complete the Job Cost Collection Sheet.

An added advantage of the Job Cost Collection Sheet is that it can serve as a task preplan during the construction phase. The superintendent can pull out the Job Cost Collection Sheet for a cost code item a few weeks before it is scheduled to start and review it with the foreman who will manage the crew. It is therefore imperative that the project manager and superintendent complete the Job Cost Collection Sheet as closely to the way the project is to be

built as possible. Another advantage of using the Job Cost Collection Sheet is that procurement documents and bid packages for high cost items can be developed directly from it. The accounting for materials later in the project will be aided greatly if the person who completes the procurement documents annotates the corresponding cost code directly on the procurement document.

The detailed estimate using the Job Cost Collection Sheet for a cost code should be accomplished by the person most qualified to do so. Only the permanent materials and installed equipment portion of the estimate can be derived directly from the drawings and specifications. Determining the duration, required equipment, and crew positions requires someone with construction expertise, so the project manager who lacks such knowledge must seek help in preparing the estimate (8, p. 213). The following estimating resources are available to provide assistance: the project superintendent, the benefiting Base Civil Engineer planning shop, completed Job Cost Collection Sheets from other RED HORSE projects, RED HORSE shop foremen, and the craftsmen, if known, who will actually manage the crews. However, the project mangager and superintendent must always perform the initial project breakdown and cost code assignment.

Completing the budget. Some cost codes in the General Conditions division cannot be completely estimated until the control schedule and project duration have been established.

When the required information is available and all of the cost codes have been estimated on Job Cost Collection Sheets, including the special codes for RED HORSE per diem and travel costs, the control budget will be assembled by the project manager and superintendent by filling in the appropriate boxes on the Chart of Job Cost Codes. When the project manager and superintendent are satisfied that the completed Chart of Job Cost Codes and corresponding Job Cost Collection Sheets accurately reflect the cost of the project as it is designed, they shall both sign and forward the Chart of Job Cost Codes to the Chief of Operations for review. The approved Chart of Job Cost Codes will then be entered into the computer data base file by the Operations Center and a computer-generated copy will be returned to the project manager.

Control Schedule Development

The control schedule for construction is assembled using the following procedures.

Initial network. The project manager and superintendent will use the same cost codes and estimated durations from the control budget as activities in an Activity-On-Arrow Critical Path Method network. The project manager should use his judgement if it appears that a cost code item will not logically fit into the network. The project manager and superintendent should strive to make the

network logic as valid as possible, so the inputs of senior tradesmen are very valuable. When the project manager has refined the network based on resource availability, he should perform the network calculations. The network calculations will yield EARLY START, LATE START, and FLOAT for each activity as well as total project duration.

Time-scaled network. The next step is to convert the raw network into a time-scaled network. Chapter 3 of CPM: Scheduling for the Construction Contractor contains procedures for making this conversion. The project manager should anchor the time-scaled network to the projected start date and include nonworking days to form the construction calendar. The construction calendar serves three important functions: it allows the project manager to (i) establish production goals for the control schedule; (ii) calculate per diem cost estimates and prepare a schedule for personnel and equipment deployment; and (iii) give the superintendent general guidance for completing the project.

Progress targets. By definition, each cost code other than those in General Conditions, is a measurable component of the complete project and represents some percentage of the total work effort. Therefore, the total percentage of all non-General Conditions cost codes added together is 100%. To weight each of the cost codes in relation to progress, the project manager will add up the estimated MAN-DAYS from every Job Cost Collection Sheet except those

in the General Conditions category. The percentage of the project for each cost code can be determined by dividing the estimated MAN-DAYS for each cost code by the total MAN-DAYS and multiplying by 100%. When the initial data input is made by the Operations Center from the Chart of Job Cost Codes, the computer will automatically make the job percentage calculations.

To establish production targets for each week, the project manager will first draw dark vertical lines at every Friday on the time-scaled network. He will then add the weighted percentage of the activities contained between the lines and make a cumulative count of percentage complete to date. Activities that span across the lines will be counted based on the percentage of the activity scheduled for the week in question. A schedule of progress values will be assembled by showing the activities scheduled, cumulative percent complete, and corresponding calendar date as shown in Appendix F. This is the control schedule and will not be altered during construction except if there is a change in the project scope.

During the construction phase, the control schedule will be used to compare actual and estimated production, but it should also be used to guide the superintendent in executing the work. The control schedule gives the superintendent a weekly list of tasks to accomplish. The superintendent is free to use the resources at his disposal

as long as he accomplishes the goals for the week. In effect, the superintendent controls the float during the week. The project manager may have to remind the superintendent which activities are more sensitive; i.e., the critical path.

Travel and per diem cost estimate. The time-scaled network is also a very valuable tool for accurately estimating the RED HORSE travel and per diem expenses associated with projects to be built at other bases. The project manager can list the Air Force Specialty Codes (trades) required for the project on the left side of the network and project downward the number of craftsmen required each day. In the civilian construction industry, it is not advantageous to hire and fire workers simply to meet a network schedule. Similarly, it does not make sense to transport a craftsman to a RED HORSE project site, send him home, and transport him again a few days later when his skill area is again required. The project manager should balance his crew to prevent turbulence and excessive travel costs.

A simple computation will determine whether a craftsman, whose skill area is temporarily unneeded, should be redeployed or not: calculate the round trip travel cost and compare it to the per diem cost if the member stayed at the jobsite. If the travel cost is less, the member should be returned to the home station and redeployed later when

required, otherwise he should be kept on the jobsite and employed usefully. These "idle" workers can be employed as laborers, as helpers to other craftsmen, or for General Conditions work around the jobsite. As before, the project manager and superintendent should use their judgement and staff the job as they see fit. Also shown in Appendix F is an example of the crew balance routine.

The per diem costs for the project can be estimated by continuing the crew numbers across nonworking days (per diem is paid for every calendar day) and adding up the total crew size for each calendar day. The daily per diem cost rate is then multiplied by the crew size for each day; this will yield the daily dollar cost. The project manager must also include the per diem cost of two travel days for each crew member. The travel cost can be estimated by counting up the number of round trips required by all crew members and multiplying by the current travel cost rate as determined by the Accounting and Finance office. The final page of Appendix F shows example calculations for estimating per diem and travel costs. When the project manager and superintendent are satisfied that the completed control schedule accurately reflects the way the project will be built as it is designed, they shall both sign it and forward it to the Chief of Operations for review.

Final Assessment/Project Review

The final step of the detailed project review is an assessment of the budget, schedule, and project scope. It is essential that the project scope as estimated and scheduled be compared to the approved programming document. If discrepancies are found, then action can be taken before any funds are obligated.

The total funded and unfunded costs annotated on the submitted DD Form 1391 should be compared to the estimated totals. If the estimated totals exceed the approved, then either the scope must be reduced, the project design must be "value engineered" to limit the cost, or a higher approved cost must be requested. If the project budget is within the approved amount, then the project can proceed as designed. If the budget is well under the approved amount, then previously deleted items can be added or the excess funds can be reallocated to a different project by HQ TAC.

The schedule should be assessed to ensure that the start and projected finish dates still are within the benefiting base's construction program. Also, the schedule must be acceptable to the performing RED HORSE unit's overall training exercise and construction schedule. When the benefiting base and the RED HORSE squadron have reached agreement on the project scope, budget, and schedule, the benefiting Base Civil Engineer will notify Headquarters, TAC via electronic message of the estimated funded and unfunded

costs, the start date, and the duration. Upon receipt and approval, Headquarters, TAC will forward funds and issue the notice to proceed.

Construction Phase

At the beginning of this phase of the project cycle, the project manager is armed with an organized array of data describing how much the project should cost and how long it will take to complete. In terms of construction control, the project manager and superintendent have set the budget and schedule standards. As time passes and money is expended, the project manager's task is to gather the "real world" data and compare them to the standards set in the preconstruction phase. This section describes procedures for gathering and processing data, data analysis, and reporting.

The control period during the construction phase has been set at two weeks (14 calendar days). The cost data collection and reporting procedures outlined in the following paragraphs are too rigorous to occur on a weekly basis, and a month is too long a span for a typical RED HORSE project (3 months). By performing the cost control routine every two weeks, the resultant information will still be timely and approximately match the amount of effort expended. This subject is highly debatable, and the final

decision on the frequency of reports must come from Headquarters, Tactical Air Command.

Actual Progress Data and Schedule Analysis

The first category of data that must be retrieved from the jobsite for the RED HORSE Project Control System is the actual quantity of work in place. As mentioned earlier in this chapter, each direct cost code is a measurable quantity of in-place work. The superintendent is responsible for calculating the number of units that have been completed during the week on each cost code that was in progress. The survey of quantities in place serves two functions: it is the fundamental measure of actual construction progress to date which is compared against the control schedule, and it helps in forecasting the final labor and equipment costs for cost codes in progress.

The project superintendent annotates the total number of units complete for each cost code on the Labor Distribution Worksheet (Figure 3-2) at the end of each week. Only cost codes that have military labor, equipment, or other costs expended during the week need to be included. The superintendent then transmits the worksheet to the project manager who will review it and make the entries on the Cost Input Document.

When the actual quantities are entered into the computer file by the Operation Center, the computer

82X CERHS
WEEKLY
LABOR DISTRIBUTION WORKSHEET

PAGE 1 OF 1

PROJECT NO: HBT 89-001T

DATE: 27 NOV 89

PROJECT TITLE: Sample Project

PREPARED BY: Keiper

COST CODE	DESCRIPTION	QUANTITY IN PLACE	U/M	MILITARY LABOR HOURS THIS WEEK RED HORSE	BCE	TOTAL
001	Superintendent	2	wk			
003	Indirect Labor (Supply)	2	wk			
005	Mobilization	.5	job			
040	Cleanup	.2	job			
060	Vehicle Maintenance	.2	job			
115	Cut and Fill	890	cy			
121	Haul Excess Cut	120	cy			
180	Chain Link Fence	660	sf			
240	Storm Sewer, 12" CMP	240	lf			
310	Slab on Grade, 4"	400	sf			

Figure 3-2 Labor Distribution Worksheet (Quantity)

automatically calculates the completion percentage for each cost code, the percentage each cost code contributes to overall progress, and total percent complete for the project. With these data, the project manager and superintendent can compare the actual percent complete to the scheduled percent complete from the control schedule to see if any managerial action is required.

Cost Data Collection

Cost data collection during the construction phase is accomplished through the following procedures.

Commitment of project funds. The project manager tracks and controls the commitment of project funds through the use of a commitment ledger (Figure 3-3). All AF Forms 9, Request For Purchase, issued as well as any other type of commitment document are posted to the commitment ledger as shown in the example. The first entry should always be the initial funds forwarded by HQ TAC for this project. Additional funds received or adjustments should also be included. Naturally, the project manager will maintain copies of each funding or commitment document as part of the project record.

By keeping a running balance on the commitments, the project manager always knows the exact amount of uncommitted project funds. When the purchase orders are issued against a purchase request, the project manager can tell if he is

82X CERHS
WORK ORDER NO: COMMITMENT LEDGER
PROJECT NO.: HBT 89-001T
PROJECT TITLE: SAMPLE PROJECT ESP: 8X PAGE 1 OF 1

DATE	DESCRIPTION	P.R./ DOCUMENT NUMBER	P.O. NUMBER	(+) DEBIT	(-) CREDIT	UNCOMM. BALANCE
10/5	HQ TAC Funding Msg	201900Z JUN 83		98200		98200
10/9	Ammend BCE COCESS Account (Initial)	F8900010	89384848		51500	46700
10/9	Ammend COPARS Account (Initial)	F8900011	89037363		3000	43700
10/9	Establish Project PFMR (Initial)	49503-1Z			15450	28250
11/1	Ammend BCE Refuse Contract (dumpster)	F8900188	89078474		1500	26750
11/1	Rental Backhoe	F8900189			2380	24370
11/1	Rental Jobsite Trailer	F8900190			3700	21670
11/4	Ammend COPARS Acct. (Decrease)	F8900256	89037363	500		22170
11/8	Fire Suppression Subcontract	F8900263			6890	15280
11/9	Pavement Striping Subcontract	F8900274			3350	11930
11/9	Rental Backhoe Cont Awarded (decrease)	F8900189	89030242	125		12055
11/9	Jobsite Trailer Awarded (increase)	F8900190	89073632		250	11805

Figure 3-3 Commitment Ledger

over or undercommitted for that purchase. When Emergency and Special Project codes are used in accordance with TACR 85-3, the project manager can easily check his commitment ledger for accuracy by comparing it to an Emergency and Special Projects report issued by the base Finance and Accounting office. This procedure will facilitate easy reconciliation between RED HORSE cost accounting data and the project's financial accounting data.

In addition to monitoring commitments, the project manager and superintendent must collect accurate data that reflects the actual expenditure of project funds. Once the data are collected, they must be coded properly so the computer cost analysis will show where the money is being spent and what the projected final cost is. This routine is to be applied to material costs, equipment costs, travel and per diem costs, military labor costs, and other funded costs. When the project manager has gathered and coded all of the expended costs for the period (two weeks), he summarizes the dollar amounts by cost code on the preprinted Cost Input Document (Figure 3-4) and submits it to the Operations Center.

Materials. The project superintendent collects all delivery tickets and annotates the proper cost code if possible. The superintendent then forwards copies to the project manager for review and additional coding if

PROJECT NO.: _____

PROJECT TITLE: _____

PREPARED BY: _____

82X CERHS

COST INPUT DOCUMENT

PAGE ___ OF ___

FOR THE PERIOD OF _____ TO _____

COST CODE	DESCRIPTION	PROGRESS		FUNDED COSTS					UNFUNDED COSTS		
				MATERIALS			OTHER		MIL	LABOR	
		QUANT.	U/M	PERIOD	TO COMP.	EQUIP.	PERIOD	TO COMP.	HRS	COST	G.O.E. DEPREC.

Figure 3-4 Cost Input Document

necessary. The project manager ensures that all delivered materials are coded with one of the active cost codes.

The project manager also estimates the amount of materials remaining to be purchased for each cost code. This sounds like a large task, but the project manager only needs to be concerned with the cost codes that have materials expenditures against them during the current period. There is a tendency to simply subtract the expended amount from the budget to get the remaining amount. This practice should be avoided because the project manager will not have accurate data unless the actual expenditures exactly match the budget (10, p. 162).

The following example shows how past performance should be used to estimate the material cost remaining on a cost code. Ten spread footings of equal size have been cast using 15 cubic yards of concrete. Ten additional footings are to be placed in the upcoming week. A total of 23 cubic yards of concrete has been budgeted and ordered on-call. The project manager should include the cost of 15 cubic yards in the remaining materials cost estimate as opposed to just 8. When the project manager has calculated the material costs for the period as well as the estimate to complete for each cost code, he lists them on the Cost Input Document.

Equipment. The project manager must track the cost of operation and maintenance of the construction equipment used

on the jobsite. For Government Owned Equipment (GOE), the unfunded depreciation cost must be calculated in addition to the operation and maintenance costs. The cost for rented equipment must also be calculated. For these data to be meaningful in the RED HORSE Project Control System, the equipment costs must be distributed to the appropriate cost codes. This is accomplished by tracking the equipment hours used on each cost code and distributing the fuel, and rental or depreciation costs appropriately.

On the jobsite, the superintendent will annotate the hours worked on each cost code by each piece of equipment and the gallons of fuel consumed. This can be accomplished by including it in the daily AF Form 1477, Construction Inspection Record, log entry that is required according to TACR 85-3. The Summary Worksheet can be used to summarize the equipment hours by cost code and registration number for the week (see Figure 3-5). The superintendent will mail or transmit via facsimile the completed summary back to the project manager each week. All costs for equipment maintenance will be accumulated under the proper General Conditions cost code.

The project manager will review the summaries for accuracy and completeness. He will then calculate rental or depreciation costs and distribute all costs by cost code using the worksheet shown in Figure 3-6. After the project manager has distributed all equipment charges by cost code,

SUPERINTENDENT'S SUMMARY WORKSHEET Date: 20 Nov 89

FOR: Weekly Equipment Hours

Project: HBT 89-001T Sample Project Page 1 of 1

Name/Type	Cost Code	005	025	115	121	180	240	Tot	FUEL (GAL)
Pickup Truck, 86B1344			15					15	7M
Dozer, TD-15, 80C301		9		21				30	240D
Farm Tractor, 84C502						30		30	14D
Dumptruck, 80C378					34			34	306D
Dumptruck, 80C379					25			25	226D
Loader, 84C1788					34			34	257D
Excavator (Rental)							27	27	223D
PAGE TOTALS									

Work Description: LIBOM, LIBPG, VACXE, VALUAH, ECPNEF, ECPMC12", LATOT

Figure 3-5 Summary Sheet for Equipment Hours

EQUIPMENT COST DISTRIBUTION WORKSHEET

FOR WEEKS 20 Nov 89 AND 27 Nov 89

Project: HBT 89-001T Sample Project

Type: Dozer, TD-15 Reg. Number: 80C301

Depreciation Rate: $ 12.50/Day Rental Rate: _____

Depreciation Cost This Period
(10 Days x $12.50 /Day) . . . . . $ 125

Rental Cost This Period
(_____ ___ X $_____/____) . . . . . $ 0

Fuel Cost This Period
(340 Gal X $ .83 /Gal) . . . $ 282

Cost Code	Weekly Equipment Hours 20 Nov	27 Nov	Total	Distributions Factor	Fuel	Rental	Deprec
005	9		9	.12	34		15
115	21	5	26	.36	102		45
119		22	22	.30	84		38
123		16	16	.22	62		27
TOT.	30	43	73				

Figure 3-6 Equipment Cost Distribution Worksheet

he will add up the equipment charges for each cost code and annotate them in the appropriate column of the Cost Input Document. It should be noted that fuel and rental charges are entered under the EQUIP. column of FUNDED COSTS while depreciation is entered under the G.O.E. DEPREC. column of UNFUNDED COSTS.

Military labor. Since RED HORSE has no payroll data to work with, military labor hours must be tracked and distributed at the jobsite by the project superintendent. Once again, the Summary Worksheet can be used by the superintendent to track military labor hours by cost code on a daily basis as shown in Figure 3-7. The military labor hours are summarized for the week on the Labor Distribution Worksheet (Figure 3-8) by the superintendent and transmitted via facsimile or mailed weekly to the project manager.

Upon receipt, the project manager checks the labor hours against the progress reported by the superintendent. Any direct cost code that is not subcontracted and shows progress for the week should also have military labor hours expended. The project manager extends the labor hours for each cost code by multiplying the hours by the appropriate rate (RED HORSE shop rate or Base Civil Engineer shop rate). The military labor costs are then transferred to the Cost Input Document.

Other funded costs. The superintendent must notify the project manager when expenses in this category have been

SUPERINTENDENT'S SUMMARY WORKSHEET Date: 20 Nov 89

FOR: Daily Military Labor Hours

Project: HBT 89-001T Sample Project Page 1 of 1

Name/Type	Work Description / Cost Code	SUPER 001	SUPPL 003	MOBIL 005	EXCAV 115	HAUL 121	FENCE 180	12" CMP 240	4" SLAB 310
Arnold		9							
Mitchell			9						
Vandenberg					8				
Eaker				2		6			
Spaatz									9
White									9
Scott				2		6			
Harmon					8				
Creech								8	
Andrews							9		
Doolittle						8			
	PAGE TOTALS	9	9	4	16	20	9	8	18

Figure 3-7 Summary Worksheet for Military Labor Hours

82X CERHS
WEEKLY
LABOR DISTRIBUTION WORKSHEET

PAGE 1 OF 1

PROJECT NO: HBT 89-001T

DATE: 27 NOV 89

PROJECT TITLE: Sample Project

PREPARED BY: Keiper

COST CODE	DESCRIPTION	QUANTITY IN PLACE	U/M	MILITARY LABOR HOURS THIS WEEK RED HORSE	BCE	TOTAL
001	Superintendent	2	wk	42		42
003	Indirect Labor (Supply)	2	wk	42		42
005	Mobilization	.5	job	35		35
040	Cleanup	.2	job	16		16
060	Vehicle Maintenance	.2	job	40		40
115	Cut and Fill	890	cy	96		96
121	Haul Excess Cut	120	cy	30		30
180	Chain Link Fence	660	sf	82		82
240	Storm Sewer, 12" CMP	240	lf	94	8	102
310	Slab on Grade, 4"	400	sf	76		76

Figure 3-8 Labor Distribution Worksheet (Labor Hours)

incurred. If a subcontract has begun, then the project manager should show the total cost listed on the Purchase Order as a cost for the period. If BCE civilian labor has been used on the project, then the superintendent can get the actual cost figures from the gaining BCE production control shop and notify the project manager of the cost.

RED HORSE travel and per diem costs. Two special cost codes have been established for tracking per diem and travel costs. The project manager will determine the travel and per diem expenses for the period by multiplying the number of men on the project each day by the daily per diem rate and by multiplying the number men who arrived at the jobsite during the period by the round-trip travel price noted on the travel orders. The actual worksheets for this cost determination have been left to the local units to develop, but the estimated cost for the period will be entered each period on the Cost Input Document.

Cost Analysis

When the project manager has completed the Cost Input Document to reflect the most acurate data available, he turns it in to the RED HORSE Operations Center for final processing. The Operations Center inputs the data into the data base file for the project. Computer products from the updated data base can be printed and used to assist the project manager in controlling costs and schedule as well as

to prepare project status reports. Also, the Operations Center will run a blank copy of a preprinted Cost Input Document for the project manager to use during the next two weeks.

The primary product of the data base file is the Summary Cost Report (see Figure 3-9 and Table 3-1). This report summarizes the progress to date, cost to date, budgeted amount, projected final cost, and projected variance for each cost code. This report is intended for use by the project manager and superintendent to identify cost codes that may need greater management attention. It also lists the percent complete of the project which should be compared to the projected percent complete from the control schedule. Finally, the summary at the bottom of this report should be used as the basis for completing the Biweekly Project Cost Report. The Summary Cost Report will be generated every two weeks and distributed to the proper project manager.

The project manager can request additional products from the data base if he desires. An individual cost report can be run for materials, equipment funded and unfunded costs, other funded costs, and military labor. Each report will show by cost code the actual progress, the budgeted amount, the cost to date, projected final cost, and the projected variance. These reports should be used to further identify potential cost differences in the specific cost category requested.

82X CERHS
SUMMARY COST REPORT

HBT 89-001T
SAMPLE PROJECT
P/M: CAPT KEIPER P/S: MSGT TURNER AS OF: 1 DEC 89

PAGE: 001
TIME: 0943
DATE: 4 DEC 89

COST CODE	DESCRIPTION	U/M	EST TOTAL QUANT	ACTUAL QUANT COMP	% COMP	% OF JOB		ACTUAL COST TO DATE	BUDGETED FINAL (B) COST	FORECAST FINAL (F) COST	FORECAST VARIANCE (B - F)
				DIVISION 100 SITE WORK							
101	Demolition	pct	100	25	25.0	1.6	F	280	220	280	-60
							U	3021	2865	3021	-156
103	Clear & Grub	ac	6	6	100	1.9	F	100	100	100	0
							U	2630	2720	2630	90
111	Grade Layout	pct	100	80	80.0	.7	F	160	180	200	-20
							U	479	600	599	1
115	Cut & Fill	cy	1200	700	58.3	2.2	F	965	1550	1653	-103
							U	1796	3200	3081	119
117	Demuck	cy	550	550	100	1.4	F	1390	1250	1390	-140
							U	2386	2200	2386	-186
119	Install Fill	cy	120	0	0	0	F	0	2800	2800	0
							U	0	1398	1398	0
121	Haul Excess Cut	cy	450	238	52.9	1.5	F	1322	2600	2499	101
							U	1624	3200	3070	130
							F	4217	8700	8922	-222
	DIVISION TOTALS					9.3	U	3158	16183	16185	- 2

<THIS SECTION FOLLOWS THE LAST DIVISION>

PROJECT SUMMARY

TOTAL PERCENT COMPLETE	23.7%			
MATERIALS	59865	63000	61040	1960
EQUIPMENT OP & RENTAL	1752	13700	13965	-265
OTHER FUNDED COSTS	9870	9000	9870	-870
TRAVEL & PER DIEM	3564	12500	11860	640
FUNDED TOTALS	75051	98200	96735	1465
MILITARY LABOR	12309	49800	51937	-2137
DEPRECIATION OF GOE	4590	20100	19367	733
UNFUNDED TOTALS	16899	69900	71304	-1404

Figure 3-9 Summary Cost Report

Table 3-1 Summary Cost Report Explanation

Item	Explanation
Cost Code, Description and Unit of Measure	from the approved Chart of Job Cost Codes activated for this project
Estimated Total Quantity	from the approved Chart of Job Cost Codes activated for this project
Actual Quantity Completed	computed by adding the quantity completed for the period from the cost input document to the previous total
Percent Complete	computed by dividing the Estimated Total Quantity into the Actual Quantity Completed and multiplying by 100%
Percent of Job Completed	computed by dividing the estimated mandays for the cost code by the total estimated mandays for the project and multiplying by the Percent Complete for the cost code
Actual Cost to Date (Funded and Unfunded)	computed by adding the Materials, Equipment and Other Funded costs (F), as well as Military Labor and Equipment Depreciation actual costs (U) from the cost input document to the previous totals
Budgeted Final Cost (Funded and Unfunded)	computed by adding the budgeted costs of the funded and unfunded cost categories from the approved Chart of Job Cost Codes
Forecast Final Cost (Funded)	computed by adding: a. Actual Cost to Date of Materials and the estimated amount to complete b. Actual Cost to Date of Other Funded cost and estimated amount to complete c. Actual Cost to Date of Equipment divided by Percent Complete and multiplying by 100
Forecast Final Cost (Unfunded)	computed by adding together both the Military Labor and Depreciation Actual Costs to Date divided by the Percent Complete and multiplying by 100
Forecast Variance	computed by subtracting the Forecast Final Cost from the Budgeted Final Cost. A minus sign indicates a forecast budget shortfall

Reporting

The final periodic accounting and control function of the Construction Phase is the preparation of the RED HORSE Bi-Weekly Project Cost Report (Figure 3-10). This report is the same as that currently required by Attachment 7 of TACR 85-3 except that it is to be published every other week and that it includes the forcasted final cost and forecasted variance for each cost category. The percentage numbers listed next to the cost categories on this report are for dividing the funded costs into Project Costs and Training Costs. This requirement is explained in paragraph 9c of TACR 85-3.

From this report, it is very clear what the final project cost is forecast to be, how much the budget variance is expected to be, and if the project has reached the scheduled progress level. The computer-generated Summary Cost Report is a valuable tool for the project manager to use while completing this report. Most of the companies that were surveyed made a special note, however, that computer-generated cost reports are just a tool and that the project manager must use his knowledge of the actual situation when completing a report. A column of the Summary Cost Report that should always be checked is the forecast final cost for each cost code. These values are calculated by simple equations based on past performance and may not exactly match the real situation. The project manager may

FROM: <RH PROJECT MANAGER> DATE: _____

SUBJ: RED HORSE BIWEEKLY COST REPORT, for weeks _____

TO: DEEC

1. Project Data.

b. Project Number and Title: _____

_____

c. Report as of date: _____

3. Project Status.

b. Original Completion Date: _____

c. Current Completion Date: _____

d. Construction Progress: _____ % Scheduled to date

_____ % Completed to date

4. Funded Cost Analysis:

Funded Project Costs;	COST TO DATE	BUDGETED FINAL COST	FORECAST FINAL COST	FORECAST VARIANCE (B - F)
a. Materials (90%)				
b. TDY (75%)				
c. Equipment (75%)				
d. Other (100%)				
TOTALS				

NOTE: Paragraph numbers and letters correspond to those on the RED HORSE Project Status Report.

Figure 3-10 RED HORSE Bi-Weekly Cost Report

Funded Training Costs;	COST TO DATE	BUDGETED FINAL COST	FORECAST FINAL COST	FORECAST VARIANCE (B - F)
a. Tng. Materials(10%)				
b. Tng. TDY (25%)				
c. Tng. Equipment(25%)				
Totals				
Funded Totals				
5. Unfunded Cost Analysis:				
a. Military Labor				
b. Deprec. of GOE				
c. RH Plan. Design				
d. Other				
Unfunded Totals				
6. Cost Summary:				
a. Funded				
b. Unfunded				
d. Total				

7. Remarks: _____

_____

_____

_____

8. Prepared By:

Figure 3-10 continued

have to make manual adjustments so the Biweekly Cost Report is completed to reflect the actual situation, regardless of what the computer products say.

System Maintenance

One of the basic requirements of a flexible but effective cost control system is the ability to input changes during the life of the project (5, p. 43). The project manager may be faced with changing the estimated data, the actual data, or both. A change in the estimated or budgeted data must come only from an approved change to the project scope or design. If the project manager must revise a budgeted quantity or cost, he will complete a Budget Change Form as shown in Figure 3-11. This form is nearly identical to the Estimate Summary Sheet and should be filled out the same way. A plus sign (+) indicates the amount added to the original while a minus sign (-) indicates the amount to be subtracted.

No matter how diligently the actual costs are recorded and coded, there will be a time when the actual costs must be adjusted during construction (5, p. 53). Costs may be inputted in the wrong cost code, or costs may be entered in the wrong cost category in the same cost code. Quantities of completed work are subject to similar errors. The project manager uses the Actual Change Form as shown in Figure 3-12. This form is very similar to the Cost Input

PROJECT NO.: HBT 89-001T

PROJECT TITLE: SAMPLE PROJECT

PREPARED BY: Keiper

82X CERHS
SYSTEM MAINTENANCE
BUDGET CHANGE FORM

PAGE 1 OF 1

DATE: 30 Nov 89

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
703	Wood Flooring	-1200	sf	-$1960			-23	-$4243	
709	Carpeting	+134	sy			+2278			
	(Approved design change requested by user, ammended carpet subcontract)								
348	Walks and Patios	-384	sf	-$275	-$128		-72	-$2412	-$87
	(4 ea. picnic table pads deleted by BCE)								

Figure 3-11 Budget Change Form

PROJECT NO.: HBT 89-001T

82X CERHS
SYSTEM MAINTENANCE
ACTUAL CHANGE FORM

PAGE 1 OF 1

PROJECT TITLE: SAMPLE PROJECT

PREPARED BY: Keiper

DATE: 29 Nov 89

COST CODE	DESCRIPTION	PROGRESS QUANT.	PROGRESS U/M	FUNDED COSTS MATERIALS PERIOD	FUNDED COSTS MATERIALS TO COMP.	FUNDED COSTS EQUIP.	FUNDED COSTS OTHER PERIOD	FUNDED COSTS OTHER TO COMP.	UNFUNDED COSTS MIL LABOR HRS	UNFUNDED COSTS MIL LABOR COST	UNFUNDED COSTS G.O.E. DEPREC.
115	Cut and Fill	-225	cy								
117	Demuck	+225	cy								
	(Progress attributed to wrong cost code)										
301	Wall Footings			-$325.75							
	(Delivery ticket counted twice)										

Figure 3-12 Actual Change Form

Document. Costs that have been mistakenly left out should be entered on the next input document by the project manager. After the Operations Center has made the changes to the actual quantities and costs, a copy of the Summary Cost Report should be run for the project manager.

CHAPTER 4

COMPLETING THE CYCLE

The final addition to the RED HORSE project process involves retaining historical data that feeds forward to future projects. The first section of this chapter describes the feed-foward loop and its value in the construction process. The final sections present recommended procedures for organizing the historical data into a useful format and actually using them to improve the construction project process.

The Feed-Forward Loop

In Figure 1-3, the feedback report is essential to control because it provides the corrective inputs to help keep the project on track. Chapter 3 discussed analyzing cost and schedule feedback to keep the construction phase of one project within budget and on time. The current project process depicted in Figure 1-2 makes no provision for using actual results to improve the entire process.

The addition of the historical data lines shown on Figure 2-1 transforms the project process into a project

cycle because the data are fed forward over a long series of projects. The concept involves retaining historical cost data after the end of each project and using it as feed-forward data to benefit future projects.

Feed-forward data improve the entire project process because they inject real world results into the planning stages of future projects. There are many books available to assist in planning and estimating construction projects, but the most reliable source of input is the past experience of the firm (10, p. 350).

Cost estimating is the largest benefactor of retained historical cost data, although valuable information for scheduling can also be stored and used. Historical cost data can be used very early in the project process to aid in quickly assembling an accurate feasibility or proposal estimate. They can also be used during design to control costs by allowing rapid cost comparison of different potential design solutions. Historical data can be used to check additional estimates and budgets as the project moves from phase to phase. Finally, historical costs can be used for comparison to actual cost data of a project under construction as part of a trend analysis. Injecting historical costs into any of these phases will tend to improve the entire process.

Organizing the Historical Data

At the end of each project that has been controlled by the RED HORSE Project Control System, the Operations Center has a well-structured record of the actual costs and man-hours on file. Since a standard code of accounts for budgeting and capturing actual construction costs has been established, it is logical that the same coding system be used for organizing historical data.

As soon as the project manager has closed out the project with the benefiting Base Civil Engineer, he will finalize all actual costs with the Operations Center by using either a final cost input document or an actual change form. This should be accomplished no later than 60 days after the completion of work. The project manager should strive to reconcile the financial reports for the project with the cost data. The Operations Center will enter the closeout cost data and run a final summary report for the project manager and project folder.

When the actual units and costs are finalized, the Operations Center will transfer the project data to the squadron's master historical database file. This file is simply a database file of all completed projects sorted by cost code instead of by project number. The following fields should be included for each cost code in the master historical database: project number, project name, project completion date, final quantity and unit of measure,

materials cost, equipment cost, other costs, military labor hours and cost, and equipment depreciation cost. The database should also calculate and display the unit costs for each of the five cost categories.

The Operations Center should print hard copies of the entire master historical cost database periodically for estimating and cost control purposes. Figure 4-1 is a suggested format for the historical database output. Additionally, project managers should be provided with an inquiry report that details only the cost codes they request. These inquiries can then travel with the project manager to the jobsite.

Using Historical Data in RED HORSE Projects

The final section of Chapter 1 stated that project control can be enacted during all phases of the project cycle. One of the main tools for controlling costs and schedules early in the project is the historical data from earlier projects that have been formatted for easy use in future projects. This section describes procedures for applying project control using historical data in the feasibilty phase, the design phase, and in the new preconstruction phase of the proposed RED HORSE project cycle.

82X CERHS
HISTORICAL COST CODE REPORT

PAGE: 018
TIME: 1352
DATE: 15 DEC 89

PROJECT NUMBER	PROJECT TITLE	COST CODE	DESCRIPTION COST CATEGORY	U/M	QUANT	COSTS	UNIT COSTS	HRS
HBT 87-031T	CONST. A/C MAINT. FAC.	311	5" SLAB ON GRADE	SF	1245			
	P/M: ORNEL		MATERIALS			1407	1.13	
	7/88 TO 11/88		EQUIPMENT			909	0.73	
			OTHER			0	0.00	
			MIL. LABOR			2066	1.66	168
			EQUIP. DEPR.			702	0.56	
SHA 87-092T	CONST. TOOL REPAIR FAC.	311	5" SLAB ON GRADE	SF	2400			
	P/M: BARNETT		MATERIALS			2784	1.16	
	8/88 TO 11/88		EQUIPMENT			1632	0.68	
			OTHER			0	0.00	
			MIL. LABOR			4416	1.84	359
			EQUIP. DEPR.			1464	0.61	
MYR 88-045T	RPR. TACAN FACILITY	311	5" SLAB ON GRADE	SF	120			
	P/M: GILLEY		MATERIALS			135	1.12	
	1/89 TO 3/89		EQUIPMENT			0	0.00	
			OTHER			0	0.00	
			MIL. LABOR			210	1.75	18
			EQUIP. DEPR.			0	0.00	
MCD 87-129T	CONST. PARACHUTE LOFT	311	5" SLAB ON GRADE	SF	3200			
	P/M: CERVIA		MATERIALS			3712	1.16	
	1/89 TO 4/89		EQUIPMENT			1888	0.59	
			OTHER			0	0.00	
			MIL. LABOR			5728	1.79	466
			EQUIP. DEPR.			1536	0.48	
HBT 88-005T	INST. ELECT. PRIMARY	311	5" SLAB ON GRADE	SF	600			
	P/M: HARMON		MATERIALS			720	1.20	
	3/89 TO 6/89		EQUIPMENT			252	0.42	
			OTHER			0	0.00	
			MIL. LABOR			1002	1.67	82
			EQUIP. DEPR.			228	0.38	

Figure 4-1 Historical Cost Code Report

Feasibilty Phase

During the RED HORSE evaluation of a project in the feasibility phase, the preliminary cost estimate is established as part of the DD Form 1391. Since this cost estimate must be completed quickly from sketchy design documents, historical cost data can prove to be very useful. This is the phase of the project where the project manager (or project evaluator) must rely heavily upon his construction experience. If the individual does not have years of estimating experience, which is typical of RED HORSE junior officers, then the body of unit experience captured in a data base is invaluable to support novice construction project estimators.

As soon as a RED HORSE project manager is assigned to perform a project evaluation, he should obtain a blank copy of the Chart Of Job Cost Codes from the Operations Center and review the DD Form 1391. The Chart Of Job Cost Codes serves as a preliminary estimate checklist, and it helps the project manager identify what cost code numbers in the historical data base should be examined. Additionally, organizing the preliminary budget in this format will facilitate budgeting actions and cost control later in the project cycle.

While conducting the actual evaluation and preliminary estimate, the project manager may elect to rely on historical costs alone for certain cost codes, especially if

no design information is available. It is more likely, however, that historical costs adjusted to meet actual conditions may be more appropriate. An example of this would be in estimating a concrete cost code. Historical data from the same cost code performed at Base X would be adjusted because of the price of Base Y's on-call ready-mix concrete contract. Cost codes that can be roughly estimated from the design and site conditions can be compared to historical costs to see if the estimate is realistic.

Design Phase

During the design phase, the project manager and designers may be faced with design/cost conflicts that will impact the scope of the project. Another possibility is that a certain design solution envisioned in the feasibility stage does not work out in the design scheme. In these situations, the project manager can make rapid and fairly accurate assessments of the impact on project costs by using historical data. When asked to compare different design alternatives, the project manager can consult the historical cost database and extract actual cost data for the relevant codes. As in the feasibility phase, it may not always be prudent to rely strictly on the historical costs for decision-making, but they do provide a starting point.

Preconstruction Phase

The data used to prepare the control budget and schedule must come from detailed estimates of time and costs required for the current project. Historical costs should not be used as the primary source of budgeting information. Historical cost information can be used in this phase as a check for the project manager and others reviewing the proposed control budget. If there are significant discrepancies between historical costs and the definitive estimate costs for a certain cost code, the project manager should review the cost code estimate carefully.

Completed Job Cost Collection Sheets (Appendix E) can serve as a form of historical data for use in the preconstruction phase. These forms from completed projects can help an inexperienced estimator identify all of the cost and productivity information required on the current project. It should be noted that Job Cost Collection Sheets contain only estimated costs in the proposed system, so they should be treated as estimating aids only. In a more advanced computerized cost accounting system, the Job Cost Collection Sheets could be updated as ledgers to show estimated and actual costs.

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

Summary

Project control in RED HORSE construction projects requires personal experience and a carefully thought out and concentrated managerial effort. This thesis contains construction management procedures and practices tailored for RED HORSE that are working well in the civilian construction industry today and will be beneficial to the RED HORSE construction process. Ultimately, the Air Force will be provided with better results and a more effective troop training program.

In Chapter 2, AFR 93-9 and TACR 85-3 were analyzed to determine what project control measures were required by regulation. This thesis shows that the basic concepts of estimating, scheduling, and cost control are discussed in general terms but lack specific guidelines. Chapter 2 also summarized the civilian construction contractor interviews. Project control procedures that are in common practice by some top quality Florida general contractors are described and they will enhance RED HORSE construction project management if implemented.

From the regulation requirements and civilian construction practices, a list of specific additions and changes to the RED HORSE project process is developed to enhance project control and create a cyclic system These additions and changes include a definitive cost estimate and control budget after design, a standardized budget format based on cost codes, and centralized cost accounting based on field-generated inputs to a computerized cost control program. Also required is a standardized scheduling technique for time control and the capture of historical project data in a useable format.

Chapters 3 and 4 provide specific instructions and guidance for preparing the budget and schedule, collecting and processing actual project data, and operating a historical database of construction information. These chapters have been arranged so they can be easily converted into squadron operating instructions or handbooks.

Recommendations

For RED HORSE squadrons to perform high quality control of construction projects using the concepts and procedures derived from control theory and typical practices of the private construction industry described in this thesis, certain actions such as changing regulations and improving training must be accomplished. This section describes these actions in the form of recommendations to Headquarters,

Tactical Air Command, the Air Force Engineering and Services Center, and to the RED HORSE squadrons.

Process Changes

A. Recommend the RED HORSE project cycle, as depicted in Figure 2-1, be adopted as standard practice. This will includes adding new emphasis to the development of a detailed cost estimate and construction schedule after the design has been frozen but before funds are obligated. This also includes an attitudinal change from a linear process to a perpetual cycle that improves with use. The historical database and feed-forward features described in Chapter 4 are the key to this change.

B. Recommend the RED HORSE units establish the data flow system of Chapter 3 where the field superintendent relays data to the office-based project manager who has overall responsibility for project success.

C. Recommend the budgeting, scheduling, and cost accounting procedures described in Chapter 3 be adopted for RED HORSE construction projects.

Regulation Changes

A. Recommend that Headquarters, TAC, and the Air Force Engineering and Services Center change both AFR 93-9 and TACR 85-3 to clearly assign the cost control responsibilty to the performing RED HORSE squadron. This thesis contains

procedures for RED HORSE to estimate, collect, analyze, project, and report construction costs because RED HORSE usually has control over the construction methods and means. It is recommended that a more appropriate role for the Base Civil Engineer would be to track construction costs through normal financial procedures and provide assistance in reconciling cost accounting with the financial data.

B. Recommend that Headquarters, TAC change TACR 85-3 to include a specific requirement for RED HORSE to perform a definitive cost estimate upon completion of project design. Headquarters, TAC could then give final approval and release the funds when they have received and reviewed the definitive cost estimate summary. Paragraph 6c of TACR 85-3 should be rewritten to reflect this action. Also included in this change would be the requirement for RED HORSE to create a bill of materials in the format described in Chapter 3 of this thesis so that the benefiting Base Civil Engineer cna produce the materials procurement documents and initiate procurement.

C. Recommend that Headquarters, TAC change paragraph 7b of TACR 85-3 to read: "The RED HORSE Commander, through his Chief of Operations, will assign an on-site project superintendent in addition to the project manager. . . ." In this thesis, the term "project manager" refers to a RED HORSE officer who has primary responsibility for all project control, coordination, and construction. If RED HORSE is

designing the project, then the project manager also manages the design schedule. The term "project superintendent" refers to the noncommisioned officer under the command of an who assists the project manager in control and manages the actual construction activity. Use of these terms better identifies their roles in the construction process and is more compatible with standard construction practice than the old expressions "Officer in Charge" and "Noncommissioned Officer in Charge."

D. Recommend that paragraph 8b of TACR 85-3 be changed so that it requires RED HORSE to submit a cost report every two weeks instead of weekly. This change provides timely cost and schedule data while not overburdening the project management personnel with paperwork. Additionally, it is recommended that the cost report shown in Figure 3-10 be used instead of the one shown in Attachment 7 of TACR 85-3. The proposed biweekly cost report shows progress and cost in a format that compares actual to expected performance and the variance between the two.

Required Equipment and Training

A. Since much of the proposed RED HORSE Project Control System is based on a computer analysis of cost and schedule data similar to the normal practices in the private construction industry, recommend that the squadron Operations Center be equipped with the personnel, hardware,

and software to implement and operate the system. Although the microcomputer hardware is already in use, two new software packages must be developed for the analysis of current project data and the storage of historical data. These packages can be easily assembled from commercial database and spreadsheet programs such as dBase IV and Lotus 1-2-3.

B. Recommend that the RED HORSE squadrons investigate the possibility of obtaining a facsimile machine for use in the Operations Center. The majority of bases served by RED HORSE construction have a facsimile machine located in the command post or communications center. By placing one directly in the squadron Operations Center, data transmission time to and from the jobsite would be greatly reduced. An alternative to facsimile would be the transmission of data via telephone modem from the host base to the Operations Center microcomputer.

C. Recommend that all RED HORSE personnel who are assigned to participate in the management of construction projects be trained in the procedures of Chapters 3 and 4 of this thesis. Those officers assigned as project managers should be thoroughly trained in all aspects of this project control system and in basic construction management skills. They should be taught to comprehend and use the valuable information from all parts of the system so that management of the whole process feeds forward and is constantly

improving itself. Some of the specific necessary management skills include CPM scheduling by the Activity-on-Arrow technique and construction cost estimating. Estimating includes identifying materials, labor, and equipment requirements and costs for the detailed construction budget, as well as cost determination at the systems level to serve as input for cost appraisal during design.

Conclusion

This thesis presents construction control principles and procedures for improving the management of RED HORSE troop training projects. As a result of learning in the classroom, literature research, and interviews with expert construction contractors from private industry, a project management system has been described which provides a basic framework for estimating, scheduling, cost accounting, and control. This system will improve the overall quality of RED HORSE construction projects and the ability of RED HORSE units to support the Air Force mission.

APPENDIX A

EXCERPTS FROM AIR FORCE REGULATION 93-9

This appendix contains Chapter 6 of Air Force Regulation 93-9, "Civil Engineering RED HORSE Squadrons." It is current through Change 2 dated 24 December 1987.

PROJECTS

Section A—Scope and Criteria

6-1. Scope. All projects performed under the guidance of this chapter will remain within the limits, terms, and authorities outlined in AFR 86-1. ANG RED HORSE squadrons will use ANGR 86-1. Emergency or contingency type projects related to tactical deployments or natural disasters are not included under the terms of this chapter.

6-2. Criteria. Projects done according to this chapter are classified as training projects and must meet the following requirements:

a. Add to unit proficiency and capability so they are similar to what the unit might reasonably be expected to accomplish during contingencies. Projects justified solely on the basis of economic benefit are not suitable.

b. Afford significant opportunity to enhance specific civil engineering skills of individual members of the unit working on the project and in equal part enhance the management, technical, and command skill of the unit.

c. Not conflict with the DOD policy of relying on the private enterprise system for products and services. Training projects should not compete with the types of work generally done by local contractors. A valid use may be when there is no contract capability in the local area, when there is a labor strike that would seriously impair the Air Force mission, when contractors are so involved in civilian contracts that there are no responses to an Air Force invitation for bids, or when security clearance requirements make contractor accomplishment infeasible. In addition, any project proposed within the US for RED HORSE accomplishment with a total cost funded and unfunded over $500,000 must be coordinated in advance with the Assistant Secretary of Defense (Manpower, Installation and Logistics) according to DODD 1135.2.

d. Should not have a mission sensitive beneficial occupancy date. RED HORSE is subject to no-notice, rapid deployment to support contingency and natural disaster requirements that would leave the project partially completed.

e. Be approved according to established project approval requirements of AFR 86-1.

6-3. Home Station Work Orders and Job Orders. RED HORSE squadrons may accomplish:

a. Approved BCE work orders and job orders that have training value and do not preempt approved training project work.

b. Cantonment maintenance of RED HORSE facilities as prescribed by section D, in this chapter.

6-4. Annual Training Project Program. An annual training project program is prepared for each RED HORSE squadron. This program includes all training projects to be accomplished by active squadrons and those to be accomplished during annual active duty tours by ANG and USAFR RED HORSE squadrons.

Section B—Training Project Program Development

6-5. Submitting Projects:

a. MAJCOMs with assigned RED HORSE squadrons. Parent MAJCOMs will establish procedures for submitting projects for RED HORSE accomplishment from bases within their command.

b. MAJCOMs without assigned RED HORSE squadrons. The requesting MAJCOM will annually or as required:

(1) Select candidate projects for RED HORSE accomplishment from MAJCOM requirements.

(2) Obtain necessary project approvals through normal procedures. Project programming documents must include:

(a) A recommendation that the project be performed as a RED HORSE training project.

(b) A detailed man-day estimate in addition to the normal cost estimate.

(c) A certification that the project will not conflict with local contractors.

(3) Review each project to make sure that it meets the criteria in paragraph 6-2.

6-6. Program Preparation for Active Duty RED HORSE Squadrons:

a. Parent MAJCOMs must prepare for each assigned squadron a schedule for training project accomplishment. For CONUS squadrons this schedule should be based on 75 percent of available man-days and address completion of already assigned training projects and the highest priority parent MAJCOM projects. Approximately 25 percent of CONUS squadron capabilities will be reserved for MAJCOMs other than the parent MAJCOM.

*b. MAJCOMs without assigned RED HORSE squadrons will submit a list, Request for Support, RCS: HAF-LEE(AR)7905, of candidate projects in MAJCOM priority sequence along with approved project documents to HQ TAC/DED with an infor-

mation copy to HQ AFESC/DEO by 1 March of each year.

★c. HQ TAC/DED:

(1) Reviews MAJCOM project submittals to ensure compatability with the criteria of paragraph 6-2.

(2) Prioritizes MAJCOM candidate and unstarted approved projects based on RED HORSE training benefit and requesting MAJCOM need.

(3) Sends the prioritized, consolidated list of projects to the parent MAJCOM by 1 May.

★d. parent MAJCOMs will integrate these projects into the training schedule for each RED HORSE squadron.

★e. HQ TAC/DED will distribute the approved training project program (by 15 July). Actual project deployments will begin on or after 1 October.

6-7. Program preparation for Reserve Forces RED HORSE Squadrons:

a. Annual training tours offer ANG and USAFR RED HORSE squadrons functional training through deployments to other defense installations. The objective of this program is to conduct deployment and employment training but a valuable byproduct is the completion base facility projects. The National Guard Bureau or HQ AFRES will task Reserve Forces RED HORSE squadrons for deployments to do Reserve Forces projects. HQ AFESC has overall responsibility for scheduling deployments to do active force projects. These are scheduled annually along with ANG and USAFR Prime BEEF training deployments. Specific details on program administration are outlined in AFR 93-3.

b. If possible, Reserve Force RED HORSE squadrons will be deployed to the European theater to permit use of prepositioned equipment and supplies.

c. When necessary, Reserve Forces RED HORSE squadron construction equipment operators, maintenance mechanics, and other RED HORSE members requiring training may deploy to an active RED HORSE squadron location.

6-8. Program Deviations. Emergency, unprogrammed priority, or peak military mission requirements override approved training project programs.

a. MAJCOMs with assigned RED HORSE squadrons can substitute an urgent project for one of their own projects in the approved program. HQ AFESC/DEO must be advised of the change.

b. MAJCOMs without assigned RED HORSE squadrons can request the substitution of an already approved project or the addition of a project by forwarding the project programming documents and a detailed justification of urgency to HQ AFESC/DEO. After staffing and coordination, HQ AFESC/DEO coordinates the revised project schedule with the proper RED HORSE parent MAJCOM.

Section C—Project Accomplishment

6-9. Project Design. Design is usually done by RED HORSE. The host BCE will provide necessary site data, as-built drawings and other engineering information necessary to facilitate the design. The host BCE may be required to provide part or all of the design when conditions dictate. Design responsibilities are as follows:

a. RED HORSE Project Engineer. Is responsible for project design and coordination, serves as primary point of contact for all squadron activities relating to the project, and maintains the project folder. Reviews design documents and supervises project if designed by other than RED HORSE. Chairs design conferences necessary to effectively coordinate the design with base representatives. Makes sure the current working estimate does not exceed the funded cost on the DD Form 1391, Military Construction Project Data, at the time of construction.

b. Host BCE. Acts as the point of contact for other base organizations concerning the project. Reviews and approves design drawings, and obtains coordination from required base organizations. Provides RED HORSE with updated DD Form 1391; AF Form 327, Base Civil Engineer Work Order; and AF Form 103, Base Civil Engineering Work Clearance Request, as required. If the project is designed by an agency other than RED HORSE, provides a reproducible set of approved drawings, plans, specifications bill of material, AF Form 1445, and a current working estimate, prepares and submits requests for additional funds if required.

6-10. Design Documents. The following will be prepared as required:

a. Drawings.
b. Specifications.
c. Site evaluations.
d. Manhour and equipment estimates.
e. Current working estimates.
f. Work scheduling data.

6-11. Design Drawings. Design drawings are usually prepared by the project engineer and are approved by:

a. Project engineer.
b. RED HORSE squadron commander.
c. Base fire chief.
d. Base civil engineer.
e. Base safety officer.
f. Base environmental health officer.
g. Using agency commander.

h. Numbered Air Force, MAJCOM or HQ USAF as required.

6-12. Construction Management. Responsibilities are divided between the host BCE and the RED HORSE squadron as follows:

a. Host BCE. The chief of the host BCE construction management office will assign an inspector to each RED HORSE training project. The inspector:

(1) Acts as liaison between RED HORSE and other base agencies and offices.

(2) Convenes a preconstruction conference between the using agency, RED HORSE project personnel, and other interested offices to coordinate the construction effort.

(3) Checks the quality of construction. A daily inspection diary is maintained (AF Form 1477, Construction Inspection Record, is recommended) including:

(a) Weather conditions.

(b) Personnel at work; hours worked.

(c) Work accomplished by trade.

(d) Problems or delays encountered and action taken to correct them.

(4) Determine design and construction deficiencies that could impair the intended functional utility of the facility and initiate action to resolve them.

(5) Conduct a prefinal and final acceptance inspection with RED HORSE and using agency representatives identifying deficiencies outstanding and annotating actions programmed to correct them.

(6) Follow up to ensure all deficiencies identified are corrected.

b. RED HORSE. The RED HORSE project OIC or NCOIC:

(1) Develops a project schedule (such as critical path methods, program evaluation review technique, or bar graph) to be used in scheduling construction effort and monitoring project progress.

(2) Coordinates allocation of RED HORSE equipment and manpower with the operations center.

(3) Arranges host base support including billeting, messing, and work and storage areas through the host BCE.

(4) Maintains project records as listed in paragraph 6-13.

(5) Keeps project cost accounting records according to paragraph 6-14.

6-13. Project Records. The following documentation is maintained by the project engineer for each training project and, at the completion of the project, copies of documents needed for the base record files are turned over to the host BCE:

a. Approved project programming documents.

b. Work directive and change orders.

c. Project drawings (updated to as-builts).

d. Specifications.

e. Manhour, equipment, and cost estimates.

f. Construction conference minutes.

g. Results of lab testing.

h. Diary of construction effort including status of progress, unique design and construction problems encountered, and results of project inspections.

i. Related project correspondence.

6-14. Project Cost Accounting:

a. For cost accounting purposes, projects are defined as all training projects, including repair and minor construction work done on RED HORSE facilities that must be capitalized.

b. RED HORSE (RH):

(1) Furnishes weekly cost reports to the host BCE for each project or work order. Includes RH labor costs. RH mobile equipment fuel costs, BCE furnished material costs, and RH estimated per diem and travel costs.

(2) Uses a shop rate based on a weighted average of the standard rates given for E-1 through E-9 in AFM 177-101. This shop rate must be updated annually as of the first day of the fiscal year.

(3) Uses equipment rates based on the operating and depreciation costs. Operating costs represent the cost of fuel, lubricating fluids, associated filters, and minor maintenance. Depreciation costs will be computed by dividing the value of equipment to be depreciated by the anticipated useful life, as reflected in T.O. 36A-1-1301, Vehicle Management Index File.

c. The host or using base:

(1) Maintains cost accounting records for each RED HORSE training project (see definition of project in a above). This will require combining data from the base automated system (if it applies) for support furnished to RED HORSE with data received from RED HORSE.

(2) Makes sure that the cost in the HAF-LEE(SA) 7101/7102 is limited to the cost for which the base is responsible for funding.

(3) Uses manual accounting records to determine the total amount to be capitalized for each project.

d. If a RED HORSE commander determines that a project offers a needed opportunity for training he may assign more manhours than required to accomplish the work. In that case, the expense of these additional training manhours will not be charged against the project. However, RED HORSE will document the use of these training manhours as part of the project file.

e. During contingencies, if HQ AFESC/DEO concurs, the parent MAJCOM may exempt squadrons

deployed to support a contingency operation from cost reporting until mission requirements permit.

Section D—Cantonment Maintenance

6-15. Applicability. These procedures, during peacetime, apply only to active and USAFR RED HORSE squadrons. In peacetime, ANG procedures for cantonment maintenance are outlined in maintenance as specified in individual ANG unit regulations.

6-16. *Maintenance Responsibility*:

a. The host BCE is responsible for maintenance of RED HORSE cantonment facilities. In the absence of a host BCE, the RED HORSE squadron commander is responsible for maintenance of RED HORSE cantonment facilities.

b. The host BCE may delegate authority to the RED HORSE squadron commander to initiate, approve, and perform work of a job order nature, as defined and authorized in AFR 85-1, when the work is done on squadron facilities. Specific authorities and responsibilities are identified in a formal memorandum of understanding.

6-17. Procedures:

a. The RED HORSE squadron operations center processes all maintenance and repair needs for RED HORSE cantonment facilities. All work for which authority has not ben delegated to the RED HORSE commander by the host BCE is sent to the host BCE using the means prescribed by AFR 85-1.

b. The operations center will keep job order and work order records. AF Forms 1879, BCE Job Order Record, and 327, supplied by the host BCE for work to be done by the RED HORSE squadron. When the work is completed these documents are turned over to the host BCE to update necessary records.

c. When authority to initiate job orders is delegated to the RED HORSE squadron commander, the operations center fills out the required AF Form 1879. Each month on the last week-day, a report is sent to the host BCE that gives the number of job orders:

(1) Generated that month.
(2) Completed that month.
(3) Outstanding at the end of the month.

NOTE: Accompanying the report is the original of every complete job order for the host BCE's files.

APPENDIX B

EXCERPTS FROM TACTICAL AIR COMMAND REGULATION 85-3

This appendix contains most of Tactical Air Command Regulation 85-3, "Management of Training Projects: Civil Engineering RED HORSE Squadrons." It is current through 10 February 1989.

Civil Engineering - General

MANAGEMENT OF TRAINING PROJECTS CIVIL ENGINEERING RED HORSE SQUADRONS

This regulation provides guidelines for the development of Real Property Maintenance, Repair, and Minor Construction projects accomplished using government furnished materials, with labor furnished by active Civil Engineering RED HORSE Squadrons (CERHS) as a means of enhancing the functional organic skill of each RED HORSE unit concerned. This regulation does not apply to Air National Guard (ANG) or US Air Force Reserve (USAFR) units and members.

1. Scope:

a. All projects performed under the guidance of this regulation will remain within the limits, terms, and authorities set forth in AFR 86-1.

b. Unless otherwise directed by HQ TAC/DE, responsibility for training projects will be as follows

(1) 823 CERHS - Ninth Air Force Bases and all areas east of the Mississippi River

(2) 820 CERHS - Twelfth Air Force Bases, Nellis AFB NV, and all areas west of the Mississippi River

c. Emergency or contingency type troop projects are not included under the terms of this regulation when directed by the Commander, Tactical Air Command, related to tactical deployments, exercise support, or natural disasters

2. Criteria. Projects developed for accomplishment under the provisions of this regulation will be classified as training projects and will meet the following criteria

a. Afford significant opportunity to enhance specific civil engineering skills of individual members of the unit performing the project and enhance the management, technical, and command skills of the unit.

b. Require HQ TAC approval and/or funding. Projects not requiring HQ TAC approval and/or funding, such as community service projects, will be coordinated by the RED HORSE squadron through the Combat Support Group commander. The RED HORSE commander may use such projects as "fillers" for the formal scheduled projects but must ensure the unit's ability to meet the schedule is not degraded by the additional work.

c. Proposed projects will not be executed in a general locality during a time when a surplus of local labor exists in that locality for the type of labor skills required in the project. This determination is the responsibility of the local project programming/approval authority. A statement of impact on local contractor/labor relations through use of a RED HORSE Squadron will be included on the DD Form 1391 (See attachment 1).

d. Projects should not be undertaken by RED HORSE if failure to accomplish the project by a specific beneficial occupancy date will result in a mission failure by the ultimate user of the facility. RED HORSE is subject to short notice, rapid deployment to support disaster recovery operations and/or contingency requirements.

3. Project Authorization:

a. Approval authority for command funded RED HORSE troop training projects will not be delegated below HQ TAC/DE.

b. Projects to be accomplished under the provisions of this regulation are normally requested and scheduled annually by HQ TAC as shown in attachment 2. Bases may, however, request insertion of a project in the RED HORSE schedule on an out-of-cycle basis.

c. Prior to project submittal, projects must be approved by the base Facilities Board (FB) and the installation commander having real property support responsibility over the project site.

d. After notification of project acceptance for RED HORSE troop construction, the base civil engineer (BCE) at the requesting installation will develop all necessary project documents including DD Forms 1391 and 1391c. These documents will be prepared in accordance with established HQ USAF and HQ TAC directives for real property projects in the format prescribed in Attachment 1. The requesting BCE will coordinate work with the appropriate RED HORSE Squadron (see paragraph 1b) during the DD Form 1391-1391c preparation stage.

e. The term "Troop Training" will be used, where applicable, in the development of all project documents.

f. Completed programming document will be forwarded to HQ TAC/DED for review. An information copy will be sent to the appropriate RED HORSE Squadron commander. HQ TAC will integrate projects into the TAC RED HORSE Projects List and will request formal project evaluation by the RED HORSE units.

g. RED HORSE will review the documents and return an evaluation to the requesting BCE with information copy to HQ TAC/DED. TDYs for TAC project evaluations will be funded by the RED HORSE squadron from their annual operating budget. Evaluations will include:

(1) Statement regarding the value of the project for enhancement of unit training.

(2) Projected availability of RED HORSE equipment. Requirements for host unit or rental equipment, if needed.

(3) Estimate number of personnel, by AFSC, and calendar days required to accomplish project.

(4) Review of funded and unfunded costs for general compliance with scope and troop deployment.

(5) Estimated fuel required to support project vehicles and equipment.

(6) Evaluation of RED HORSE design capability.

(7) Recommended period of accomplishment

h. The requesting BCE will review the RED HORSE evaluation, revise project documents as appropriate and submit the original, plus five copies, of the project documents (including the RED HORSE evaluation) to HQ TAC/DED, with information copy to the RED HORSE unit

i. HQ TAC/DE staff will review projects for suitability as training projects and approve, disapprove, or forward for higher headquarters action.

(1) DD Forms 1391 for disapproved projects will be returned to the originator with informational correspondence to the RED HORSE Squadron

(2) Disposition of DD Forms 1391 for approved projects will be as follows

(a) Original to HQ TAC/DEPD file

(b) Duplicate to appropriate RED HORSE Squadron, requesting BCE, the Numbered Air Force Chief of Staff (if applicable), and HQ TAC/DED

j. Procedures in paragraphs c through f above also apply when revised DD Forms 1391/1391c are prepared. Additionally, requesting BCEs and RED HORSE Squadrons should periodically review appropriateness of programmed costs. This is particularly important when the project is not started soon after preparation of project documents.

k. Procedures for obtaining RED HORSE project authorization for MAJCOMs other than TAC (attachment 3) are as follows (also see AFR 93-9):

(1) Requesting MAJCOM will forward AF Forms 1391/1391c to HQ TAC/DED with justification for use of RED HORSE for project accomplishment.

(2) HQ TAC/DED will review documents and forward them to a RED HORSE squadron for evaluation

(3) RED HORSE will accomplish evaluation in accordance with paragraph 3 f and send to requesting BCE with info copy to HQ TAC/DED

(4) After notification of project acceptance for RED HORSEconstruction, requesting BCE will prepare project documents based on RED HORSE evaluation and obtain project approval and funding at appropriate level.

(5) Approved DD Forms 1391/1391c will be forwarded to HQ TAC/DED by MAJCOM. HQ TAC/DED will review documents for sufficiency and forward to appropriate RED HORSE Squadron with work directive.

4. Unit Home Station Work Authorization:

a. The RED HORSE commander has the authority to authorize accomplishment of unit home station BCE approved work orders having training value. Status of these work orders will be included in the RED HORSE Activity Summary Report.

b. Initiation, approval, and accomplishment of RED HORSE cantonment maintenance of a job order nature as defined in AFR 85-1 and AFR 93-9 may be delegated to the RED HORSE Squadron by the BCE. Specific authority and responsibilities will be identified in a written agreement in accordance with AFR 11-4.

5. Project Scheduling:

a. HQ TAC/DED will furnish RED HORSE and the respective bases with a current prioritized project listing prior to the start of the new fiscal year. The using BCE will ensure necessary actions to effect design, secure funding, procure materials, and arrange accommodations to permit projects to start on the scheduled date. RED HORSE will be billeted on base whenever possible.

b. Where practical, individual members of the RED HORSE Squadron will not be continuously deployed from the unit home station for a period exceeding 60 consecutive calendar days on any training project or combination of projects. For extended projects, personnel will be rotated to limit individual TDY periods. Project funds will be used for rotation of personnel.

c. Deployment Report, (attachment 4) will be prepared as required to notify HQ TAC/DED of RED HORSE resources that are deployed.

d. RED HORSE Project Schedule will include those projects, major exercises, and major training activities the squadron has worked during the previous quarter and those scheduled for the future 9 months (12 months total). AF Form 3130, General Purpose Form, may be used to prepare reports, but will not be locally reproduced (Attachment 5). Computer generated reports may be used so long as all required information is included.

6. Project Design:

a. During the RED HORSE evaluation of the project documents, RED HORSE will determine if engineering manhours and expertise are available within RED HORSE for project design. Careful consideration will be given to ac-

complishing a sufficient number of designs to ensure the RED HORSE engineering branch is adequately trained in each engineering discipline and overall project technical administration (drawings, current working estimate, etc) Using BCE will design those projects RED HORSE determines it does not have the manpower and/or expertise to design Refer to paragraph 3f(6)

b Once design begins, the BCE will begin reporting design and material status in para 2, Design/Materials Status, of the RED HORSE Project Status Report (attachment 6) This information will be reported as of the fourth Friday of each month until design and materials are 100% complete The report will be forwarded to HQ TAC/DED and the supporting RED HORSE squadron not later than the following Monday

c Upon completion of project design, the BCE will forward copies of the approved project design, bill of materials, copy of CMAS inquiry for work order materials, or copies of AF Forms 1445, Materials and Equipment List, and current working estimate(CWE) to the supporting RED HORSE Squadron for review and approval. Projects designed by RED HORSE will be submitted to the host BCE for review of technical and functional adequacy, obtaining signatures, and ordering materials

7. Project Management. For projects covered by this regulation, RED HORSE and the using BCE will assume the following responsibilities in addition to those identified in AFR 93-9

a The using BCE will assign technical inspection responsibilities to the Contract Management Office The Chief of the Contract Management Branch will assign an inspector, by letter to RED HORSE, to the project and be responsible for the following

(1) Act as BCE liaison with RED HORSE and other base agencies

(2) Convene a pre-construction conference with the using agency, RED HORSE project manager, inspector and other required agencies prior to work start

(3) Monitor status of BCE government furnished material and equipment Ensure materials are 100% complete prior to construction start date otherwise RED HORSE commander (at his option) may reschedule project

(4) Check quality of construction and workmanship Since the primary purpose of RED HORSE projects is for troop training, all work must meet or exceed industry standards to be acceptable

(5) Determine design and construction deficiencies that could impair intended functional use of the facility or project

(6) Maintain the following in a Project Jacket File and furnish to RED HORSE 30 days prior to start of work AF Form 327, Base Civil Engineer Work Order, copy of MAJCOM approved DD Forms 1391/1931c, project drawings, AF Forms 103, Base Civil Engineering Work Clearance Request, and other pertinent data

(7) Conduct pre-final and final acceptance inspections with RED HORSE and other required agencies to identify deficiencies and actions to correct them

(8) Follow up to ensure all identified deficiencies have been corrected

b The RED HORSE commander, through his Chief of Operations, will assign an on-site project manager whose responsibilities will include the following

(1) Coordinate arrival of equipment and manpower with the BCE 30 days prior to deployment and ensure project design, siting, materials, billeting, and messing are available to support deployment, and notify HQ TAC/DED of any unresolved problems encountered

(2) *Prior to start of work:*

(a) Provide contract management with a project schedule of activities (e g , CPM, PERT, Bar Graph, etc)

(b) Inventory bill of materials to verify all items are on hand

(3) Attend pre-construction conference

(4) Ensure both quality of workmanship and final product meet or exceed national construction standards

(5) Maintain project folder on the job site containing copies of AF Form 327, project drawings, specific matters of applicability, bills of materials or copies of AF Forms 1445 material status, copy of approved DD Forms 1391/1931c, AF Form 103; project schedule of activities (e g , CPM, PERT, Bar Graph, etc); record of funded and unfunded projects costs to date, CWE; up to date as-build drawings, copy of final DD Form 1354, Transfer and Acceptance of Military Real Property; and other pertinent data

(6) Arrange for pre-final inspection of the project. At the conclusion of the inspection, a deficiency list will be established to note construction and design deficiencies in accordance with AFR 89-1 It will be signed by the RED HORSE project manager, the BCE representative, and the using agency. If disagreement occurs between RED HORSE project manager and in-

spector concerning correction of deficiencies, the base Chief of Engineering will have final authority for acceptance of the work.

(7) Upon resolution of deficiencies, schedule a final inspection to be attended by the BCE representative, using agency, and RED Horse project manager

(8) Provide complete as-build drawings and DD Form 1354, to host BCE

c. The RED HORSE Operations Center is responsible for maintaining current status and a project file for each approved project. Project engineers are responsible for continuously reviewing the project files for each of their assigned projects to ensure the file is current and pertinent documents are in the file

8. Project Cost Accounting. The BCE and RED HORSE have a joint requirement in the collection and reporting of project costs, to include the following

a. The BCE will:

(1) Ensure approved funded, training, and unfunded amounts for projects are not exceeded without prior approval from HQ TAC/DED

(2) Establish a work order for each project with appropriate cost in WIMS Input and track requirements against the work order in WIMS

(3) Issue base service store cards and tool issue cards chargeable to the project as necessary.

(4) Accumulate all costs related to RED HORSE. Project costs expended will be obtained by contract management who will submit RED HORSE Project Status Report (attachment 6) to HQ TAC/DED with information copies to appropriate NAF and RED HORSE Squadron. Purpose of this report will be to provide current status of funded, training, and unfunded costs expended on project, project completion status, and CWE for project. This information will be current as of close of business the fourth Friday of each month during the construction of the project beginning with deployment. The report will be forwarded to appropriate agencies not later than the following Monday.

(5) Report scheduled pre-final and final inspection dates in paragraph 5, "Remarks," of RED HORSE Project Status Report

(6) Prepare completed construction transfer documents. AF Form 1442,Real Property Engineering Data, will be prepared by the BCE upon final acceptance to transfer accountability of completed new construction to real property records. Project cost records will provide pertinent information for capitalization to BCE real property and/or cost accounting records dependent upon project classification

(7) Verify RED HORSE estimated per diem and travel costs accrued within 30 days after completion of all work by RED HORSE and submit final project status report to HQ TAC/DED

(8) Ensure project costs do not exceed statutory limits. If project costs appear to be reaching said limits, BCE will identify portions of work and alternatives to keep costs below limits.

(9) Estimate project funds required to finish the fiscal year and return the remainder to HQ TAC/DEP (or other funding MAJCOM) 60 days prior to the end of fiscal year. Funding MAJCOM will return sufficient funds at the beginning of the new fiscal year to complete the project

b. RED HORSE will

(1) Provide contract management with the RED HORSE Weekly Cost Report (Attachment 7) by close of business each Friday during the construction of the project. When more than one project is being constructed at a base, per diem costs will be prorated equitably among the projects. All funded costs reported are to be actual costs incurred, with the exception of per diem, which is estimated. Send info copy to the appropriate RED HORSE squadron, HQ TAC/DED, and DEPF (no cover letter required)

(2) Maintain a daily inspection diary. AF Form 1477, Construction Inspection Record, will be used for this purpose. Reports of inspections will be made on a daily basis to include weekends and holidays, as appropriate. On days when no work is accomplished, an entry indicating this will be made for the day's report. The following information will be included in the daily inspection diary:

(a) Name/number of project

(b) RED HORSE project OIC/NCOIC

(c) Date

(d) Weather conditions.

(e) Number of men on project, hours they work, and their trade

(f) Work accomplished on the project.

(g) Actual or potential delays on the project, cause, and action taken to correct them

(3) Include reasons for the differential in the remarks section of the RED HORSE Weekly Cost Report and project get-well date if status varies 5 percent from project schedule.

(4) Request separate AF Forms 616, Funds Cite Authorization (FCA), from the benefiting base for TDY and convoy costs prior to deployment

(a) The AF Form 616 for TDY costs can be returned to the issuing office when all orders have been published or upon expiration of AF Form 616 Copies of TDY orders must be forwarded to the accountable AFO (office which issued the authority).

(b) AF Form 616 for convoy costs (fuel, oil, emergency repairs, etc) must be annotated with the costs incurred Credit card purchases (obligating documents) will be returned to the RED HORSE home base AFO upon arrival at the destination or, in the event of round trips, upon return to home base.

1. Convoy expenses are initially charged to the RED HORSE program A refund receivable may be established in the RED HORSE program to offset expenses incurred This action provides for normal use of funds.

2. When expenses are finalized (liquidated or firm), transfer the costs between stations by charging the benefiting base and crediting RED HORSE funds (use the same record that reflects the refund receivable) Charge appropriation reflected on the authority

3. Return AF Form 616 either upon expiration or completion of the project but NLT the expiration date on AF Form 616

(c) If construction is in progress during the change of fiscal years, RED HORSE will return expiring authorities and request new ones as required. RED HORSE will notify the issuing base immediately and request additional funds if it becomes apparent that expenses may exceed the authority

(5) Maintain fiscal responsibility, as best as the estimates reflect, to ensure the project does not exceed the approved project funding

c. The benefiting base.

(1) Vehicle Maintenance Control and Analysis section will forward all Vehicle Transfer Return Listing/Card reports (PCN: N310019 and PCN: N310020) to the RED HORSE vehicle maintenance section for use in updating vehicle maintenance and fuel consumption records.

(2) Will establish separate PFMR account and Emergency Special Project (ESP) suffix to the BCE RC/CC code prior to incurring any expenditures against the project. These codes should be used on all servo-plates, AF Form 1445, etc , charged to the project. Standard shop codes with an organizational code assigned specifically to the project may be used By establishing these codes, expenditures for fuel, supplies, equipment rental, COCESS, COPARS, etc., will be summarized on the D-11 report and on a monthly RC Manager's ESP report Inquiries may also be requested as required

(3) ACF will furnish RED HORSE an obligation authority for convoy expenses, travel, and per diem prior to deployment RED HORSE Squadrons will use their own commercial credit cards while on convoy. RED HORSE will return AF Form 616 to the accountable station and receipts to the unit host station, i e , Hurlburt Field for the 823 CERHS and Nellis AFB for the 820 CERHS

d RED HORSE Proficiency Training Costs The RED HORSE commander may assign more personnel to projects than required to accomplish work in an efficient manner, if considered essential for training purposes These additional personnel will be exempt from costing procedures Their travel and per diem costs will be funded by the RED HORSE Squadron and will not be included as part of the project cost

9. Project Funding:

a A 12-month training project program will be developed by HQ TAC/DED for each RED HORSE Squadron in order to identify funds required for ensuing fiscal year. The required funding will be programmed in PE XXX94 for O&M projects, P-722 for MFH projects, and P-341 for MC projects between $200,000 and $1,000,000. Only funded costs and authorized training costs (paragraph 9c) as shown on the project document (DD Form 1391/1391c) will be used for budget purposes Funded costs are defined in AFR 86-1 and paragraph 9c, below. Total funds required to complete a training project is the aggregate sum of the funded costs and authorized training costs

b. HQ TAC will fund approved TAC projects directly supporting RED HORSE troop training RED HORSE project funds will be used for per diem, travel, contract billets (unless no additional costs are incurred as a result of the TDY), construction material, and vehicle/construction equipment operating and rental costs. HQ TAC operations and maintenance funds will be used for contract work or materials supporting contract or BCE work Major equipment repair costs that occur during the project are also excluded from these funds

(1) Funds to support RED HORSE TDY, transportation of equipment and over-the-road costs, if applicable, will be provided to the unit host station of the supporting RED HORSE squadron by the using base via fund citation or other acceptable documentation TAC policy for funding RED HORSE TDY is stated in TAC Supplement, AFM 172-1, Vol I, paragraph 10-10a(3)

Attachment 1

1 COMPONENT	FY 19$\underline{8X}$ MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
COLONIAL AIR FORCE BASE, VIRGINIA (TAC)	CONSTRUCT ENGINE SHOP STORAGE

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
RED HORSE	211-157	COL 83-00001*	80

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Engine Shop Storage Facility.....	SF	5,000		
Material (90% x $63,000).....				56.7
TDY (75% x $20,133).....				15.1
Equip-Maint, POL, Rental (75% x $10,523/3,4.....				7.9
Total Funded Cost				79.7
Training Material (10% x $63,000).....				6.3
Training TDY (25% x $20,133).....				5.0
Training Equip, etc (25% x $10,523).....				2.6
Total Training Cost.....				13.9
Military Labor.....				60.8
Depreciation of GOE.....				1.5
Planning & Design.....				4.7
Total Unfunded Cost.....				67.0
Total Project Cost (Funded & Training & Unfunded).....				160.6

10 DESCRIPTION OF PROPOSED CONSTRUCTION

Construction of an Engine Shop Storage Facility. Facility will be a pre-engineered metal building with two overhead doors and two personnel doors. The building will have a 6" thick foundation of reinforced concrete. Also provided will be roof and wall insulation with electrical lighting and fire detection system. Electrical service to new facility will be run underground from nearby existing pole. Access driveways will also be constructed. Project is to be designed in-house and accomplished by RED HORSE.

11. REQUIREMENT: 12,400 SF Adequate: 7,040 Substandard: 0

SPECIFIC PURPOSE: To provide engine storage area under the reorganization of the 33rd TFW Maintenance Complex.

PROJECT: Construct an Engine Shop Storage Facility.

REQUIREMENT. An additional storage area is necessary under the reorganization of the 33rd TFW Maintenance Complex to provide sufficient area to organize an establish the required shops and sections for engine intermediate maintanence, build-up, teardown, accessory repair section, JEBM bearing facility, non-powered AGE and small gas section. This project is to be accomplished by RED HORSE to enhance troop training, to maintain mobility posture, and insure proficiency in time of emergencies or contingencies. (To 1391 Author: Use "Troop Training" where applicable.)

BASE APPROVAL

COMMAND APPROVAL **

GEORGE WASHINGTON, General, USAF
Commander

DD FORM 1391

PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED

Attachment 1

1 COMPONENT	FY 1988 MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X

3 INSTALLATION AND LOCATION

COLONIAL AIR FORCE BASE, VIRGINIA (TAC)

4 PROJECT TITLE	5 PROJECT NUMBER
CONSTRUCT ENGINE SHOP STORAGE	COL 88-0001*

CURRENT SITUATION: Under present conditions more than half of the usable space is needed for storage of engines and equipment. Many man-hours are used to move equipment or engines to gain access to the engine or equipment that is required for a particular job. The shop is responsible for storage of 17 engines valued in excess of $5,600,000 and equipment valued at approximately $168,000.

IMPACT IF NOT PROVIDED: Further expensive and inefficient operating conditions due to the present practice of storing engines and equipment in more than half of the usable space available. Manhours and money spent on this undesirable situation could otherwise be used to increase productivity and mission effectiveness.

12. LOCAL LABOR CERTIFICATION: Accomplishment of this project by RED HORSE will have no adverse effect on local Contractor/Labor Relations. This project will provide troop training and job proficiency for RED HORSE personnel. (To 1391 Author: DO NOT FORGET TO INSERT THIS STATEMENT!) (see para 2c)

* As in O&M projects, separate DD Forms 1391/1391c are required for companion minor construction and maintenance/repair. The same project number is used for each set of 1391/1391c's, but an A or B suffic is added to the project number.

** All command funded projects, regardless of cost, require TAC/DE approval

DD FORM 1 DEC 68 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF.

DD FORM 1391c — PREVIOUS EDITION IS OBSOLETE IN THE USAF.

1 COMPONENT	FY 19 8X MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X
3 INSTALLATION AND LOCATION		
COLONIAL AIR FORCE BASE, VIRGINIA (TAC)		
4 PROJECT TITLE	5 PROJECT NUMBER	
CONSTRUCT ENGINE SHOP STORAGE	COL 83-0001	

1. Cost Estimate

1. MATERIALS:

DESCRIPTION	U/M	QUANTITY	UNIT COST	TOTAL
Site Prep (fill)	CY	200	$ 5.00	$ 1,000
Pre-engineering Bldg	EA	1	$33,000	33,000
Reinforced Concrete (footings & 6" slab)	CY	120	70.00	8,400
Electrical service & lights	LS	1	3,500	3,500
Driveway	SY	400	12.50	5,000
Curbs (concrete)	LF	400	4.00	1,600
Dry Pipe Sprinkler System	LS	1	6,500	6,500
Insulation	LS	1	4,000	4,000
Item 1, Total Cost for Materials				$ 63,000

2. TDY Costs

a. Travel to and from Colonial Air Force Base, Virginia		
(24MN x 1 round trip x $334 air fare)	=	$ 8,016
(1 officer x 3 round trips x $334 air fare)	=	1,002
b. Per diem and billeting		
(1) Enroute to and from Colonial AFB		
Convoy (4MN x 2 round trips x 4 days/trip x $35.00/day)	=	1,120
Convoy (4MN x 1 round trip x 4 days/trip x $35.00/day)	=	560
Other (24MN x 2 days x $12.50/day)	=	600
(2) On site at Colonial AFB		
(19MN x 63 days x $6.50/day)	=	7,780
(5MN x 14 days x $6.50/day)	=	455
Officer (1MN x 30 days x $20.00/day)	=	600
Item 2, Total Cost of TDY		$ 20,133

Attachment 1

DD FORM 1391C PREVIOUS EDITION IS OBSOLETE IN THE USAF.

1 COMPONENT	FY 19 8X MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X
3 INSTALLATION AND LOCATION		
COLONIAL AIR FORCE BASE, VIRGINIA (TAC)		
4 PROJECT TITLE	5 PROJECT NUMBER	
CONSTRUCT ENGINE SHOP STORAGE	COL 83-0001	

3. Transportation of government owned (RED HORSE) equip - convoy

a. Rental of tractor trucks:	
($375/wk x 2 wk x 2 tractors) =	$1,500
(.15/mile x 1500 mile/round trip x 2 round trip x 2 tractors) =	900
Total Rental Costs	$2,400
b. Fuel:	
1500 mile/round trip x 5 round trips x 1 gal/6 mile (tractor) = 1,250 gal	
1500 mile/round trip x 1 round trip x 1 gal/5 mile (M-35) = 300 gal	
Total Fuel 1550 gallons x $1.29/gal =	$2,000
c. Maintenance (flat tires, etc) =	200
Item 3, Total Cost of Transportation of GOE	$4,600

4. Operation of government owned equipment (on-site):

a. RED HORSE	Hours	Gal Hr	Total Gal
Backhoe	16	1	16
Forklift	20	1.5	30
Tractor	20	5	100
Trailer	20	-	-
M-35	65	4	260
Jeep	65	2	130*
Van	80	-	-
b. Base			
Grader	32	3	96
Roller	32	6	192
Dumptruck	40	6	240
Loader	40	1	40
1-1/2 Ton	20	4	80*
Crane	20	1	20
Line Truck	12	2	24*
Totals	482 hrs		9947234*

* = Mogas

Attachment 1

1 COMPONENT	FY 19 8X MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X

3 INSTALLATION AND LOCATION

COLONIAL AIR FORCE BASE, VIRGINIA (TAC)

4 PROJECT TITLE	5 PROJECT NUMBER
CONSTRUCT ENGINE SHOP STORAGE	COL 83-0001

Operations (Fuel): Diesel 994 gal x $1.25/gas = $1,242.50
Mogas 234 gal x $1.20/gal = $ 280.80
Item 4, Total Cost for Operations: $1,523.30 — $ 1,523

Minor Maintenance (Vehicle parts/civ labor - lump sum): $ 2,000

Total Funds Required for Project: (total of items 1-4) $93,656

II. Cost Estimate - Unfunded

5. Military Labor: 7240 hrs x $8.40/hr* = $60,816
6. Depreciation of govt owned equipment (on site):

	Hours	Dep Hr***	Total Dep	
a. RED HORSE				
Backhoe	16	$ 2.99	$ 47.84	
Forklift	20	3.79	75.80	
Tractor	20	3.79	75.80	
Trailer	20	1.78	35.60	
M-35	65	2.99	194.35	
Jeep	65	1.10	71.50	
Van	80	1.20	96.00	
b. Base				
Grader	32	5.67	181.44	
Roller	32	1.20	38.40	
Dump Truck	40	2.99	119.60	
Loader	40	2.57	102.80	
1-1/2 Ton	20	1.00	20.00	
Crane	20	15.54	310.80	
Line Truck	12	10.06	120.72	
Totals	482 hrs		$1,490.65	$ 1,491

* Contact RED HORSE Squadron for current shop rate.
** Refer to AFM 170-27, Table 2-2 for depreciation costs.

Attachment 1

1 COMPONENT	FY 19 8X MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X

3 INSTALLATION AND LOCATION

COLONIAL AIR FORCE BASE, VIRGINIA (TAC)

4 PROJECT TITLE	5 PROJECT NUMBER
CONSTRUCT ENGINE SHOP STORAGE	COL 83-0001

III. Cost Estimate - Unfunded (Con't)

7. Planning, design, and construction management (5% of funded cost)	$ 4,683
Unfunded Subtotal, Item 5-7	$ 66,990
Total Estimated Project Cost (Aggregate sum of items 1-7)	$160,646

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF.

Attachment 1

1 COMPONENT	FY 19<u>88</u> MILITARY CONSTRUCTION PROJECT DATA	2 DATE
AF (TAC)		21 Mar 8X

3 INSTALLATION AND LOCATION

COLONIAL AIR FORCE BASE, VIRGINIA (TAC)

4 PROJECT TITLE	5 PROJECT NUMBER
CONSTRUCT ENGINE SHOP STORAGE	COL 83-0001*

Project Evaluation FY 82Xth Civil Engineering RED HORSE Squadron

1. Enhancement of Unit Training: This project will provide desirable means for maintaining and enhancing the operational mission skills for personnel of the 82X CERHS.

2. Availability of Equipment: The following equipment is available from 82X CERHS assets.

3. Estimate of Mandays: Twenty-four men will require 78 calendar days (56 work days) to complete this project.

4. Review of Funded vs Unfunded Costs: Recommend both funded and unfunded costs be revised IAW attached estimates.

5. Evaluation of RED HORSE Design Availability: Recommend design by 82X CERHS (or XXX CES/DE).

6. Recommended Period of Accomplishment:

7. Estimate of Fuel Required: 4626 gal diesel; 900 gal MOGAS.

JOHN J. DOE, Colonel, USAF
Commander

* NOTE: Above entries are typical examples. No set format is required for this information. The only mandatory entries are Item 1 and RH commander's signature. <u>These two items must appear in DD Forms 1391c for any RH project</u>.

DD FORM 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF.

Attachment 2

RED HORSE Training Project Milestones (TAC)

OPR	REQ'D COMPLETION DATE	ACTION
HQ TAC/DED	15 Jan XX	Initiate FYXX Project Call.
Base Civil Engineer	27 Feb XX	Submit front page 1391s and integrated priority of potential RED HORSE training projects. (Two copies to HQ TAC/DED and one copy to supporting RED HORSE Squadron)
RED HORSE	15 Apr XX	Evaluate base submittals for training value and submit the following to HQ TAC/DED: a. List of projects acceptable for further evaluation. b. List of projects that do not have sufficient training value with short explanation of reason. c. Tentative schedule for visiting bases and preparing project evaluations.
HQ TAC/DED	30 Apr XX	Notify bases of projects accepted for further evaluation and projects RED HORSE will not construct.
HQ TAC/DED	15 May XX	Send MAJCOM integrated priority list to RED HORSE Squadrons.
RED HORSE	30 Jun XX	Complete project evaluations. Forward one copy to Base Civil Engineer and one copy to HQ TAC/DED.
RED HORSE	30 Jun XX	Send integrated priority list and FYXX Bar-Chart schedule to HQ TAC/DED (Include project duration.) Note: The MAJCOM priority list should be used where similar projects are contending for construction.
HQ TAC/DED	15 Jul XX	Notify bases of approved projects and tentative construction start dates. NOTE: Upon receipt of approved project, BCE should begin design.
Base Civil Engineer	15 Aug XX	Forward base approved 1391/1391c to HQ TAC/DED
HQ TAC/DED	30 Sep XX	Obtain headquarters approval for RED HORSE troop training projects.

Attachment 6

RED HORSE Project Status Report

FROM: BCE

TO: HQ TAC/DED

INFO: Numbered Air Force/CS
RED HORSE Squadron

SUBJECT: RED HORSE Project Status Report

1. Project Data:

   a. Air Force Base:

   b. Project Number and Title:

   c. Report as of Date:

   d. Approved Funded Cost:

   e. Approved Training Cost:

   f. Approved Unfunded Cost:

*2. Design/Materials Status:

   a. Percent Design Complete:

   b. Scheduled/Actual Design Completion Date:

   c. Date Materials Ordered:

   d. # Line Items Ordered: _____. # Line Items Received: _____.

   e. Estimated Date all Materials On-Hand:

   f. Estimated Start Date of Project:

3. Project Status:

   a. Start Date of Project:

   b. Original Completion Date:

   c. Current Completion Date:

   d. Construction Percentages: _____ percent scheduled

      _____ percent actual

4. Funded/Training Cost Details (see para 9c for breakout of funds):

	TOTAL (Funded + Training)	FUNDED	TRAINING
a. Material Costs Expended:			
b. Equip O&M Costs Expended:			

* Include this section during the design phase only except for d & e which are to be reported until 100% of materials are on hand.

Attachment 6

c. Estimated Per Diem Expended:

d. BCE Civilian Labor Expended:

e. Estimated Travel Expended:

f. Other Funded Costs Expended (Equipment Rental, Contract Support, Contract Billeting, etc):

Total Expended: _____ ____ _____

5. Unfunded Cost Details:

a. RED HORSE Labor Costs Expended:

b. BCE Military Labor Costs Expended:

c. Equipment Depreciation Costs Expended:

d. Other Unfunded Costs Expended (free material, self-help labor from using organization, etc):

6. Cost Summary:

	Approved	Expended	CWE
a. Funded	_____	_____	_____
b. Training	_____	_____	_____
c. Unfunded	_____	_____	_____
d. Total	_____	_____	_____

7. Remarks:

8. Prepared by: _____, AV _____-_____. (Name and phone number of BCE point of contact.)

....Transmit this report by message or official electronic mail.....

Attachment 7

RED HORSE Weekly Cost Report

FROM: RED HORSE Project Manager _____
(Date)

SUBJECT: RED HORSE Weekly Cost Report, for the week ending _____.

TO: DEEC

1. Project Data.

   b. Project Number and Title: _____.

   c. Report as of date: _____.

2. Project Status.

   a. Original Completion Date: _____.

   b. Current Completion Date: _____.

   c. Construction Percentages:

      _____ percent scheduled.

      _____ percent actual.

3. Funded Cost Details:	Report Period	Cumulative
a. Estimated Per Diem expended (75%):	_____	_____
b. Estimated Travel expended (75%):	_____	_____
c. Equipment O&M costs expended (75%):	_____	_____
d. Rental Equipment cost expended (75%):	_____	_____
e. Material Cost Expended (90%):	_____	_____
TOTAL	_____	_____

4. Training Cost Details:		
a. Training per diem expended (25%):	_____	_____
b. Training travel expended (25%):	_____	_____
c. Training Equipment O&M costs expended (25%):	_____	_____
d. Training rental costs expended (25%):	_____	_____
e. Training material cost expended (10%):	_____	_____
TOTAL	_____	_____

NOTE: Paragraph numbers and letters correspond to those on the RED HORSE Project Status Report.

Attachment 7

5. Unfunded Cost Details:

a. RED HORSE labor costs expended: _____ _____

b. Equipment depreciation costs expended (from AFM 170-27): _____ _____

TOTAL _____ _____

c. Other Unfunded costs expended:

_____for _____.

_____for _____.

6. Cost Summary:

a. Funded: _____.

b. Unfunded: _____.

c. Total: _____.

7. Remarks:

8. Prepared by: _____.

AV ____- _____. (Name and phone number of RED HORSE point of contact.)

cc: RED HORSE Squadron
HQ TAC/DED/DEPF,
Langley AFB, VA

Attachment 8 10 February 1989

SUMMARY OF REQUIRED REPORTS

REPORTS REQUIRED	PREPARED BY	PREPARED FOR	FREQUENCY	FORMAT
Deployment Report	RED HORSE	TAC/DED	AS REQUIRED	Message (Atch 4)
RED HORSE Weekly Cost Report	RED HORSE	BCE: INFO: RED HORSE TAC/ DED/DEPF (No cover ltr required)	WEEKLY As of COB Fridays	Letter (Atch 7)
RED HORSE Project Status Report	BCE	TAC/DED INFO: Numbered AF/CS RED HORSE Sqdn	4th Friday beginning w/ design directives; 4th Friday beginning w/deployment.	Message (Atch 6)
RED HORSE	RED HORSE	TAC/DED	QUARTERLY	General Purpose Form (Atch 5)

APPENDIX C

COMPANIES CONTACTED FOR RESEARCH

ENTERPRISE BUILDING CORPORATION
P.O. Box 42600
St. Petersburg, Florida 33742
(813) 576-2885

FEDERAL CONSTRUCTION COMPANY
1355 Snell Isle Blvd N.E.
P.O. Box 1257
St. Petersburg, Florida 33731
(813) 821-8000

GULF CONSTRUCTION COMPANY
P.O. Drawer 4256
Sarasota, Florida 33578
(813) 366-2552

THE LANE-FAJANS GROUP
P.O. Box 127
Jacksonville, Florida
(904) 781-6921

OPUS SOUTH CORPORATION
4350 West Cypress Street, Suite 700
P.O. Box 21327
Tampa Florida 33622
(813) 873-3600

APPENDIX D

CHART OF JOB COST CODES

The following pages contain a suggested chart of cost codes. It is intended as a beginning point for the RED HORSE squadrons to establish their own chart of cost codes.

PROJECT NO.: _____

PROJECT TITLE: _____

PROJECT MANAGER: _____

82X CERHS
CHART OF JOB COST CODES
ESTIMATE SUMMARY

DATE: _____

SUPERINTENDENT: _____

COST CODE	DESCRIPTION			FUNDED COSTS MAT'LS	FUNDED COSTS EQUIP.	FUNDED COSTS OTHER	UNFUNDED COSTS MILITARY LABOR MANDAYS	UNFUNDED COSTS MILITARY LABOR COST	UNFUNDED COSTS EQUIP. DEPREC.
	*** COST SUMMARY ***								
000	GENERAL CONDITIONS								
100	SITEWORK								
200	UTILITY SYSTEMS								
300	CONCRETE								
400	MASONRY								
500	METALS								
600	CARPENTRY								
700	SPECIALTIES								
800	PLUMBING & HVAC								
900	ELECTRIC								
	COLUMN TOTALS								
	PER DIEM AND TRAVEL	*							
	TOTAL FUNDED/UNFUNDED					*			*

* - Fill in this category only

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 2

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
000	GENERAL CONDITIONS								
001	Superintendent		wk					*	
003	Indirect Labor (Supply, Admin. etc.)		wk					*	
005	Mobilization		job						
007	Demobilization		job						
010	Job Trailer (Rental)		wk			*			
012	Site Storage (Rental)		wk			*			
013	Temp. Water		wk			*			
014	Temp. Electricity		wk			*			
015	Temp. Telephone		wk			*			
016	Temp. Toilets		wk			*			
017	Temp. Fence (Rental)		wk			*			
018	Refuse Removal (Rental)		wk			*			
025	Military General Purpose Vehicles		wk						
030	Unassigned Equipment		job						
032	Small Tools (Purchased)		job	*					
035	Safety Equipment		job						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 3

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
040	Cleanup		job						
045	Punchlist	100	pct						
050	Misc. Supplies		job						
060	Vehicle Maintenance		job						
065	Miscellaneous Hauling		job						
067	Transportation of Government Equipment		job						
070	Engineering Testing		job						
075	Environmental Protection		job						
080	COCESS NPI Charge		job						
098	Per Diem		job			*			
099	Travel		rt			*			

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 4

CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
100	SITEWORK								
101	Demolition	100	pct						
103	Clear and Grub		ac						
104	Grass Mowing		ac						
110	Property Surveying	100	pct						
111	Grade Layout	100	pct						
112	Roadway Layout	100	pct						
113	Building Layout	100	pct						
115	Cut and Fill		cy						
117	Demuck		cy						
119	Install Fill (Borrowed or Purchased)		cy						
121	Haul Excess Cut		cy						
123	Install Pavement Base		sy						
130	Base Course (Bituminous)		sy						
131	Wearing Surface (Bitum.)		sy						
132	Patching (Bituminous)		sy						
134	Tack Coat		sy						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 5

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
135	Seal Coat		sy						
140	Landscaping (Misc.)	100	pct						
142	Backfill Curbs		lf						
144	Topsoil		sy						
146	Seed and Sod		sy						
147	Planting Beds		sf						
148	Trees and Shrubbery	100	pct						
150	Pavement Painting	100	pct						
152	Signage	100	pct						
154	Appurtenances	100	pct						
160	Dewatering		job						
162	Seawalls		lf						
164	Docks		sf						
170	Foundation Piles		ea						
180	Chain Link Fence		sf						
183	Wood Fence		sf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 6

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
200	UTILITY SYSTEMS								
201	Sanitary Sewer (6"-12" RCP)		lf						
202	Sanitary Sewer (13"-18" RCP)		lf						
204	Sanitary Sewer (4"-8" CI)		lf						
205	Sanitary Sewer (9"-12" CI)		lf						
207	Sanitary Sewer (4"-8" PVC)		lf						
208	Sanitary Sewer (9"-12"PVC)		lf						
210	Sanitary Manholes		ea						
212	Lift Station		ea						
214	Septic Tanks		ea						
215	Drain Field		lf						
217	Grease Interceptors		ea						
219	Sewege Ejectors		ea						
220	Water Service (1"-4" Copper)		lf						
221	Water Service (1"-4" Plastic)		lf						
223	Watermain (4"-8" PVC)		lf						
224	Watermain (8"-12" PVC)		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 7

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
225	Watermain (13"-18" PVC)		lf						
228	Hydrant and Valve		ea						
229	Misc. Fittings and Valves		ea						
240	Storm Sewer (6"-15" CMP)		lf						
241	Storm Sewer (16"-24" CMP)		lf						
242	Storm Sewer (25"-42" CMP)		lf						
244	Storm Sewer (12"-18" RCP)		lf						
245	Storm Sewer (19"-24" RCP)		lf						
246	Storm Sewer (25"-42" RCP)		lf						
248	Storm Manholes		ea						
249	Inlets and Catch Basins		ea						
250	Misc. Drainage Structures		ea						
260	Power Poles, Wood		ea						
261	Power Poles, Concrete		ea						
263	Overhead Conductor		lf						
265	Overhead Fittings & Gear		ea						
267	Burried Conduit (3/4"-2" Plastic)		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 8

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
268	Burried Conduit (4" Plastic)		lf						
269	Conduit, Rigid Steel		lf						
270	Conductor, Direct Bur.		lf						
271	Conductor		lf						
272	Conductor		lf						
273	Conductor		lf						
274	Conductor		lf						
275	Transformer		ea						
276	Transformer		ea						
277	Transformer		ea						
278	Transformer		ea						
280	Telephone Distrib.		lf						
282	Cable TV Distrib.		lf						
284	Vaults and Manholes, Electric		ea						
286	Exterior Lights and Poles		ea						
288	Communications Systems		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 9

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
300	CONCRETE								
301	Wall Footings		lf						
305	Column Footings		ea						
309	Misc. Footings		ea						
310	Slab On Grade 4"		sf						
311	Slab On Grade 5"		sf						
312	Slab On Grade 6"		sf						
320	Walls, CIP		sf						
323	Columns, CIP		lf						
326	Beams, CIP		lf						
329	Retaining Walls, CIP		sf						
332	Structural Slabs, CIP		sf						
340	Curb and Gutter		lf						
344	Pavement		sf						
347	Aprons and Pads		sf						
348	Walks and Patios		sf						
350	Trench Drains		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 10

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
353	Stairs		trd						
356	Special Foundations		ea						
358	Utility Encasements		lf						
360	Precast Beams & Cols.		ea						
364	Precast Slabs		sf						
366	Concrete Topping Slabs		sf						
370	Tilt-Up Slabs		sf						
375	Special Finishes		sf						
380	Masonry Core Fill		lf						
382	Masonry Bond/Tie Beams and Lintels		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 11

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
							MILITARY LABOR		EQUIP.
				MAT'LS	EQUIP.	OTHER	MANDAYS	COST	DEPREC.
400	MASONRY								
401	Brick Veneer		sf						
405	Brick Walls		sf						
409	Brick Paving		sf						
410	Walls, 12" CMU, Plain		sf						
415	Walls, 8" CMU, Plain		sf						
420	Walls, 4" CMU. Plain		sf						
430	Stone		sf						
440	Glass Block		sf						
450	Bituminous Damproofing		sf						
451	Silicone Damproofing		sf						
454	Block Sealing		sf						
457	Stain		sf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 12

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
500	METALS								
501	Columns, Structural		ton						
508	Girders and Beams, Str.		ton						
510	Purlins and Girts		ton						
512	Fireproofing		sf ca						
515	Pre-engineered Metal Building Contract		sf	*					
520	Open Web Joists		ton						
524	Floor & Roof Deck		sf						
527	Metal Siding		sf						
530	Standing Seam Roofing		sf						
533	Batten Seam Roofing		sf						
540	Fascia		sf						
544	Soffit		sf						
548	Gutter and Downspout		lf						
550	Metal Stairs		trd						
553	Metal Railings		job						
560	Trench Frame & Grate		sf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 13

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
570	Lightguage Joists		lf						
580	Slab Nosing		lf						
582	Bollards		ea						
590	Misc. Metals		job						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 14

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
600	CARPENTRY								
601	Wood Partition Framing		bf						
603	Modular Framing Units		sf						
604	Wood Floor/Ceiling Joists		bf						
605	Wood Stairs		trd						
607	Wood Rafters		bf						
608	Wood Trusses		lf						
612	Wood Lintels		lf						
614	Wood Furring		bf						
617	Plywood Subfloor		sf						
619	Plywood Roof Deck		sf						
621	Wood Siding		sf						
623	Soffit & Fascia		sf						
630	Hollow Metal Frames		ea						
633	Prehung Doors Solid Core Wood		ea						
635	Prehung Doors Hollow Core Wood		ea						
636	Bifold Doors		ea						

PROJECT NO.: _____ PROJECT TITLE: _____

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
637	Metal Doors		ea						
640	Overhead Garage Doors		ea						
642	Overhead Rolling Doors		ea						
649	Finish Door Hardware	100	pct						
650	Wood Windows		ea						
652	Metal Windows		ea						
653	Vinyl-Clad Windows		ea						
655	Storefront and Door		sf						
656	Sliding Glass Doors		ea						
657	Window/Curtain Walls		sf						
659	Skylight and Hatch		sf						
660	Batt Insulation		sf						
662	Loose Fill Insulation		sf						
664	Rigid Insulation		sf						
666	Vapor Barrier		sf						
668	Blown Insulation		sf						
670	Shingle Roofing		sq						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 16

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR		EQUIP. DEPREC.
							MANDAYS	COST	
672	Single Ply Membrane Roofing		sq						
674	Built Up Membrane Roofing		sq						

PROJECT NO.: _____ PROJECT TITLE: _____

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
700	SPECIALTIES								
701	Concrete Floor Painting		sf						
703	Wood Flooring		sf						
705	Vinyl Tile flooring		sf						
707	Ceramic Tile Flooring		sf						
709	Carpet		sy						
710	Vinyl Cove Base		lf						
711	Wood Cove Base		lf						
713	Gypsum Wallboard		sf						
715	Plaster or Stucco		sf						
716	Paneling		sf						
718	Wall Covering		sf						
719	Painting		sf						
721	Suspended Ceiling Grid		sf						
722	Suspended Ceiling Tiles		sf						
724	Other Accoustical Ceilings		sf						
730	Toilet/Shower Partitions		ea						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 18

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
733	Projection Screens		ea						
735	Folding Partitions		ea						
736	Wood Shelves		sf						
738	Mirrors		sf						
740	Fold-Down Shelves		ea						
742	Bathroom Accessories		job						
746	Misc. Accessories		job						
750	Kitchen Cabinets		job						
753	Vanity Cabinets		ea						
758	Misc. Built-Ins		ea						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 19

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
800	PLUMBING AND HVAC								
801	Water Supply Piping, Copper		lf						
804	Water Supply Piping, Plastic		lf						
807	Water Supply Valves		ea						
809	Underslab DWV Piping, Plastic		lf						
811	DWV Piping, Plastic		lf						
813	Floor Drains		ea						
815	Roof Drains		ea						
817	Foundation Drains		lf						
820	Water Heater, Electric		ea						
823	Water Fountains		ea						
825	Emergency Shower/Eyewash		ea						
826	Commodes		ea						
828	Wash Basins		ea						
830	Bath Tubs		ea						
832	Shower Fixtures		ea						
834	Industrial Sinks		ea						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 20

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
835	Kitchen Sinks		ea						
837	Urinals		ea						
840	Wet Pipe Sprinkler		sf						
842	Dry Pipe Sprinkler		sf						
845	Pumps		ea						
850	Boilers		ea						
854	Baseboard Electric Heat		lf						
856	Electric Unit Heaters		ea						
860	Window A/C Units		ea						
864	Package Heatpump Units		ea						
866	Split System Heatpump, 1-2 ton		ea						
870	Supply Ductwork		lf						
875	Return Ductwork		lf						
880	Fans		ea						
882	Ventilators		ea						
886	Compressed Air Tubing		lf						
890	Air Compressor		ea						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 21

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
900	ELECTRICAL								
901	Service Entrance		ea						
904	Conduit, Rigid Steel		lf						
907	Conduit, EMT		lf						
910	Conduit, Plastic		lf						
914	Junction Boxes		ea						
916	Outlet and Switch Boxes		ea						
918	Fixture Boxes		ea						
920	Circut Panel, 50-100 Amp		ea						
921	Circut Panel, 150-200 Am		ea						
924	Circut Breakers		ea						
927	Safety Switches		ea						
929	Cable Tray		lf						
930	Conductor		lf						
931	Conductor		lf						
932	Conductor		lf						
933	Conductor, Rolmex		lf						

PROJECT NO.: _____ PROJECT TITLE: _____ PAGE 22

COST CODE	DESCRIPTION	EST. QUANT.	U/M	FUNDED COSTS			UNFUNDED COSTS		
				MAT'LS	EQUIP.	OTHER	MILITARY LABOR MANDAYS	MILITARY LABOR COST	EQUIP. DEPREC.
934	Conductor, Telephone		lf						
935	Conductor, Alarm		lf						
936	Conductor, Computer		lf						
940	Flour. Light Fixture Surface		ea						
942	Flour. Light Fixture Recessed		ea						
944	Flour. Light Fixture Pendant		ea						
946	Incandes. Light Fixture		ea						
947	Incandes. Light Fixture		ea						
950	HID Fixture		ea						
951	HID Fixture		ea						
960	Emergency Light Fixture		ea						
962	Exit Light Fixture		ea						
965	Heat Detector		ea						
968	Smoke Detector		ea						
970	Alarm Panel and Transmitter		ea						
972	Motion Detector		ea						
974	Alarm Bell		ea						

APPENDIX E

INSTRUCTIONS FOR COMPLETING THE JOB COST COLLECTION SHEET

The Job Cost Collection sheet is the primary tool for assembling the detailed estimate required by the RED HORSE Project Control System. It serves as an estimate summary sheet for each cost code, as an estimating checklist, and as a task preplan during the construction phase of the project. This appendix consists of an example Job Cost Collection Sheet and the procedure for completing it. The data contained on the example sheet are purely for demonstration purposes, so the values are entirely hypothetical.

JOB COST COLLECTION SHEET

Cost Code No.	Description	Project No.	Date
310	Slab on Grade, 4"	HBT-8901T	29 Oct. 89

PRODUCTIVITY CALCULATIONS

Base Quantity: 1200 sf
and Unit of Measure
Set forms: 5 hrs, fine grade: 6 hrs, place wire & vapor barrier: 3 hrs, place & finsh conc: 6 hrs.

Crew Hrs.: 24

Work Days: 3

MILITARY LABOR

Position	No.	Shop	Calculations						
			Total # Pers.		Work Days				Man-Days
Foreman	1	Carp.	6	X	3	(+1)		=	19
Formers	2	Carp.	# Pers.	X	Crew Hrs		Rate		Cost
Helpers	2	Labor	(RH) 6	X	24	X	$12.30	=	$1772
Finisher (1 day)	1	Carp.	(BCE) 0	X		X		=	0
Backhoe Operator	(1)	Equip.					Total		$ 1772
	6								

EQUIPMENT OPERATION, RENTAL, & DEPRECIATION

Type	No.	Gal. D/M	Op. Cost	Ren.Rate	Ren.Cost	Dep.Rate	Dep.Cost
RH Backhoe (fine grade 1 day)	1	9 D	$9.00			$6.95/ day	$6.95
Conc. finisher	1	6 M	$7.00			0	0
Totals		9D 6M	$ 20	********	$ 0	********	$ 7

OTHER FUNDED COSTS (MISC. CONTRACTS, CIV. LABOR)

Description	Cost
Total	$ 0

COST SUMMARY

MATERIALS (FROM REVERSE)	$ 1403	MILITARY LABOR	$ 1772
EQUIPMENT OP. & RENTAL	$ 20	EQUIPMENT DEPRECIATION	$ 7
OTHER FUNDED COSTS	$ 0		

Figure E-1 Sample Job Cost Collection Sheet

PERMANENT MATERIALS

Source Number	Description	U/M	Quant.	Unit Cost	Extension
BPA F89002736	Concrete, 3000 psi	cy	13	49.00	637
MRL 38483-82	WWF, 10X10, #6	rl	7	32.35	227
MRL 94758-25	(Vapor Barrier) Plastic, Visqueen, 6 mil	rl	5	22.30	112
MRL 47483-35	Rebar, #4, 21'Lg	ea	11	15.79	174
NPI	Chairs, rebar, 3", Box of 10	ea	5	12.87	65
MRL 38383-87	Anchor Bolts, 1/2"X10"	ea	69	.95	66
				SUBTOTAL	$ 1215

OTHER MATERIALS & SUPPLIES

MRL 383763-35	Lumber, 2X4X10'	ea	22	1.12	25
NPI	Nails, Scaffolding, 16d	lb	5	2.48	13
NSN 737-737373-2	Form Oil	qt	3	1.79	6
MRL 94758-25	(Curing cover) Plastic, Visqueen, 6 mil	rl	5	22.30	112
MRL 48545-39	Rebar Tie Wire, 50' roll	rl	2	7.95	16
	NPI Charge (line item)	ea	2	8.00	16
				SUBTOTAL	$ 188

INSTALLED EQUIPMENT

				SUBTOTAL	0
				MATERIALS TOTAL	$ 1403

Figure E-1 continued

Procedures

1. The first data entered are project and cost code information. The cost code number and description must be the same as that listed on the Chart of Job Cost Codes. Specific information such as geographic location or some other project-specific designator can be included in the description.

2. The next step is to identify the unit of measure from the Chart of Job Cost Codes and survey the design drawings to determine the total quantity. A backup sheet should be used if necessary. In this example, the item is a 60'x20', 4" thick concrete slab on grade, which is 1200 square feet. The total number of units is entered next to "Base Quantity and Unit of Measure" in the "PRODUCTIVITY CALCULATIONS" section.

3. After the base quantity has been determined, the project manager and superintendent determine what manpower and equipment are required to execute the work on this cost code. The workers are first identified by crew position such as "Foreman" or "Helper" and listed under the "Position" column of the "MILITARY LABOR" section. The number of workers required for each position is listed under the "No." column. The RED HORSE duty section that is likely to provide the crewmember is listed under the "Shop" column. As an alternative, the project manager or superintendent could write the desired Air Force Specialty Code (AFSC) such

as 55250 in the "Shop" column. This will assist the project manager in requesting labor support from his squadron and from the host Base Civil Engineer if necessary. When a crew position does not require a specific craftsman, such as "helper," it is listed as "Labor" in the "Shop" column. These positions can be filled by skilled workers on the jobsite who are not currently being employed in their primary craft area.

The type and number of motorized equipment items required are listed in the appropriate columns of the "Equipment . . ." section. If an equipment item is to be used for brief periods of time on several cost codes, then the costs should be attributed to cost code 030, Unassigned Equipment. This will simplify the accounting for equipment when the distributed costs to each cost code are very small. In this example, the backhoe and power finisher costs should be included under cost code 030, but they have been shown here under cost code 310 for demonstration purposes. If a piece of equipment is required but will be accounted for under cost code 030, it still should be listed without costs to help the foreman assemble his resources prior to commencing work on the cost code.

4. With the tentative crew makeup and equipment package established for the cost code, the person preparing the Job Cost Collection Sheet should return to the "PRODUCTIVITY CALCULATIONS" section. The preparer

calculates the number of hours the crew will require to complete the work for the cost code based on the total number of units. The "Crew Hours" amount should be rounded up to be roughly divisible by eight since most tasks usually consume an entire day. The "Work Days" value is simply the crew hours divided by eight. "Work Days" can now be used in the CPM scheduling network. If the Job Cost Collection Sheet is being prepared for a subdivided cost code, the same productivity procedures apply, except the crew hours and work days apply only to the subdivided cost code task. The crew and equipment list composition can be adjusted during the procedure to reach the optimum production rate.

5. The cost of military labor and the number of man-days should now be estimated. The man-days value will be used to develop the control schedule by assigning a relative constructive effort percentage to each cost code except those in the General Conditions division. Man-days are estimated under "Calculations" of the "MILITARY LABOR" section. The total number of persons in the crew multiplied by the number of workdays yields the "Man-Days" value. In this example (Figure E-1), the crew of 6 is estimated to work for 3 days resulting in 18 man-days. Additionally, one backhoe operator will assist for one day bringing the total to 19. It is not necessary to estimate man-days for General Conditions Cost Codes.

The estimated unfunded cost of RED HORSE military labor is calculated by multiplying the number of RED HORSE personnel by the estimated crew hours and the current shop labor rate. If any of the crew members are to be "borrowed" military personnel from the host Base Civil Engineer (BCE), their labor cost is calculated in the same manner. If civilian personnel are to be "borrowed" from the Base Civil Engineer, their funded labor cost is estimated in the "OTHER FUNDED COSTS . . ." section. In this example, no military or civilian labor is expected to be provided by the BCE.

6. The preparer should next calculate the estimated costs for equipment operation, rental, and depreciation attributable to this cost code. As mentioned before, insignificant equipment costs for an item that is used on several cost codes should be included in cost code 030, Unassigned Equipment. When the cost is not insignificant or the equipment item is used soley for a particular cost code, its associated fuel, rental, and depreciation costs are estimated on the applicable Job Cost Collection Sheet.

The estimated operation cost for each item is found by first multiplying the crew hours (or the appropriate fraction of crew hours) by the fuel consumption per hour of the item to yield the number of gallons of fuel required. "D" stands for diesel fuel and "M" stands for MOGAS or gasoline. The cost itself is calculated by multiplying the required gallons of fuel by the current stock fund fuel

price. Estimated costs for lubricants, oil, and grease should be included in cost code 060, Vehicle Maintenance. Estimated costs for the transportation of military equipment to and from the site should be included in cost code 067, Transportation of Government Equipment.

If an equipment item is to be rented for the project, the estimated rental cost attributable to the cost code is determined by multiplying the estimated rental rate by the number of days the item is to be employed on the cost code. Estimated rental costs for time of an item that sits idle between activities, as well as pickup and delivery charges, should be estimated in the Unassigned Equipment cost code.

The estimated depreciation cost for government owned equipment is calculated by multiplying the estimated equipment hours or days by the appropriate depreciation rate. Generally, only military vehicles require the calculation of depreciation costs. Depreciation costs are always unfunded.

When the costs in each category have been tabulated for each equipment item, the "EQUIPMENT . . ." section is finalized by calculating the estimated total gallons of fuel required, the estimated total operation cost, rental cost, and depreciation cost. The estimated total gallons of fuel for the project is important because the project manager may have to notify the host base fuel depot of the upcomming requirement, especially if the requirement is quite large.

7. The preparer should use the "OTHER FUNDED COSTS . . ." section to estimate the cost of any civilian labor-only subcontracts, labor and materials subcontracted work, borrowed Base Civil Engineer civilian labor, or other funded costs directly supporting the cost code but not applicable in other sections. Estimated costs for materials-only contracts such as pre-engineered metal building packages, are included in the "MATERIALS" section found on the reverse side. The middle column headings of this section have been intentionally left blank so the preparer can use them as required. In this example, no "OTHER . . ." costs are expected.

8. The final cost category to be estimated is materials. As shown on the reverse side of the Job Cost Collection sheet, "MATERIALS" consists of permanently installed items, consumable materials and supplies, and installed equipment such as pumps or generators. Based on the design drawings and specifications, the preparer assembles the cost code bill of materials by entering the item description, unit of measure, and quantity. The associated unit costs are taken from current Civilian Operated Civil Engineer Supply Store (COCESS) listings, current bulk materials delivery contracts, federal stock and GSA listings, and prevailing civilian prices. The "Source Number" column, which refers to the procurement identifier and the above mentioned materials sources, should be

included if known. The total estimated cost of materials for the cost code is summarized at the bottom of the back page.

9. The last action in preparing the Job Cost Collection Sheet is the summarization of the costs by category at the bottom of the front side under "COST SUMMARY." Since equipment operation costs and rental costs are funded, they are added together in the cost summary. Depreciation costs for government equipment are unfunded and stand alone in the cost summary. When the project manager and superintendent agree that the Job Cost Collection Sheet is accurate and complete, the data can be transferred to the Chart of Job Cost Codes.

APPENDIX F

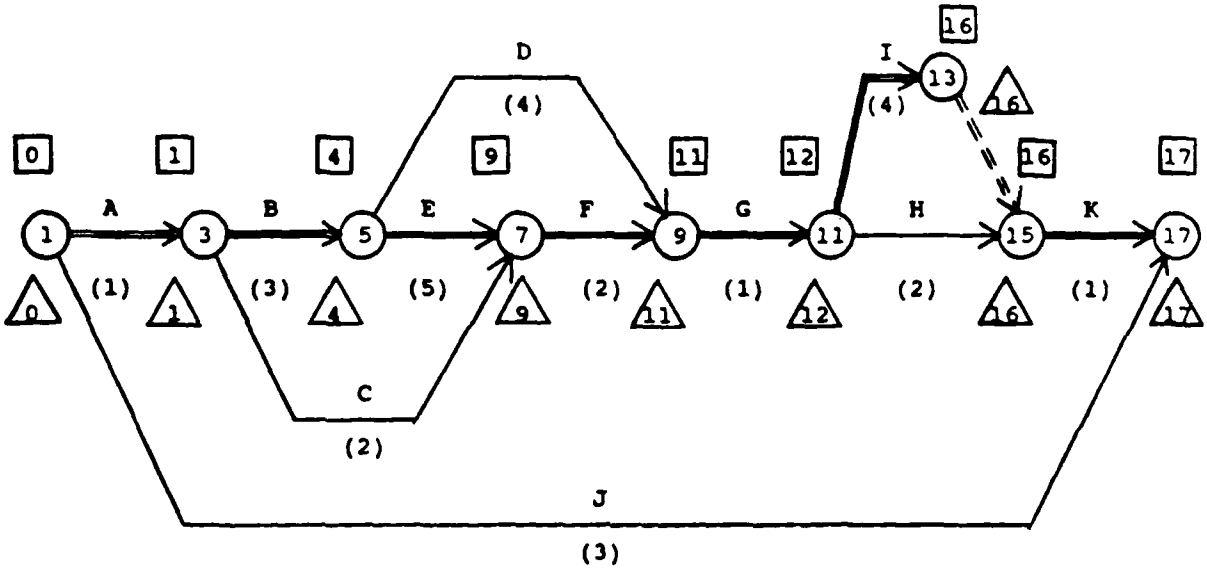
SCHEDULE AND PER DIEM ESTIMATE EXAMPLE

SCHEDULE AND PER DIEM ESTIMATE EXAMPLE

GIVEN: the hypothetical project CPM network below, the list of manpower required, and the tabulation sheet on the following page.

GIND: A. the CONTROL SCHEDULE.

B. the per diem and travel estimated costs.



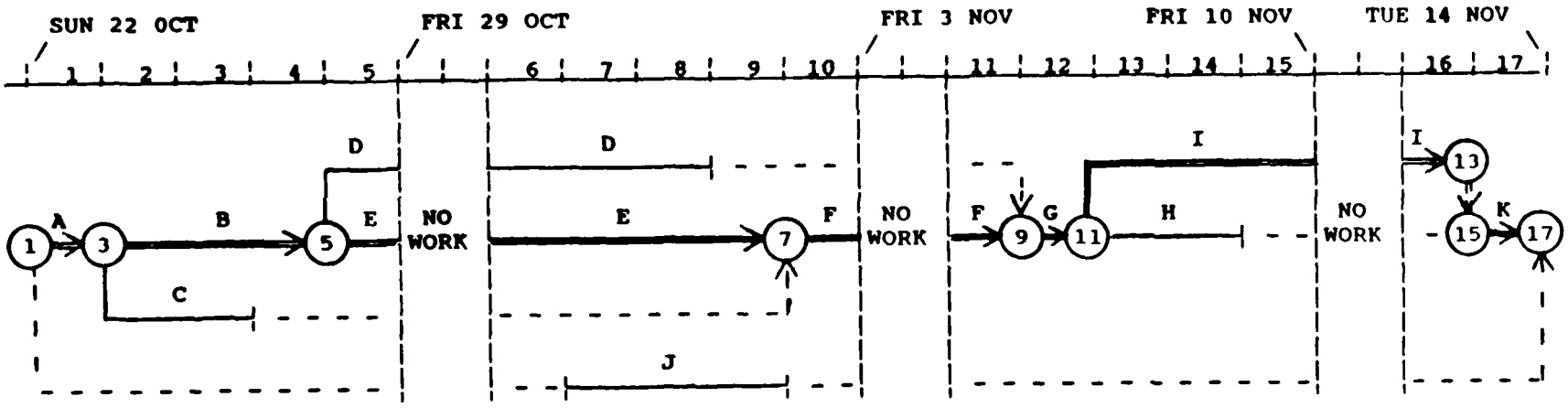
MANPOWER REQUIRED (ALL FROM RED HORSE)

TRADE		ACTIVITIES A	B	C	D	E	F	G	H	I	J	K
CARPENTER	(CA)		3	2		4						
EQUIP. OP.	(EQ)			4								
SHEET METAL	(SM)				3			3				
REFRIG. TECH.	(RF)						2					
ELECTRICIAN	(EL)								2	2		
PLUMBER	(PB)										2	
LABORER	(LA)	10	2			4			2			5
SUPERINTENDENT				(ENTIRE PROJECT)								

NETWORK TABULATION SHEET

ACTIVITY	DUR	ES	EF	LS	LF	TF	MAN DAYS	% OF PROJ
1-3 A	1	0	1	0	1	0	10	7.7
1-17 J	3	0	3	14	17	14	12	9.2
3-5 B	3	1	4	1	4	0	15	11.5
3-7 C	2	1	3	7	9	6	12	9.2
5-7 E	5	4	9	4	9	0	40	30.8
5-9 D	4	4	8	7	11	3	12	9.2
7-9 F	2	9	11	9	11	0	4	3.1
9-11 G	1	11	12	11	12	0	3	2.3
11-13 I	4	12	16	12	16	0	8	6.2
11-15 H	2	12	14	14	16	2	8	6.2
13-15	0	16	16	16	16	0	0	0
15-17 K	1	16	17	16	17	0	6	4.6
					TOTALS		130	100%

TIME-SCALED NETWORK



MANPOWER REQUIREMENTS BY WORKDAY (UNBALANCED)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SUP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CA		5	5	3	4	4	4	4	4								
EQ		4	4				2	2	2								
SM					3	3	3	3				3					
RF										2	2						
EL													4	4	2	2	
PB							2	2	2								
LA	10	2	2	2	4	4	4	4	4				2	2			5
T	11	12	12	6	12	12	16	16	13	3	3	4	7	7	3	3	6

MANPOWER REQUIREMENTS BY WORKDAY (BALANCED)

	1	2	3	4	5		6	7	8	9	10		11	12	13	14	15		16	17
SUP	1	1	1	1	1	(1 1)	1	1	1	1	1	(1 1)	1	1	1	1	1	(1 1)	1	1
CA	(5)	5	5	(5)	(5)	(4 4)	4	4	4	4	(2)	(2 2)	(2)	(2)	(2)	(2)	(2)	(2 2)	(2)	(2)
EQ	(4)	4	4	(4)	(4)	(4 4)	(4)	(4)	(4)	(4)	(1)	(1 1)	(1)	(1)	(1)	(1)	(1)	(1 1)	(1)	(1)
SM	(1)	(1)	(1)	(1)	3	(3 3)	3	3	3	(3)	(3)	(3 3)	(3)	3						
RF								(2)	(2)	(2)	2	(2 2)	2							
EL														(4)	4	4	2	(2 2)	2	(2)
PB	(1)	(1)	(1)	(1)	(1)	(1 1)	(1)	2	2	2										
LA	10	2	2	2	4		4	4	4	4					2	2				5
T	12	12	12	12	14	13 13	13	16	16	16	9	9 9	9	11	8	8	6	6 6	6	6

PROJECT NO.: _____ DATE: _____

PROJECT TITLE:

P/M: _____ P/S: _____

CONTROL SCHEDULE

AS OF DATE	ACTIVITY	PERIOD %	TOTAL %
27 OCT	A	7.7	
	B	11.5	
	1/5E	6.2	
	C	9.2	
	1/4D	2.3	
		36.9	36.9
3 NOV	3/4D	6.9	
	4/5E	24.6	
	1/2F	1.5	
	J	9.2	
		42.2	79.1
10 NOV	1/2F	1.6	
	G	2.3	
	3/4I	4.6	
	H	6.2	
		14.7	93.8
14 NOV	1/4I	1.6	
	K	4.6	
		6.2	100.0

PER DIEM AND TRAVEL ESTIMATE

ENLISTED PER DIEM RATE = $20.00/DAY (ASSUMED)

OFFICER PER DIEM RATE = $30.00/DAY (ASSUMED)

CONVOY PER DIEM RATE = $50.00/DAY (ASSUMED)

ROUND TRIP AIRFAIR = $250.00/TRIP (ASSUMED)

PER DIEM

	# DAYS	RATE $/DAY	COST
JOBSITE CREW	242	20.00	$4840
EN ROUTE (22 TRIPS)	2	20.00	$880
PROJECT MANAGER	14	30.00	$420
EQUIPMENT CONVOY (4 MEN)	4	50.00	$800
		TOTAL	$6940

TRAVEL

PM AND JOBSITE CREW: 22 TRIPS X $250/TRIP = $5500

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BIOGRAPHICAL SKETCH

Captain Tilghman H. Keiper, III, [redacted], [redacted] He grew up in central Pennsylvania and graduated from Cedar Cliff High School in 1981. He was appointed to the United States Air Force Academy in Colorado Springs, Colorado, and graduated in May of 1985 with a Bachelor of Science in Civil Engineering degree.

Upon graduation, Captain Keiper was commissioned a Second Lieutenant in the Regular Air Force and assigned to the 823rd Civil Engineering RED HORSE Squadron (TAC) at Hurlburt Field, Florida, where he served until July of 1988. He was selected to pursue a master's degree under the Civilian Institute program of the Air Force Institute of Technology and assigned to the University of Florida's School of Building Construction.

Captain Keiper attained his present rank in May of 1989 and is married to the former Michele Barnett of Louisville, Kentucky. He is a member of the American Society of Military Engineers, and his awards include the Parachutist Badge and the Air Force Commendation Medal. Following completion of his graduate program, Captain Keiper was

assigned to the 47th Civil Engineering Squadron at Laughlin Air Force Base, Texas.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Building Construction.

George S. Birrell, Chairman
Professor of Building Construction

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Building Construction.

Rodney E. Cox
Professor of Building Construction

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Building Construction.

Jack W. Martin
Associate Professor of Building Construction

This thesis was submitted to the Graduate Faculty of the College of Architecture and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Master of Science in Building Construction.

December 1989

Dean, College of Architecture

Dean, Graduate School