PDHonline Course G276 (3 PDH)

Construction Cost Estimates

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UNIFIED FACILITIES CRITERIA (UFC)

CONSTRUCTION COST ESTIMATES

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UNIFIED FACILITIES CRITERIA (UFC)

CONSTRUCTION COST ESTIMATES

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes EI 01D010, dated 1 September 1997. The format of this UFC does not conform to UFC 1-300-01; however, the format will be adjusted to conform at the next revision. The body of this UFC is the previous EI 01D010, dated 1 September 1997.

FOREWORD

\1\
The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

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EI 01D010
1 September 1997

US Army Corps
of Engineers®

Engineering Instructions

CONSTRUCTION COST ESTIMATES

Approved for public release; distribution is unlimited.

Headquarters
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CONSTRUCTION COST ESTIMATES

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FOREWORD

These engineering instructions (EI) provide design criteria and guidance for all U.S. Corps of Engineers (USACE) commands having military construction (MILCON), civil works, and Hazardous, Toxic, and Radioactive Waste (HTRW) design responsibility. These engineering instructions are to be used as a guide when planning, programming, and designing military, civil works, and HTRW projects.

EI are living documents and will be periodically reviewed, updated, and made available to users as part of the HQUSACE responsibility for technical criteria and policy for military, civil works, and HTRW construction. CEMP-EA is responsible for administration of the EI system; technical content of EI is the responsibility of the HQUSACE element of the discipline involved. As these engineering instructions were prepared under the joint responsibility of both Cost Engineering Branches in Military Programs and Civil Works, respectively, changes to these instructions will be reviewed by both Directorates in USACE. Recommended changes to EI, with rationale for the changes, should be sent to HQUSACE, ATTN: CEMP-EA, 20 Massachusetts Ave., NW, Washington, DC 20314-1000.

EI are effective upon issuance. EI are distributed only in electronic media, primarily through TECHINFO Internet site at http://www.hnd.usace.army.mil/techinfo/index.htm and the Construction Criteria Base (CCB) compact disk. Hard copies produced by the user from the electronic media should be checked against the current electronic version prior to use to assure that the latest instructions are used.

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Engineering Instructions
No. 01D010

1 September 1997

CONSTRUCTION COST ESTIMATES

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CHAPTER 1
INTRODUCTION

1-1. Purpose

This document establishes uniform guidance to describe methods, procedures, and formats for the preparation of construction cost estimates for U. S. Army Corps of Engineers projects. Guidance is also provided for the preparation of estimates for project/construction contract modifications.

1-2. Applicability

This manual applies to all U. S. Army Corps of Engineers commands having military construction, civil works, and HTRW design responsibility.

1-3. References

References cited in this manual are listed in appendix A.

1-4. Scope

This document addresses all phases of construction cost estimating from planning phases through modification estimates during construction. The term construction includes remedial action environmental projects, dredging and other construction type work often implemented as service contracts. For the purposes of this document, the term cost engineer applies to all individuals, whether employed by the Government or under contract to the Government, who are engaged in the preparation or review of cost estimates.

1-5. Arrangement

The information in this document is arranged by chapters. Contents in each chapter begin with information and instructions common to all programs. The last paragraph of each chapter is used for program specific requirements, i.e., military, civil works, and HTRW programs. Therefore, the cost engineer should first become familiar with the common guidance and then refer to the program specific guidance. Appendix B contains sample estimate pages. Appendix C contains the work breakdown structure for civil, military, and HTRW. Appendix D contains a checklist for cost estimate preparation. Appendix E contains an overview of automation systems used for developing cost estimates. Reproducible blank forms are included at the end of this document.

1-6. Program Specific Requirements

a. Overall cost engineering policy, guidance, and procedures for all projects assigned to USACE for civil works, military programs, and HTRW programs are provided in Engineer Regulation (ER) 1110-1-1300. Additional guidance is provided in specific cost engineering regulations as specified in the following paragraphs. Further supplemental guidance is referenced in Engineer Federal Acquisition Regulations System (EFARS), Part 36. Supplemental guidance is also provided in ER 5-7-1 (FR).

b. Civil Works. The appropriate guidance is provided in ER 1110-2-1302. Further, Public Law (PL) 95-269 requires that no works of river and harbor improvement will be done by private contract if the contract price is more than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or more than 25 percent in excess of a fair and reasonable estimated cost (without profit) of a well-equipped contractor doing the work.

c. Military**.** The appropriate guidance is provided in ER 1110-3-1300. Further guidance is provided in Army Regulation (AR) 415-15. The Chief of Engineers is responsible for design, including preparation of construction cost estimates and construction of Army facilities, unless the responsibilities are otherwise assigned. The Chief of Engineers is also responsible for preparing and supporting budget estimates for construction financed with Military Construction Army (MCA) funds.

d. Hazardous, Toxic, and Radioactive Waste. The appropriate guidance for HTRW is provided in ER 1110-3-1301. This includes cost estimates for Superfund, Defense Environmental Restoration Program (DERP), Base Realignment and Closure Environmental Restoration (BRACER), and HTRW work for others.

CHAPTER 2
BACKGROUND AND OBJECTIVES

2-1. Estimating Philosophy

Cost estimates should be prepared as though the Government were a prudent and well-equipped contractor estimating the project. Therefore, all costs which a prudent, experienced contractor would expect to incur should be included in the cost estimate. This philosophy prevails throughout the entire project cycle--from programming through completion of construction. Each estimate should be developed as accurately as possible, in as much detail as can be assumed, and be based upon the best information available. This objective is to be maintained so that, at all stages of the project design and during construction, the cost estimate will in all aspects represent the "fair and reasonable" cost to the Government. Directives for military**,** civil works, and HTRW programs require cost engineers to use automation. The complete Tri-Service Automated Cost Engineering System (TRACES) automation tools are discussed in appendix E.

2-2. Responsibility for Preparation and Review

a. Preparation and review of construction cost estimates through contract award is, by regulation, the responsibility of the Cost Engineering Office. In concert with this responsibility, the cost engineer must be accountable for the completeness, quality, and accuracy of the reasonableness of the cost estimate.

b. When it is necessary to contract services for the preparation of quantities and/or cost estimates, such services will be provided by competent firms specializing in cost engineering. In all cases, the procedures and requirements of this manual will apply. Other specific needs, submittal, and requirements should also be provided to insure a complete understanding of the Corps cost engineering requirements. These supplementary requirements should be included as part of a comprehensive contract scope of work. Architect-Engineer (A-E) contracts should provide that each final estimate submitted to the Government be accompanied by a letter of transmittal which includes the following statement: "To the best of my knowledge the confidential nature of this estimate has been maintained." This statement should be signed and dated and maintained until the official markings have been removed.

c. All construction cost estimates, whether prepared in-house or by contract, will be given an independent review by government cost engineers. The estimate should be reviewed for the purpose of confirming the validity of the assumptions and the logic used in estimating the cost of construction tasks. The review should always include a check of the quantities, unit prices, and arithmetic. It is important that the reviewer develop and use a uniform checklist procedure in the review process to better assure that important considerations have not been overlooked (see checklist in appendix D).

2-3. Work Breakdown Structure (WBS)

It is important that the format of all estimates be as consistent as possible. A WBS has been established for this purpose. It is a hierarchical presentation of the scope of work. The WBS provides a common, ordered hierarchy framework for summarizing information and for quantitative reporting to customers and management. The purpose of the WBS is to: (1) provide an organized manner of collecting project cost data in a standard format for cost reporting and cost tracking; (2) provide a checklist for categorizing costs; and (3) provide a means to maintain historical cost data in a standard format. Separate unique WBS's have been developed for civil works, military, and HTRW programs. Each WBS is provided both in hard copy and electronically within Microcomputer Aided Cost Engineering System (MCACES). The appropriate WBS is to be used.

2-4. Estimating Methodology

a. Detail estimating methods are to be employed whenever adequate design information is known or can be reasonably assumed. Detail can be reasonably assumed for many projects from experience in past

designs, designer and cost engineer experience, and use of parametric models. When details cannot be reasonably assumed then historical bid unit prices will be used. Methodologies and procedures discussed in this manual are applicable whether the cost estimate is prepared manually or by using automation.

b. When analyzing construction tasks in an estimate, the cost engineer should identify the tasks that account for the major costs in the estimate. These tasks can be identified by applying the 80/20 rule, which states that approximately 80 percent of the project cost is contained in 20 percent of the tasks. Because these significant tasks account for most of the project cost, they should receive prime emphasis and effort in both preparation and review.

2-5. Degree of Detail

a. All cost estimates within the scope of this manual will be prepared on the basis of calculated quantities and unit prices that are commensurate with the degree of detail of the design known or assumed. This is accomplished by separating construction into its incremental parts. These parts are commonly referred to as construction tasks and are the line-by-line listings of every estimate. Each task is then defined and priced as accurately as possible. Tasks are seldom spelled out in the contract documents, but are necessary for evaluating the requirements and developing their cost.

b. At the most detailed level, each task is usually related to and performed by a crew. The cost engineer develops the task description by defining the type of effort or item to be constructed. Task descriptions should be as complete and accurate as possible to lend credibility to the estimate and aid in later review and analysis. An example, sample forms and a brief explanation of forms used in preparing manually prepared construction cost estimates are provided in chapter 17.

c. Whenever a significant amount of design assumptions are necessary such as in design-build process, the cost engineer should use historical cost data from previous similarly designed projects and/or use parametric estimating models.

2-6. Parametric Estimates

As an alternate method to detail task-by-task estimate preparation, especially in the early stages of project development when details are not available, the use of parametric estimating may be incorporated. Parametric estimating is the process of using various factors to develop an estimate. The factors are based on engineering parameters, developed from historical data bases, construction practices and engineering/ construction technology. The parameters include physical properties that describe project definition characteristics (e.g., size, building type, foundation type, exterior closure material, roof type and material, number of floors, functional space requirements, interior utility system requirements, etc.). The appropriateness of selecting the parametric method depends upon the extent of project definition available, the similarity between the project and other historical data models, the ability to calculate details, and known parameters or factors for the project. Appendix E provides additional information on the automated parametric system.

2-7. Accuracy and Completeness

Accuracy and completeness are critical factors in all cost estimates. An accurate and complete estimate establishes accountability with the cost engineer and enables management to place greater confidence in the cost estimate.

2-8. Rounding Figures

a. Rounding of costs is desirable to avoid the use of decimals when allocating the total distributed cost (markup) to the direct subtotal costs for each work item.

b. Cost estimates prepared manually to determine preliminary or alternative cost estimates when design details are limited, may be rounded based on the experience of the cost engineer, whereby the end cost is not significantly affected.

c. For reporting purposes, the total cost of the project, represented by the Current Working Estimate (CWE) for Military and HTRW, and the Total

Current Working Estimate (TOTAL CWE) for Civil Works may be rounded to the nearest thousand dollars.

2-9. Price Level/Escalation Adjustment

All cost estimate elements will be priced to a common calendar date base (month and year). The establishment of this date should be based on the ability to obtain current known costs and adjust historical costs with reliability. This date is referred to as the effective price level date. Once the cost estimate has been prepared to the effective price level date, the estimate may require cost adjustment to accommodate the project schedule, therefore the cost engineer should calculate escalation as a separately identifiable element and calculation methodology should be clearly defined and indicated. Additional information on cost escalation is provided in chapter 13.

2-10. Safeguarding Cost Estimates

Although not required by regulations, estimates based on less than completed design should be handled by the cost engineer in a discretionary manner. Access to each estimate and its contents will be limited to those persons whose duties require knowledge of the estimate. Estimates prepared by A-E's will also be similarly handled. Any request by the public for information and pricing in the estimate will not be provided until coordination, verification of data, and approval have been given by the commander or designated authority.

2-11. Security and Disclosure of Government Estimate

a. Contents of the Government estimate. The Government estimate consists of a title page, signature page, and bid schedule. Supporting documents that are publicly available as part of the solicitation (such as plans, specifications, and project descriptions) are not part of the Government estimate. Government estimates for contract awards and contract modifications are treated the same.

b. Access to the Government estimate. Access to the estimate and its contents will be limited to personnel whose duties require they have knowledge of the subject. When an A-E is responsible for preparing any such estimate, the A-E submittal should include a list of individual's names who have had access to the total amount of the estimate. Government personnel also should sign the same or a similar list. A list similar to figure B-1, in appendix B should be filed with the Government estimate.

c. Marking the Government estimate. The Government estimate will be marked in accordance with AR 25-55. The preparer of the Government estimate will ensure that the protective marking " For Official Use Only" (FOUO) is properly applied to all pertinent documents, computer files, floppy disks, printouts, and other documents prepared manually or electronically for incorporation into the Government estimate.

d. Disclosure outside of the Government. After contract award, ordinarily, only the title page, signature page, and bid schedule are disclosed outside the Government. The Government estimate backup data should not be released since it contains sensitive cost data (e.g., contractor quotes, crews and productivity) that are proprietary or might compromise cost estimates for future similar procurement.

e. Bid protests and litigation. During bid protests and litigation, if appropriate and to the extent possible, Counsel should have the Government estimate and/or the Government estimate backup data placed under a "protective order." There are valid reasons for not releasing the backup data supporting the Government estimate to the contractors. In the case of a bid protest, there is a possibility that the contract could be re-advertised or converted to a negotiated procurement. Release of the backup data would provide bidders with the detailed cost data that supports the Government estimate. If, however, the apparent low bidder protests the details of the Government estimate, the Command may provide the details of the Government estimate and Government backup data, to the protestor only, upon receipt of complete details of the protestor's estimate. See, EFARS 33.103 (S-101). If the protest is not sustained and the proposal is re-advertised, all bidders are entitled to have the same information as the protestor.

2-12. Release of Government Estimates under the Freedom of Information Act (FOIA)

a. The Government estimate and Government estimate backup data, prepared for construction contracts and modifications, are sensitive procurement information and should in many cases be withheld under the FOIA.

b. Definitions.

(1) Government estimate. The Government estimate consists of a title page, signature page, and bid schedule.

(2) Governments estimate backup data. The Government estimate backup data is the detailed cost data, which includes production and crew development methodology, labor, equipment and crew backup files, subcontractor quotes, and all other data identified on MCACES software as detail sheets.

(3) Fair market price determinations, under the Small Business Program, Federal Acquisition Regulations (FAR) 19.202.6, will be treated as Government estimates for purposes of this guidance**.**

(4) Supporting documents that are publicly available as part of the solicitation, such as plans, specifications and project description, or that contain no cost information, such as sketches, soil boring and material classifications, are not part of the Government estimate or backup.

c. Government estimates and Government estimate backup data are intra-agency memoranda which may be withheld under FOIA Exemption 5, "confidential commercial information" and "deliberative process" privileges. Proper use of Exemption 5, however, requires a showing that release of information will harm the Government's interests. Therefore, requests for Government estimates and backup data will be reviewed on a case-by-case basis, based on the following guidance, to determine whether release will harm the Corps' interests. In reviewing requests the FOIA Officer will seek the assistance of the cost engineer. If the FOIA Officer determines that release will harm the Corps' interest, the information will be withheld.

(1) Before contract award.

(a) When sealed bidding is used, neither the Government estimate nor the Government estimate backup data should be released prior to bid opening. FAR 36-203(c), 36.204. It is well established that release of Government estimates and backup data before contract award would harm the interests of the Government. FAR 36.203, Federal Open Market Committee v. Merrill, 443 U.S. 340 (1979), Morrison-Knudson v. Department of the Army, 595 F. Supp. 352 (D.D.C. 1984), aff'd 762 F.2d 138 (D.C. Cir 1985).

(b) The Government estimate will normally be released when bids are opened. In some instances, however, the Government estimate will not be released at that time, such as when all bids received are nonresponsive and a re-procurement is envisioned.

(c) In negotiated procurement for construction under FAR Parts 15 and 36, the Government estimate should not be released prior to contract award, except that Government negotiators may disclose portions of the Government estimate in negotiating a fair and reasonable price, see FAR 36-203(c).

(d) Government estimate backup data should not be released.

(2) After contract award through contract completion.

(a) The Government estimate may be released.

(b) The Government estimate backup data should not be released. Release of Government estimate backup data after contract award and before completion of a construction contract, may also result in harm to the Government. The Government estimate backup data is used to develop cost estimates for modifications and claims. Release of the backup data prior to contract completion provides the contractor with the details of the Government's

position and would allow the contractor to develop a biased price proposal. This could harm the Government's ability to negotiate a fair and reasonable price for the modification or claim, putting the Government at a serious commercial disadvantage. Moreover, knowledge of the construction methods contemplated by the Government might reduce the contractors incentive to discover less expensive methods. This could also reduce the contractors incentive to locate and charge out materials at a lower cost, or to achieve project goals using less labor and equipment. Quarles v. Department of the Navy, 983 F.2d 390, (D.C. Cir 1990). Taylor Woodrow International, Ltd. V. Department of the Navy, No. 88-429R, (W.D. Wash. Apr 6, 1989).

(3) After contract completion (and after all claims have been resolved). Generally, the Government estimate backup data may be released after the contract is completed. Situations where the information should not be released include, multiple-phased projects where a series of similar contracts are awarded in sequence, and frequently recurring contracts. In those cases, each Government estimate is based upon the same backup data and the same analysis of how to perform the work.

2-13. Team Involvement

Cost engineers are an important member of the project team. The cost engineer is expected to have a clear understanding of those responsibilities and areas where contributions can be made. It is imperative that the team concept be enhanced and supported by each member. As such, the cost engineer is encouraged to lead in cost issues and provide ideas for cost control and sharing measures.

2-14. Life Cycle Cost (LCC) Study Support

Quality management policy requires LCC studies to be performed to evaluate system alternatives. These analyses are the responsibility of the design team. The cost engineer will be called upon to support the analysis by providing cost input. As preparation to such responsibility, the cost engineer should be familiar with the LCC procedures contained in Technical Manual (TM) 5-802-1 and should receive adequate formal training prior to performing LCC studies.

2-15. Work Breakdown Structure by Program

a. Civil Works. The Civil Works Breakdown Structure (CWBS) is a standard product oriented format that identifies all civil works related project requirements that include construction costs and the nonconstruction activity costs for Real Estate; Planning, Engineering and Design; and Construction Management. The CWBS groups the products by feature (table 2-1) and further requires an expansion to the appropriate title and detail level necessary to insure all product specific work tasks are included for preparation of the cost estimate.

Table 2-1 Feature Codes and Descriptions

Number	Feature Description
01	Lands and Damages
02	Relocations
03	Reservoirs
04	Dams
05	Locks
06	Fish and Wildlife Facilities
07	Power Plant
08	Roads, Railroads, and Bridges
09	Channels and Canals
10	Breakwaters and Seawalls
11	Levees and Floodwalls
12	Navigation Ports and Harbors
13	Pumping Plants
14	Recreation Facilities
15	Flood Control and Diversion Structures
16	Bank Stabilization
17	Beach Replenishment
18	Cultural Resource Preservation
19	Buildings, Grounds, and Utilities
20	Permanent Operating Equipment
21	Reconnaissance Studies
22	Feasibility Studies
30	Planning, Engineering, and Design
31	Construction Management
33	HTRW

b. Military Programs. The Military Construction Work Breakdown Structure (MCWBS) provides a common framework for preparing cost estimates, developing models, and collecting cost data for Department of Defense (DOD) military

construction projects. It is to be used for categorizing facility costs and associated supporting facility costs for all conventional military construction projects. This MCWBS is comprised of 15 primary facility systems and four supporting facility systems. Each system is divided into one or more subsystems, which are further divided into assemblies made up of construction line items. An example of MCWBS levels numbering is as follows:

Level 1	Scope
Level 2	Facility (Building)
Level 3 (System)	02 - Superstructure
Level 4 (Subsystem)	01 - Floor Construction
Level 5 (Assembly Category)	03 - Floor Decks and Slabs
Level 6 (Assembly)	03 - Precast Concrete Slab
Level 7 (Detail Line Item)	03412 1105 Erection 03412 1901 100 mm Precast Slab

(1) A unit of measure is associated with each level of the MCWBS and should be followed in all estimates to facilitate the estimating review process. This will allow estimates to be compared to other similar project estimates.

(2) The standard numbering structure and description manual is available and referred to as "Data Dictionary." The dictionary includes description of building functional components and associated supporting facilities. A sample MCWBS to level 2 is provided in appendix C. The complete MCWBS is located in MCACES.

c. HTRW

(1) The HTRW Remedial Action Work Breakdown Structure (RAWBS) is for categorizing remedial action construction costs only and does not include WBS items for pre-design studies, engineering and design, other pre-construction costs, or other estimated post-construction costs such as post-construction operation and maintenance which can also be charged to the project.

(2) The RAWBS consists of four numbered levels of cost breakdown. Each level is identified by a two digit number; Level 1 (Account) represents HTRW RA and is identified by 33. The detail increases with each succeeding level as shown below:

Level 1 (Account)	33 1 xx - HTRW Remedial Action
Level 2 (System)	15 - Stabilization/ Fixation/Encap
Level 3 (Subsystem)	07 - Sludge Stabilization
Level 4 (Assembly Category)	03 - Construction of Permanent Treatment Plant

(3) The RAWBS numbering system and standard descriptions may not be changed for HTRW estimates for the first three levels (Account, System, and Subsystem). Items not found in the HTRW RAWBS should be coded with the appropriate two digit number from 90-99 (Other). As a minimum, estimates are to be structured and include summaries to the third (Subsystem) level.

(4) The "Standard Description" manual (also referred to as the "Data Dictionary") for the HTRW RAWBS includes written descriptions of the second (System) and third (Subsystem) levels and can be used as a reference to assist in determining the appropriate breakdown of costs. Refer to appendix C for a listing of Level 2 (system) of the HTRW RAWBS. The complete RAWBS is located in MCACES.

2-16. Civil Works Program Specific Requirements

a. Virtually every study, project, or activity funded under the civil works program requires a project cost estimate. The cost estimate is an essential tool that serves as a foundation in accomplishing management objectives, budgetary submissions, and economic analysis. In a typical project life, cost estimates may be divided into a series of different types throughout the project development. The type of estimates occurring are identified below.

(1) Estimates for reconnaissance reports.

(2) Estimates for feasibility reports.

(3) Estimates during engineering and design.

(4) Government estimates for contract award and for contract modifications.

(5) The cost engineer may also be required to prepare cost estimates for special purposes such as continuing project management and budgetary submissions; special programs such as Continuing Authority Program (CAP), Dam Safety Assurance Program, Environmental Restoration 1135 projects and Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R).

b. The definitions and appropriate policies applicable to the wide variety of projects encompassed in the civil works program are described in ER 1110-2-1302. The technical details for preparing cost estimates are provided in this manual.

2-17. Military Program Specific Requirements

In the Military Construction (MILCON) program, construction cost estimates are prepared throughout the planning, design, and construction phases of a construction project. These construction cost estimates are categorized as follows: Programming estimate; concept estimate; final estimate; and Government estimate. In the planning phase, the cost estimate is called programming estimate and is prepared on a Department of Defense form, DD Form 1391. This programming estimate is developed based on preliminary project scope or mission requirements. Historical data and parametric estimating procedures are used to develop the estimate. The concept estimate is prepared during the 15 percent or 35 percent design phase of the project and is used to update the programming estimate. The estimate is refined more during this phase since the design criteria and project requirements have been defined. The accuracy and reasonableness of the concept estimate is critical as this estimate becomes the basis for Congressional funding authorization and appropriation for construction. The final estimate is the detailed bottoms-up cost estimate based on the final plans and specifications. This estimate serves as the basis for establishing the Government estimate.

2-18. HTRW Program Specific Requirements

a. Remedial action cost estimates are required during all phases of an HTRW project. Most existing HTRW sites are remediated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which has distinct and legally required phases that differ from the design and construction process applicable to traditional USACE programs.

b. CERCLA project phases are: Preliminary Assessment (PA); Site Inspection (SI); Remedial Investigation (RI); Feasibility Study (FS); Record of Decision (ROD); Remedial Design (RD); and Remedial Action (RA). During the PA, SI, or RI phases of a HTRW project the estimates are called preliminary budget estimates. The project scope, type, level, or extent of contamination, and the primary remedial technology have not been defined during these early phases. All available tools such as HTRW historical information and parametric estimating procedures should be used to develop the preliminary budget estimates. The estimates are refined more during the FS phase, which compares the technical merits of alternative remedial action methods. Historical data, parametric estimating, detailed quantity take-off estimating and life cycle-cost techniques should be used to compare the costs of competing technologies. The cost estimate of the selected remediation alternative from the FS generally serves as a basis for the ROD estimate. The ROD estimate is the basis for funding authorization of an HTRW project. During the remedial design phase, the cost estimate for remedial action is a CWE. The CWE is the detailed cost estimate developed from design documents and serves as the basis for establishing the Government estimate. The remedial action phase is the actual site cleanup of an HTRW project.

c. HTRW projects not covered by CERCLA may fall under other applicable public laws such as the Resource Conservation and Recovery Act (RCRA).

In general, the identification, study, decision, design, and remedial action processes are similar to CERCLA and have similar cost engineering implications. RCRA terminology differs from CERCLA as follows:

RCRA	CERCLA
RCRA Facility Assessment (RFA)	PA/SI
RCRA Facility Investigation (RFI)	RI
Corrective Measures Study (CMS)	FS
Corrective Measures Implementation (CMI)	RD/RA

d. USACE may or may not be involved in all the above phases of an HTRW project. Frequently, USACE takes responsibility for an HTRW project after the ROD has been completed. For those project phases for which USACE is responsible, the cost engineer must be involved in development and/or review of project cost estimates for remedial action.

CHAPTER 3
BASICS FOR PREPARATION OF ESTIMATES

3-1. General

a. This chapter establishes uniform guidance to be used prior to estimate preparation. In the normal sequence of events toward the preparation of any estimate, it is of utmost importance to understand basic fundamental principles and responsibilities.

b. Construction cost estimates consist of:

(1) Descriptions of work elements to be accomplished (tasks).

(2) A quantity of work required for each task.

(3) A cost for each task quantity.

c. A unit cost for each task is developed to increase the accuracy of the estimating procedure and should provide a reference comparison to historic experience. Lump sum estimating when used at the task level must be documented.

3-2. Planning the Work

The cost engineer must thoroughly understand the project scope of work, the biddability, environmental constructibility, operability (BECO), and aspects of the project being estimated. The cost engineer must also review drawings, specifications, and other references to formulate a construction sequence and duration. A site visit is strongly recommended to enable the cost engineer to relate the physical characteristics of the project to the available design parameters and details. This is particularly important on projects with difficult site conditions, major maintenance and repair projects, alteration/addition projects, environmental projects, and dredging projects. The construction sequence must be developed as soon as possible and should be used to provide a checklist of construction requirements throughout the cost estimating process. The overall format of major cost elements in an estimate must be compatible with current standards, management needs, the anticipated bidding schedule, and the appropriate WBS.

3-3. Quantities

a. The quantity "take-off" is an important part of the cost estimate. It must be as accurate as possible, and should be based on all available engineering and design data.

b. After the scope has been analyzed and broken down into the construction tasks, each task must be quantified prior to pricing. Equal emphasis should be placed on both accurate quantity calculation and accurate pricing. Quantities should be shown in standard units of measure and should be consistent with design units (inch-pound/metric). Assistance for making "take-off's" may be provided by others within the organization in support of cost engineering or by A-E contract; however, the responsibility for the accuracy of the quantities remains with cost engineering.

c. The detail to which the quantities are prepared for each task is dependent on the level of design detail. Quantity calculations beyond design details are often necessary to determine a reasonable price to complete the overall scope of work for the cost estimate. Project notes will be added at the appropriate level in the estimate to explain the basis for the quantity calculations, to clearly show contingencies , and to note quantities determined by cost engineering judgment that will be reconciled upon design refinement.

3-4. Types of Costs

a. Various types of cost elements must be evaluated in detail.

b. Direct costs are those costs which can be attributed to a single task of construction work. These costs are usually associated with a construction labor crew performing a task using specific materials for the task. Labor foreman cost should normally be considered as a direct cost. Subcontracted costs should be considered as direct costs to the prime contractor in estimates.

c. Indirect costs are those costs which cannot be attributed to a single task of construction work. These costs include overhead, profit, and bond. Indirect costs are also referred to as distributed costs.

d. Estimates based on detailed design will be developed from separate direct cost pricing of labor, material, construction equipment, and supplies. Applicable indirect costs will be added later to reflect the total construction cost. Other costs, including lands and damages, escalation, design contingencies, construction contingencies, construction supervision and administration (S&A), Engineering During Construction (EDC), As-built, and Operation and Maintenance (O&M) Manuals, will be added to the construction costs to determine the total project cost as required by program specific requirements.

3-5. Price Sources

a. Various pricing sources should be obtained and be available to the cost engineer. In pricing from any source, experience and ability to relate data in hand to a specific circumstance is important. The following discussion is provided on commonly used sources and source development.

b. Unit Price Book (UPB). The unit price book is the common name for the U. S. Army Corps of Engineers construction direct costs data base. This UPB is printed in hard copy and is part of MCACES. It contains repetitive construction tasks with direct cost pricing (labor, equipment, material) based on a typical crew and production rate for new construction. Some UPB line items may include quotes for work that is fully provided and installed by subcontractor. All quotes for work fully priced by subcontractor are shown in the UPB, column identified as “Unit Cost.” Each office is encouraged to use this pricing source and to refine the data base to more accurately reflect local costs at the project site.

c. Historical data. Historical costs from past similar work are excellent pricing sources when adequate details have been saved and adjustment to project specifics can be defined. Portions of other estimates having similar work can be retrieved and re-priced to the current project rates. Automated historical data bases are discussed in appendix E.

d. Parametric data base. A parametric data base of predefined assemblies for buildings and site work; and HTRW work using UPB pricing, has been developed and is discussed in appendix E.

e. Development of specific tasks. When standard tasks do not meet project needs, specific new tasks need to be developed. Such development requires experience. Descriptions developed must adequately define the scope and material requirement for each task. Unit cost for each task is developed as a direct cost with separate costing for the labor, equipment, and material components. Notes which explain key factors in the pricing and methodology should accompany the task development. Comparison with existing pricing guides is recommended.

(1) Labor unit cost. This cost is based on a defined crew from the UPB or on a newly developed crew which performs the tasks at an assigned production rate. Hourly rates for each craft are applied to the crew labor to arrive at the hourly crew labor cost. The total crew labor cost/hour is divided by the expected production rate (units/hour) to derive the labor cost/unit.

(2) Equipment unit cost. This cost is derived similar to labor unit cost. Hourly equipment rates are obtained from the appropriate regional manual, entitled, "Construction Equipment Ownership and Operating Expense Schedule" (herein referenced as, Equipment Ownership Schedule), Engineer Pamphlet (EP) 1110-1-8, or developed according to the methodology as described in this pamphlet.

(3) Material unit cost. This cost is developed using vendor quotes, historical costs, commercial pricing sources, or component calculations. The price should include delivery to the project site.

f. Commercial unit cost books. These common sources are typically available through subscription or purchase. Basis of costs shown are typically explained along with adjustment methodology. Such publications are valuable "second-opinion" verification and appropriate for minor commercial type work item pricing.

3-6. Costs and Pricing

a. The cost for each task should be developed by summing the direct cost elements for labor, equipment, and materials. The indirect costs and other markups associated with each task or work item should be identified and are considered separately for the specific project.

b. The direct cost of construction tasks of minor overall cost significance and of a repetitive nature can normally be priced from any of those sources discussed above.

c. When using historical pricing, adjustments must be made for project location, work methodology, quantity of work, and other dissimilarities which affect prices.

d. Use of lump sum items is discouraged. If lump sum items are used in the estimate they must have backup cost data relating to their tasks and source of the data.

e. As a general rule of thumb, when a task extended direct cost is $10,000 or more, or 5 percent of the total direct cost, whichever is less, detailed backup for the cost should be prepared or quotations obtained as pricing support to the cost estimate.

f. Applying the same rule of thumb, unit price bid items for Government estimates may be based on suitable experienced bid prices or historical cost data, i.e., predetermined bid item does not exceed $100,000, or 5 percent of the estimated total cost, whichever is less. For cost estimates prepared during preliminary or planning phases, where design is limited or not available, predetermined unit prices adjusted to current pricing level may be used by the cost engineer. Use of experienced prices should consider any necessary adjustments in prime contractor's profit or distributed costs appropriate to the contract requirements. The cost engineer must use extreme care and sound judgment when using predetermined unit costs. The basis for the unit costs should be well documented and included in the supporting data of the estimate. Where a bid item consists mostly of equipment and labor costs, with very little materials and supplies, it is advisable to develop the cost as indicated above, even though the item may fall under this rule of thumb.

3-7. Cost Estimate Format and Supporting Documentation

All construction cost estimates are composed of contract costs and other allowable project costs authorized by directives or regulations. The overall format of the cost estimate should be in accordance with the appropriate WBS as described in chapter 2. The cost engineer should always remain mindful of the documentation necessary to support the cost estimate submission requirements specified for each phase of project development. Support documentation such as project narrative, bid schedule, plan of construction, backup data, and drawings and sketches are further discussed in chapter 4.

3-8. Civil Works Program Specific Requirements

The total project cost summary provides a summary of project costs in accordance with ER 5-7-1, (FR). It relates the cost estimate and identified price level date to the fully funded cost estimate by applying the appropriate adjustments for inflation in accordance with the developed project schedule. A total project cost summary shall be prepared in conjunction with the preparation of cost estimates which support major project milestones. Approval and signature by the Chief, Cost Engineering, affirms that the construction feature costs are correct and that the backup data provided for the nonconstruction features (Lands and Damages; Planning, Engineering and Design; and Construction Management) have been included.

3-9. Military Program Specific Requirements

In addition to costs described in this chapter, the CWE for MILCON projects should include all other costs authorized by directive to be charged to construction as funded cost. These costs include installation costs or installed equipment in place to be furnished by the using service or other agency,

and the cost of Government-Furnished Materials (GFM) or Government-Furnished Equipment (GFE) purchased with construction funds and furnished to the contractor without reimbursement.

3-10. HTRW Program Specific Requirements

In addition to costs described in this chapter, for HTRW projects, the CWE should include an allowance for Government Laboratory Quality Assurance if applicable to the project. This is a Government cost to perform chemical analysis for verification purposes. Contingencies and other costs associated to HTRW are discussed in chapter 13.

CHAPTER 4
COMPOSITION OF GOVERNMENT ESTIMATES

4-1. General

The Government estimate is the formal, approved construction cost estimate prepared to support contract award. The presentation format for this type of estimate is: Government Estimate of Contract Cost, Narrative of Contract Cost, Government Estimate Backup Data, and Miscellaneous Support Data. Each part is shown in figure 4-1. Sample Government estimate sheets are illustrated in appendix B. Security and control of the Government estimate is described in chapter 2.

4-2. Government Estimate of Contract Cost

a. The Government estimate is the portion of the cost estimate to be submitted as required by procurement regulations. It includes the title page, signature page, and bid schedule.

b. Title page. The title page should include the name and location of the project, the district responsible for the project design, the cost engineer responsible for preparation of the cost estimate, and the date and price level of the cost estimate.

c. Signature page. The signature page should contain the names and signatures of those individuals responsible for the preparation, review, submittal, and approval of the cost estimate. It is necessary that the sheet contain the total amount of the estimated costs. The number of amendments included in the estimate should appear on the same page so that there will be no question as to the approved amount.

d. Bid/Price schedule. The bid schedule required by the solicitation documents must be completed as part of the Government estimate. As part of the design team, the cost engineer should be involved in the development of the bid schedule. The format of the bid schedule must be anticipated in planning and design estimates. When the bid schedule is finalized for procurement, it must show unit prices, quantities, extension of unit prices, lump sum items, and total costs. Rounding off is not permitted on the bid schedule between the unit price and extension. Any rounding adjustments must be performed in Details and Analysis. Instructions in the bidding request documents also pertain to the Government estimate.

4-3. Narrative of Contract Costs

a. This part of the estimate of construction cost consists primarily of those sheets, with notes, which describe the scope tasks and costing. It also contains discussions, considerations, and the developed construction plan. The types of items normally included are as follows:

b. Table of contents. This page denotes the backup content.

c. *Project narrative*. The project narrative provides general details of the project. The narrative defines the assumptions made during the preparation of the cost estimate. It describes the project requirements that must be performed in sufficient detail to give a clear understanding of the scope of work. It also describes project details including length, width, height and shape of primary features, special problems that will be encountered in performing the work, site conditions affecting the work, reasons for selection of major plant and equipment, method and time for mobilization and demobilization of all equipment, and the reasons for unusually high or low unit prices. Each estimate will include a statement which relates both the development of design, as appropriate, and date of effective pricing. Other factors to be considered in the project narrative include:

(1) Construction schedule, use of overtime, construction windows, phasing, acquisition plan, and subcontracting.

(2) Project-related details include site access, borrow areas, construction methodology, unusual conditions (soil, water or weather), unique techniques of construction, equipment/labor availability and distance traveled, environmental

concerns, contingencies by feature or subfeature, if appropriate, and effective dates and sources for labor, equipment and material pricing.

d. Construction Schedule. The cost engineer will prepare a construction schedule to support the cost estimate that is consistent with the schedule for completion of the project. It may be in the form of a bar chart or network analysis system ,or may be prepared using the MCACES Scheduling Interface module; but it must identify the sequence and duration of the tasks upon which the cost estimate is developed. The schedule must be prepared in sufficient detail to adequately develop the required labor, equipment, crew sizes, and production rates required for each of the identified construction tasks.

e. Equipment and materials utilization. On those projects involving considerable heavy construction equipment, it is necessary to sufficiently plan the equipment usage against the work schedule to identify the actual number of cranes, dozers, and allow for proper mobilization to assure that demand for the equipment is not over or understated. For equipment selected from EP 1110-1-8, Equipment Ownership Schedule, indicate the region and date of the equipment schedule used for pricing the equipment. Materials which require long lead-time and can become critical to the construction schedule should be noted, planned, and adequately considered.

f. Labor discussion and utilization. The estimate should clearly state the sources for the various labor classifications and rates and include a tabulation by crafts of the various composite wage rates used. When extensive overtime beyond the normal work day is used in the estimate, an explanation should be included.

4-4. Government Estimate Backup Data

a. This part of the estimate consists of all the support and backup documentation. The various categories of support documentation contained in this part are:

b. Cost analysis summary sheets. The MCACES or manually prepared summary sheets for direct, indirect and owner costs are used to summarize cost components for each bid item and by the appropriate Work Breakdown Structure. Distribution of overhead and profit is shown on this sheet.

c. Mobilization, preparatory work, and demobilization. These costs should be itemized and costed separately. These costs may be combined at summary level with overhead if these costs are not paid as a separate bid item. This item may be shown as a lump sum on the bid schedule.

d. Profit computation sheet. When profit is included, the weighted guidelines will be used to compute the profit and will be part of the cost estimate backup.

e. Overhead costs. The itemization and calculations of overhead costs, both job site and home office, should be accomplished in accordance with chapter 10.

f. Bond costs. Bond costs should be calculated in accordance with chapter 12. Distribution is made to bid items similar to or as part of overhead costs distribution.

g. MCACES detail sheets. The completed direct costs should be organized in the proper sequence by the appropriate Work Breakdown Structure for each bid item.

h. Production rates. The MCACES or manually prepared details are used to express production rate analysis of crews. See chapter 6 for further discussion.

i. Crew, labor, equipment rates. These MCACES or manually prepared details are used to express the crew composition, and associated rates for labor and equipment costs. The information contained on these sheets provides the backup support for the task unit labor and equipment costs shown.

j. Quantity computations. The quantity take-off computations for the tasks estimated, should be organized by task for the bid items and kept as backup. The take-off should reference the drawing and clearly explain the computation.

k. Quotations. Quotations should be collected and compiled by task or bid item into an organized reference. When quotations were not obtained for significant material and supply items, the basis for the cost used should be fully described. Quotations should be considered proprietary information and should be kept confidential to protect the information entrusted to the cost engineer.

4-5. Miscellaneous Support Data

a. Include all other information pertinent to the estimate such as drawings and sketches which were used as the basis of the cost estimate. Drawings may include a project map showing the location of the work with respect to principal cities, roads, railways, and waterways; a site map showing the location of the work, borrow, quarry, and spoil areas, and existing work access roads; any existing facilities usable by the contractor; a general plan and elevation, or profile of the work with typical sections; and a construction layout.

b. Supporting documents that are publicly available as part of the solicitation, such as plans, specifications and project description, or that contain no cost information, such as sketches, soil boring and material classifications, are not part of the Government estimate or backup.

4-6. Requirements for Revision to Government Estimate for Bidding

Prior to award, the Government estimate may be changed or revised as a result of errors, differing conditions or additional information. Approval authority for revision to the estimate remains the responsibility of the Contracting Officer or authorized original estimate approving official. Each office should assure that appropriate justification is attached to the revised cost estimate. Estimates may be revised by supplementary sheets or by actually changing the contents of the original estimate pages. The method used will be determined by the nature of the revision and the format of the estimate. Whichever the method, all revisions to the estimate must be clearly indicated, dated, justified, and approved. A new signature sheet relating both the previously approved total and revised total will be re-approved. A copy of each estimate that has been approved should be included in a file along with the details and circumstances reflecting the revisions.

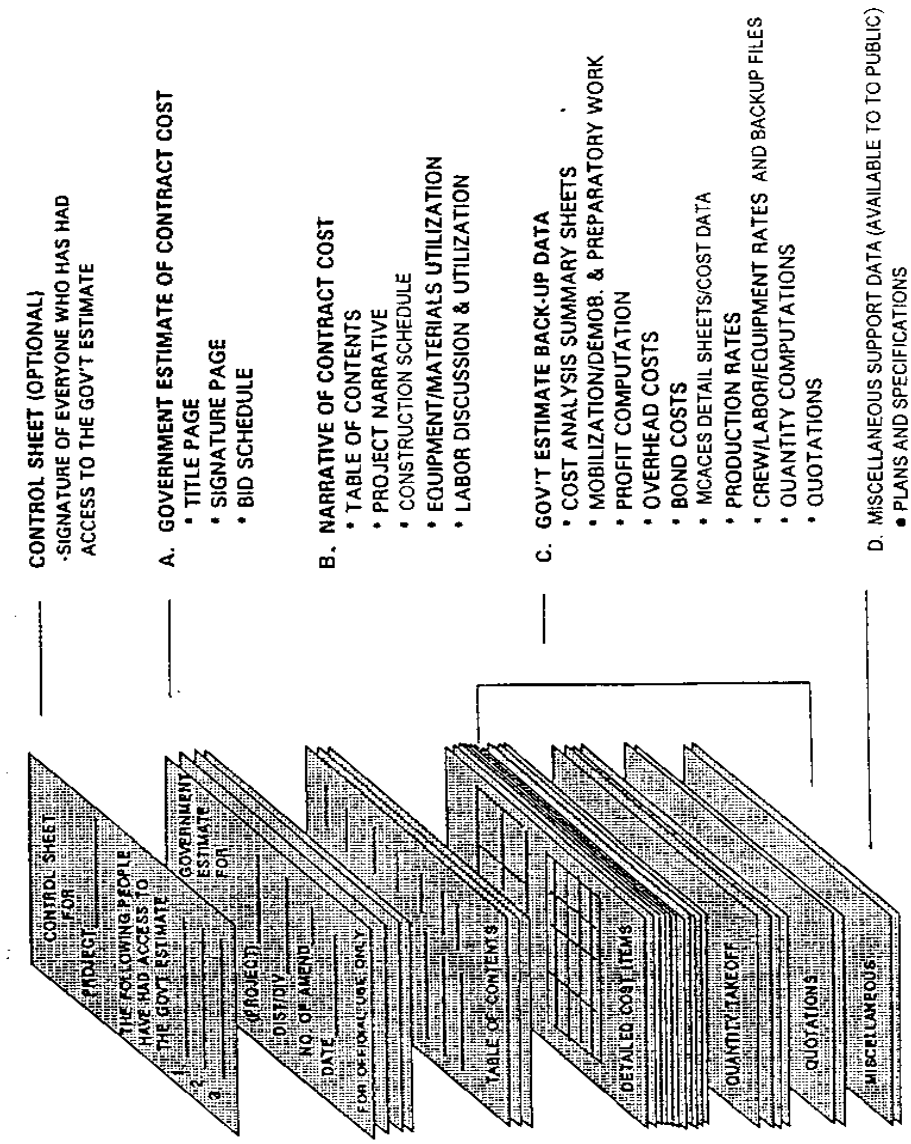


Figure 4-1. Composition of an estimate

CHAPTER 5
LABOR

5-1. General

a. Direct labor costs are defined as base wages plus labor cost additives including payroll taxes, fringe benefits, travel, and overtime allowances paid by the contractor for personnel who perform a specific construction task. In addition to the actual workers, there are generally working crew foremen who receive an hourly wage and are considered part of the direct labor costs.

b. Indirect labor costs are wages and labor cost additives paid to contractor personnel whose effort cannot be attributed to a specific construction task. Personnel such as superintendents, engineers, clerks, and site cleanup laborers are usually included as indirect labor costs (overhead).

5-2. Crews

Direct labor cost requirements are broken into tasks of work. Since each task is usually performed by a labor crew including equipment, the crew must be defined, costed, and a production rate established for the task. Crews may vary in size and mix of skills. The number and size of each crew should be based on such considerations as having sufficient workers to perform a task within the construction schedule and the limitation of work space. Once the crews have been developed, the task labor costs can be determined based on the production rate of the crew and the labor wage rates.

5-3. Wage Rates

a. A wage rate must be developed for each labor craft which will represent the total hourly cost rate to the construction contractor. This total rate will include the base wage rate plus labor overtime, payroll, taxes and insurance, fringe benefits, and travel or subsistence costs as further described in this chapter. The composite wage rate for each craft will be used for development of the estimate. The computation will be prepared on Department of Army (DA) Form 5420-R or similar local forms, or MCACES.

b. Wage rates are generally well defined. The Davis-Bacon Act, PL 74-403, requires a contractor performing construction in the United States for the Government to pay not less than the prevailing rates set by the Department of Labor. A schedule of minimum rates is included in the project specifications and is normally kept on file for each location by each local Office of Counsel. The cost engineer should consult with the District Labor Advisor on any questions regarding determination coverage, specific definitions, or concerns. Where labor is in short supply for certain crafts in the area, or the work is in a remote area, or it is well known that rates higher than the set rate scale will be paid, these higher wage rates should be used instead of the minimum wage since this would be required of the contractor in order to attract labor to the job. The wage rate should be adjusted to include travel time or night differential where these are a customary requirement.

c. For a long duration project, where future wage rates are known and used, care must be taken to avoid duplication by also applying an escalation rate to such costs.

5-4. Overtime and Shift Differential

a. The cost engineer should carefully consider the available working time in the construction schedule for each task accomplishment in a normal time period. The efficiency of both the second and third shifts should be adjusted to recognize that production will not be as high as the day shift for most types of construction operations. A three-shift operation should normally be avoided due to a lower labor efficiency and the requirement to include equipment maintenance.

b. Overtime should be included in the labor cost computation when work in excess of regular time is required by the construction schedule or is the custom of labor in the local vicinity. Overtime is normally calculated as a percentage of the base wage rate. It is usually based on time and one-half, but may be double time depending on the existing labor agreements. Tax and insurance costs are applied to overtime, but fringe

benefits and travel and/or subsistence costs are not. Example 5-1 shows overtime calculation for 40 hours regular time, plus 8 hours overtime at time and one half:

Example 5-1

48 hours at straight time	= 48.00 hours
8 hours at double time	= 4.00 hours
paid equivalent straight time	= 52.00 hours

(52 hrs paid/48 hrs worked = 1.0833) -1 x 100% = 8.33%

c. Many construction projects utilize multiple shift operations. When estimating direct labor costs for multiple shift operations, the cost engineer should estimate the number of hours to be worked (include shift differential work loss) and the number of hours to be paid for each shift based upon the developed construction schedule. Differential shift premiums may need to be added to the hourly rate.

d. A tabulation of overtime percentages for most conditions is shown in table 5-1. The percentage also includes an allowance for the direct work loss of multiple shift or shift differential, where applicable.

5-5. Taxes and Insurance

a. Rates for all taxes and insurance should be verified prior to computation for the following and any additional components.

b. Workman's compensation and employer's liability insurance costs applicable for the state in which the work is performed should be included in the composite wage rate. Insurance rates may be obtained from the state if the state law provides a monopoly or from insurance companies providing this type insurance. The project compensation rate is based on the classification of the major construction work and applies to all crafts employed by the contractor.

c. Unemployment compensation taxes are composed of both state and Federal taxes. Unemployment compensation tax will vary with each state while the Federal unemployment tax will be constant for all projects. Insurance rates can be obtained from the state unemployment office, commercial publications, or the Bureau of Labor Statistics.

d. The social security tax rates and the income ceilings on which social security taxes must be paid vary from year to year. Therefore, the cost engineer must verify the rate to be used in the cost estimate. Current and future rates can be obtained from the Social Security Administration.

e. The total percentage of the above taxes and insurance is summed and then applied to the basic hourly wage rate plus overtime for the various crafts. Example 5-2 illustrates the method for deriving the total tax and insurance percentage. Since rates are subject to change and in some cases vary by region, the calculations shown are presented as an example only. Actual values must be determined by the cost engineer for the specific project.

Example 5-2

Workman's compensation and employer's liability (varies with state and contractor)	7.60%
State unemployment compensation (varies with each state)	3.20%
Federal unemployment compensation	0.80%
Social Security & Medicaid	7.65%
Total taxes and insurance	19.25%

Note: Foreman and overhead labor rates must also include these applicable costs. See sample estimate sheets for method of application.

5-6. Fringe Benefits and Travel/Subsistence

a. Fringe Benefits. Fringe benefits may include health and welfare, pension, apprentice training, depending on the craft and the location of the work. These summed costs are usually expressed as an hourly cost with the possible exception of vacation which may be easily converted to an hourly cost. The type of

fringe and the amount for the various crafts can usually be found with the Davis-Bacon Act wage determination in the specifications. Non-union contractors pay comparable fringe benefits directly to their employees.

b. Example 5-3 illustrates the calculations for fringe benefits. Since the values change and vary by region and union agreement, the calculations shown are presented as an example only. Actual values must be determined by the cost engineer.

Example 5-3

Health and welfare $0.70/hr

Pension 0.75/hr

Apprentice training 0.00/hr

(N/A in this case)

Total fringe benefits $1.45/hr

c. Travel and Subsistence. Travel and subsistence costs are normally expressed as a daily or weekly cost. When included in the cost estimate, they should be converted to an hourly cost and excluded from an overtime premium unless travel and subsistence are part of an increased hourly wage. See sample estimates for methodology.

d. Some fringe benefits and travel/subsistence are subject to payroll taxes. For example, vacation benefits are taxable and should be added to the basic wage rate.

5-7. HTRW Program Specific Requirements

HTRW cleanup projects may include activities classified as either construction and/or service (non-construction). HTRW contracts are frequently comprised of both types of activities. An example would be a contract which contains the construction of a permanent treatment plant and the operation of that plant for three years following construction completion. The overall contract classification is usually determined by which type of activity is more predominant. This determination will control the wage rates applicable to the particular activities, (i.e., Davis-Bacon for construction activities and Service Contract Act for service activities). Some union agreements may require an additional amount be added to the basic wage rate for a worker who must wear protective clothing, respirators, etc. The cost engineer must insure that appropriate wage rates are used in the HTRW cost estimate.

Table 5-1. Overtime and shift differential

Shift	Actual Hours Worked Day	Week	Hours Paid Reg	OT	Percentages for OT and Shift Differential 1.5x Wk/Sat 2x 2x Sun	1.5x Week 2x Sat/Sun	Week All OT
One-shift operation							
5-Day Week	8	40	40	0	0	0	0
	9	45	40	5	5.55	5.55	11.11
	10	50	40	10	10.00	10.00	20.00
	11	55	40	15	13.64	13.64	27.27
	12	60	40	20	16.67	16.67	33.33
6-Day Week	8	48	40	8	8.33	16.67	16.67
	9	54	40	14	12.96	21.30	25.93
	10	60	40	20	16.67	25.00	33.33
	11	66	40	26	19.70	28.03	39.39
	12	72	40	32	22.22	30.56	44.44
7-Day Week	8	56	40	16	21.43	28.57	28.57
	9	63	40	23	25.40	32.54	36.51
	10	70	40	30	28.57	35.71	42.86
	11	77	40	37	31.17	38.31	48.05
	12	84	40	44	33.33	40.68	52.38
Two-Shift Operation (one 8 hours and one 7.5 hours)							
5-Day Week	15.5	77.5	80	0	3.23	3.23	3.23
	18	90	80	12.5	9.72	9.72	16.67
	20	100	80	22.5	13.75	13.75	25.00
	22	110	80	32.5	17.05	17.05	13.82
	24	120	80	42.5	19.79	19.79	37.50
6-Day Week	15.5	93	80	16.0	11.83	20.43	20.43
	18	108	80	30.5	16.44	24.77	30.56
	20	120	80	42.5	19.79	28.13	37.50
	22	132	80	54.5	22.54	30.87	43.18
	24	144	80	66.5	24.83	33.16	47.92
7-Day Week	15.5	108.5	80	32.0	25.35	32.72	32.72
	18	126	80	48.5	28.37	35.52	40.48
	20	140	80	62.5	31.25	38.39	46.43
	22	154	80	76.5	33.60	40.75	51.30
	24	168	80	90.5	35.57	42.71	55.36
Two-Shift Operation (each 7.5 hours)							
5-Day Week	15	75	80	0	6.67	6.67	6.67
	18	90	80	15	13.89	13.89	22.22
	20	100	80	25	17.50	17.50	30.00
	22	110	80	35	20.45	20.45	36.36
	24	120	80	45	22.92	22.92	41.67
6-Day Week	15	90	80	16	15.56	24.44	24.44
	18	108	80	33	19.91	27.24	35.19
	20	120	80	45	22.92	31.25	41.67
	22	132	80	57	25.38	33.71	46.97
	24	144	80	69	27.43	35.76	51.39
7-Day Week	15	105	80	32	29.52	37.14	37.14
	18	126	80	51	31.35	38.49	44.44
	20	140	80	65	33.93	41.07	50.00
	22	154	80	79	36.04	43.18	54.55
	24	168	80	93	37.80	44.94	58.33
Three-Shift Operation							
5-Day Week	22.5	112.5	120	0	6.67	6.67	6.67
6-Day Week	22.5	135	120	24	15.56	24.44	24.44
7-Day Week	22.5	157.5	120	48	29.52	37.14	37.14

CHAPTER 6
LABOR PRODUCTIVITY

6-1. General

Estimating labor productivity is subject to many diverse and unpredictable factors. There is no substitution for the knowledge and experience of the cost engineer when estimating labor productivity. For some types of work, the task productivity of crew members such as equipment operators, helpers, or oilers is determined by the productivity of the equipment. For some labor based crews, the task productivity of craftsman such as carpenters, steel workers, and masons may be based on average experience in the UPB, tempered with the experience of the cost engineer, historical records, or other appropriate reference manuals.

6-2. Productivity Adjustment Considerations

a. The complexity of the variables affecting productivity makes it difficult to estimate a production rate. Therefore, production rates should be based on averaging past production rates for the same or similar work. The cost engineer must incorporate particular job factors and conditions to adjust historical data to the project being estimated. Other sources for production rates include reference manuals, field office reports, construction log books, and observation of ongoing construction.

b. The labor effort needed to perform a particular task varies with many factors, such as the relative experience, capability, morale of the workers, the size and complexity of the job, the climatic and topographic conditions, the degree of mechanization, the quality of job supervision, amount of similar task repetition, and the existing labor-management agreements and/or trade practices. The effort from these labor efficiency factors and work practices that exist in the project locality must be considered in each productivity assignment.

c. The effect on worker productivity decrease from long periods of overtime is included in figure 6-1. Several tables and averaging charts have also been developed by private industry to show this effect. The cost engineer should carefully consider other alternatives such as schedule duration change instead of multiple shift work and discuss the impact of both options with the project manager.

6-3. Civil Works Program Specific Requirements

Civil works projects are normally heavy equipment oriented, and care should be used based on the tasks performed to insure reasonable production rates are used. Operational requirements for pumping on dredges is unique and appropriate details are covered in chapter 15 for preparing dredge estimates.

6-4. HTRW Program Specific Requirements

a. Labor productivity on an HTRW remedial action project will generally be lower than that of conventional construction due to the more stringent health and safety requirements associated with HTRW projects. One factor decreasing productivity is the restricted mobility of the worker due to the protective equipment and clothing which must be worn. Heat stress on the worker due to the protective gear will be a factor reducing productivity under certain climatic conditions. The amount of physical exertion required by a particular task may be classified in the range of light work to heavy work. Thus, production rates need to be estimated considering the classification of the work task, the climatic conditions, the restricted mobility, and other relevant factors in conjunction with the level of personal protection required for the task. These considerations will determine the amount of break time a worker needs based upon the task being performed. In addition to break time, other factors contributing to nonproductive time on a HTRW remedial action project include safety meetings, suiting-up, suit removal and personal decontamination, cleanup, and air tank change unless noted otherwise. The production rates (output) listed in the UPB are normal construction rates which do not take into account the non-productive time experienced on HTRW projects due to health and safety requirements stated above. Thus the UPB production rates will typically need to be reduced on an HTRW project.

b. The following are typical personal protection requirements depending on the level of protection

specified and example calculation to show reduced production rates.

c. Levels of personal protection. Each HTRW remedial action project will likely consist of work tasks requiring various levels of personal protection. 29 Code of Federal Regulations (CFR) 1910.120, appendix B (or 29 CFR 1926.65 appendix B) defines four basic levels: Level A, Level B, Level C, and Level D. Figure 6-2 depicts the different levels of protection. Each level is described below. An additional level, Modified Level D is also described. Together, the levels describe personal protective equipment options used to protect on-site workers at HTRW remedial action sites. The required protection levels for each HTRW contract is listed in the contract specifications.

(1) Level A: Level A is selected when the greatest level of skin, respiratory, and eye protection is required. Level A is the option of choice only in the most extreme exposure conditions Immediately Dangerous to Life and Health (IDLH) and is not used at typical HTRW sites except as a last option in an extreme emergency. Even then, SOP's for a site would typically specify evacuation in place of donning Level A. The following constitute Level A equipment:

Positive pressure, full-face, self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA.
Totally encapsulating chemical-protective suit.
Coveralls (optional).
Long underwear (optional).
Gloves, outer, chemical-resistant.
Gloves, inner, chemical-resistant.
Boots, chemical-resistant, steel toe and shank.
Hard hat (optional).

(2) Level B: Level B protection is used when the type and atmospheric concentration of substances have been identified which require a high level of respiratory protection, but a lesser level of skin protection; or when the atmosphere is less than 19.5% oxygen or other IDLH conditions exist without attendant severe skin hazards. The following constitutes Level B equipment:

Positive pressure, full-face, self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA.
Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one- or two-piece chemical splash suit; disposable chemical-resistant overalls).
Coveralls (optional).
Gloves, outer, chemical-resistant.
Gloves, inner, chemical-resistant.
Boots, outer, chemical-resistant, steel toe and shank.
Boot covers, outer, chemical-resistant, (disposable).
Hard hat (optional).
Face shield (optional).

(3) Level C: Level C protection is used when the concentrations and types of air contaminants are known and the criteria for using air purifying respirators are met. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin. The following constitute Level C equipment:

Full-face or half-mask air purifying respirators.
Hooded chemical-resistant clothing (overalls two-piece chemical splash suit; disposable chemical-resistant overalls).
Coveralls (optional).
Gloves, outer, chemical-resistant.
Gloves, inner, chemical-resistant.
Boots, outer, chemical-resistant, steel toe and shank.
Boot covers, outer, chemical-resistant (disposable).
Hard hat (optional)
Escape mask (optional).
Face shield (optional).

(4) Level D Modified: Level D Modified is a modified basic work uniform affording the same skin protection provided by Level C against direct contact with contaminated materials (i.e., contaminated dust) and/or liquid splashes, in the absence of inhalation hazards of any type. Level D Modified is not defined in 29 CFR 1910.120/29 CFR 1926.65, but has been defined through extensive reference in Site Safety and Health Plans prepared for HTRW projects. The following constitute Level D Modified equipment:

Hooded or nonhooded chemical-resistant or dust-resistant clothing (overalls; two-piece chemical splash suit; disposable chemical resistant and/or dust-resistant overalls).
Coveralls (optional).
Gloves, outer, chemical-resistant.
Gloves, inner, chemical-resistant.
Boots/shoes, chemical-resistant, steel toe and shank.
Boots, outer, chemical-resistant (disposable) (optional).
Safety glasses or chemical splash goggles.
Hard hat (optional).
Escape mask (optional).
Face shield (optional).

(5) Level D: Level D is a work uniform affording minimal protection, used for nuisance contamination only. Level D protection is used when the atmosphere contains no known hazard; and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. The following constitute Level D equipment:

Coveralls.
Gloves (optional).
Boots/shoes, chemical-resistant, steel toe and shank.
Boots, outer, chemical-resistant (disposable) (optional).
Safety glasses or chemical splash goggles.
Hard hat (optional).
Escape mask (optional).
Face shield (optional).

d. Ideally, HTRW site chemical hazards should be controlled through engineering controls or work practices to the extent that most, if not all, routine work in the exclusion zone can be performed in Level D where possible. The use of Level D Modified and other levels of protection place a significant heat burden on the worker under relatively moderate ambient temperature (70 degree F) conditions, and otherwise significantly impact worker productivity and comfort.

e. Productivity example. Example 6-1, Production, illustrates how HTRW productivity could be presented in an estimate. The example reflects excavation of contaminated soil at a hazardous waste site, using levels of protection A, B, C, and D+ at various project stages. A column is also included which reflects normal productivity for comparison. Paid time per day is 8 hours (480 minutes). Nonproductive time is that time required for standard losses, scheduled heat stress breaks, and dexterity losses due to personal protection, and is developed based on job-site conditions. Standard losses account for all time losses independent of temperature variations. They include safety meetings, instructions, donning/doffing personal protective equipment (PPE), decontamination, switching air supply/filters, monitoring delays, and cleanup. Scheduled heat stress breaks account for all paid rest periods per day. Dexterity losses account for a slowdown of normal work due to factors such as discomfort, clumsiness, weight, and restricted breathing and communication as a result of wearing PPE. Productive time is obtained by subtracting nonproductive time from paid time. Productivity is then calculated as a percentage ratio of productive time for each level of protection divided by productive time for normal work (430 minutes). The 430 minutes is based on a total paid time of 480 minutes minus a 50 minute delay on a (normal) clean site. The 50 minute delay is composed of 10 minutes safety meetings and instruction plus 10 minutes for clean up plus 30 minutes for breaks. This percentage is applied to a normal production rate (190 m^3/ hr) to arrive at a reduced production rate for each level of protection.

f. Once the reduced crew production rate has been developed, the cost engineer must decide whether or not to add additional crews to reduce the excavation time. If reduced excavation time reduces the total project time, overhead cost will be lower. This may result in lower total cost than would occur if additional crews were not added. Each remedial action task requiring personal protective equipment requires a productivity evaluation.

g. A USACE report, entitled "Productivity Study" for HTRW remedial action, contains additional detailed productivity considerations for an HTRW cost estimate. This report is available in all MSC and District Cost Engineering Offices. Estimating assumptions used in the productivity calculations for a particular HTRW remedial action project will be documented with notes. Table 6-1 and table 6-2 indicate the standard losses, scheduled/heat stress breaks and dexterity losses as a

factor of temperature and protection level. Figure 6-3 graphically illustrates the correlation between the protection level and productivity for heavy and light work.

Example 6-1. Production Example

This example is for light work with average temperature > 85 degrees

PROTECTION LEVEL		**A**	**B**	**C**	**D+**	**Normal**
Paid Time (minutes) (per person or crew)		480	480	480	480	480
Nonproductive Time(minutes):						
Standard Losses		160	140	128	76	20
Scheduled Heat Stress Breaks		120	86	101	63	30
Dexterity Losses		60	64	44	3	0
Nonproductive Time (min.)		340	290	273	142	50
Productive Time (minutes)		140	190	207	338	430
Productivity		140/430	190/430	207/430	338/430	430/430
	x	100%	100%	100%	100%	100%
	=	33%	44%	48%	79%	100%
Example: Normal production Rate (M^3/HR)		190	190	190	190	190
X Productivity		x .33	x .44	x .48	x .79	x 1.00
= Reduced Production Rate (M^3/HR)		63	84	91	150	190

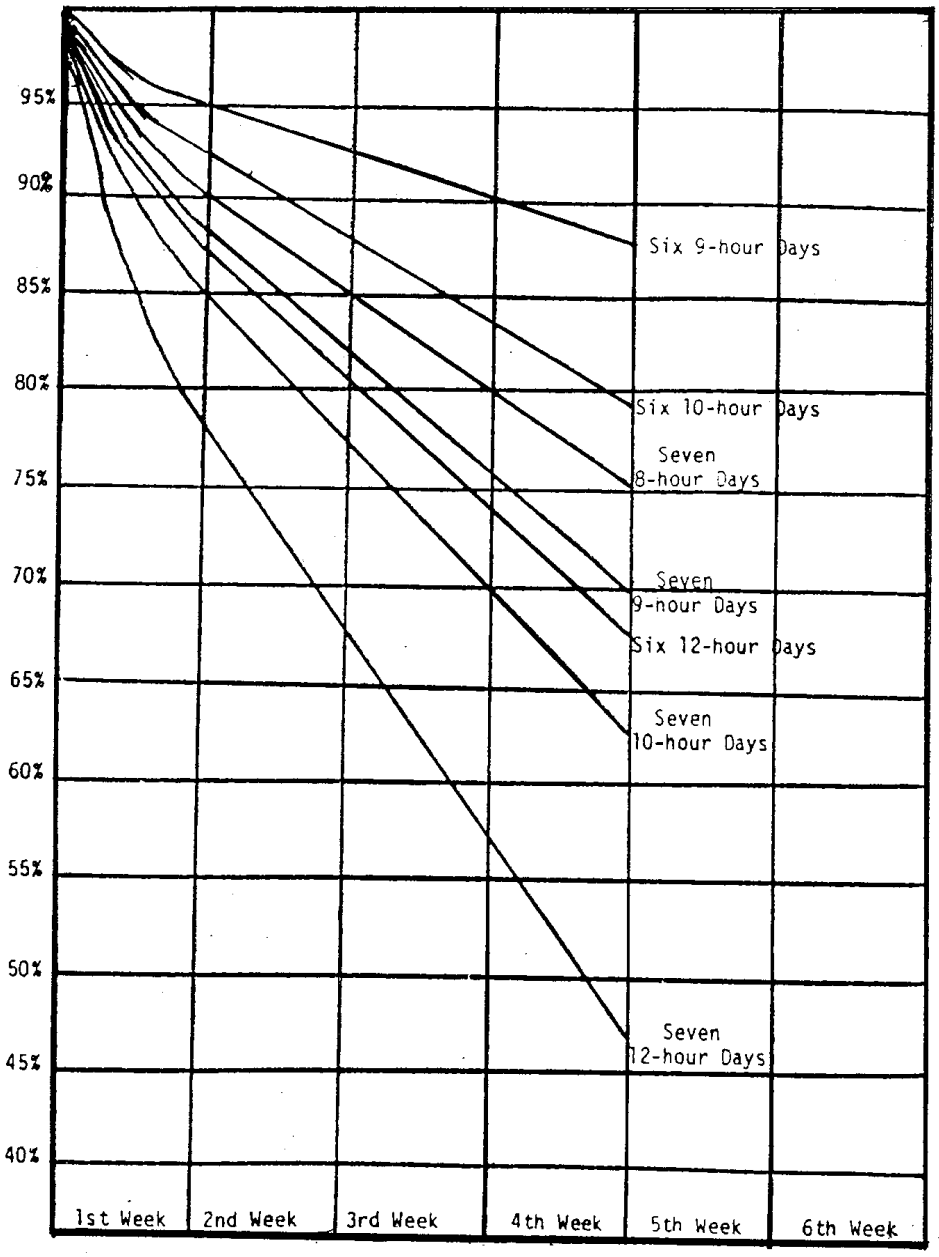
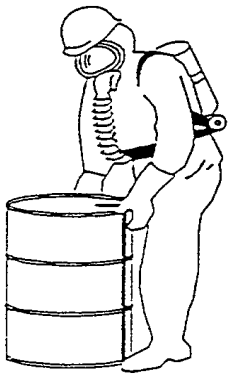


Figure 6-1. Productivity versus overtime

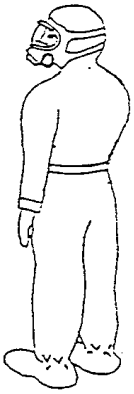
LEVEL A Protection

Totally encapsulating vapor-tight suit with full-facepiece SCBA or supplied-air respirator.



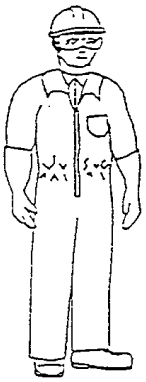
LEVEL B Protection

Totally encapsulating suit does not have to be vapor-tight. Same level of respiratory protection as Level A.



LEVEL C Protection

Full-face canister air purifying respirator. Chemical protective suit with full body coverage.



LEVEL D Protection

Basic work uniform, i.e., longsleeve coveralls, gloves, hardhat, boots, faceshield or goggles.

Figure 6-2. Levels of protection

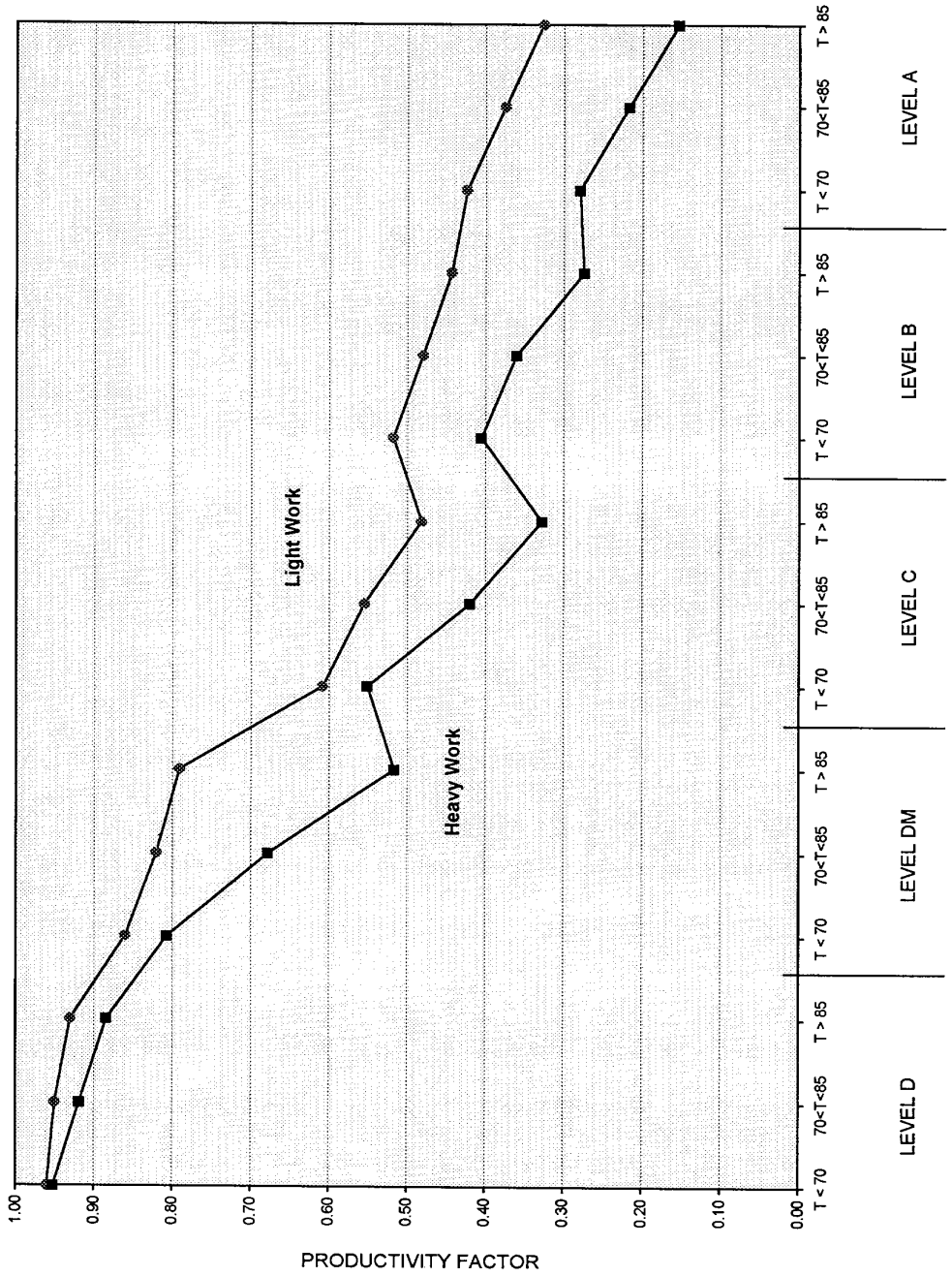


Figure 6-3. HTRW productivity factors

VARIABLES	U/M	LEVEL A			LEVEL B			LEVEL C			LEVEL D MODIFIED			LEVEL D		
		T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85
A. Standard Losses	Min	220	220	220	204	204	204	135	135	135	76	76	76	28	28	28
B. Scheduled / Heat Stress Breaks	Min	60	105	150	50	75	123	64	131	178	30	90	165	30	45	60
C. Dexterity Losses	Min	80	62	44	52	46	35	44	34	26	28	24	18	11	10	10
D. Total Time Lost per 8 hr MD	Min	360	387	414	306	325	362	243	300	339	134	190	259	69	83	98
E. Productive Time per 8 hr MD	Min	120	93	66	174	155	118	237	180	141	346	290	221	411	397	382
F. Productive Time on Clean Site	Min	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430
G. HTRW Productivity Factor		**0.28**	**0.22**	**0.15**	**0.40**	**0.36**	**0.27**	**0.55**	**0.42**	**0.33**	**0.80**	**0.68**	**0.51**	**0.96**	**0.92**	**0.89**

Notes:

1. Standard Losses account for all time losses independent of temperature variations. They include safety meetings, instructions, donning / doffing PPE, decontamination, switching air supply / filters, monitoring delays, and cleanup.
2. Scheduled / Heat Stress Breaks account for all paid rest periods per manday.
3. Dexterity Losses are based on subjective opinions of the percentage that PPE slows down a normal worker because of factors such as discomfort, clumsiness, weight, and restricted breathing and communication. The number of minutes actually worked is reduced by the percentage representing the average response for that particular PPE level.
4. Values for A, B, and C were derived by averaging the survey responses for each PPE level. Responses that varied greatly from the average were subject to omission at the author's discretion.
5. Total Paid Time = 480 Minutes
6. Delay on clean site = 10 min. safety meeting & instructions + 10 min. cleanup + 30 min. breaks
7. Calculations:
   D = A + B + C
   E = 480 - D
   F = 480 - 50
   G = E / F

   U/M = Unit of Measure
   MD = Man-Day
   Min = Minutes
   T = Temperature Farenheit
8. Level A protection is used in extreme emergency situations only. Productivity factors for Level A should be used with caution because they were extrapolated from 2 data points.

Table 6-1. HTRW Light Work

VARIABLES	U/M	LEVEL A			LEVEL B			LEVEL C			LEVEL D MODIFIED			LEVEL D		
		T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85	T < 70	0<T<8	T > 85
A. Standard Losses	Min	220	220	220	204	204	204	135	135	135	76	76	76	28	28	28
B. Scheduled / Heat Stress Breaks	Min	60	105	150	50	75	123	64	131	178	30	90	165	30	45	60
C. Dexterity Losses	Min	80	62	44	52	46	35	44	34	26	28	24	18	11	10	10
D. Total Time Lost per 8 hr MD	Min	360	387	414	306	325	362	243	300	339	134	190	259	69	83	98
E. Productive Time per 8 hr MD	Min	120	93	66	174	155	118	237	180	141	346	290	221	411	397	382
F. Productive Time on Clean Site	Min	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430
G. HTRW Productivity Factor		**0.28**	**0.22**	**0.15**	**0.40**	**0.36**	**0.27**	**0.55**	**0.42**	**0.33**	**0.80**	**0.68**	**0.51**	**0.96**	**0.92**	**0.89**

Notes:
1. Standard Losses account for all time losses independent of temperature variations. They include safety meetings, instructions, donning / doffing PPE, decontamination, switching air supply / filters, monitoring delays, and cleanup.
2. Scheduled / Heat Stress Breaks account for all paid rest periods per manday.
3. Dexterity Losses are based on subjective opinions of the percentage that PPE slows down a normal worker because of factors such as discomfort, clumsiness, weight, and restricted breathing and communication. The number of minutes actually worked is reduced by the percentage representing the average response for that particular PPE level.
4. Values for A, B, and C were derived by averaging the survey responses for each PPE level. Responses that varied greatly from the average were subject to omission at the author's discretion.
5. Total Paid Time = 480 Minutes
6. Delay on clean site = 10 min. safety meeting & instructions + 10 min. cleanup + 30 min. breaks
7. Calculations:
   D = A + B + C
   E = 480 - D
   F = 480 - 50
   G = E / F

   U/M = Unit of Measure
   MD = Man-Day
   Min = Minutes
   T = Temperature Farenheit
8. Level A protection is used in extreme emergency situations only. Productivity factors for Level A should be used with caution because they were extrapolated from 2 data points.

Table 6-2. HTRW Heavy Work

CHAPTER 7
CONSTRUCTION EQUIPMENT AND PLANT

7-1. General

Construction equipment and plant refers to the tools, instruments, machinery, and other mechanical implements required in the performance of construction work. Construction plant is defined as concrete batch plants, aggregate processing plants, conveying systems, and any other processing plants which are erected in place at the job site and are essentially stationary or fixed in place. Equipment is defined as items which are portable or mobile, ranging from small hand tools through tractors, cranes, and trucks. For estimating purposes, plant and equipment are grouped together as equipment costs.

7-2. Selection of Equipment

a. An important consideration in the preparation of an estimate is the selection of the proper equipment to perform the required tasks. The cost engineer should carefully consider number, size, and function of equipment to arrive at optimum equipment usage. Some factors to consider during the selection process are: conformance to specification requirements; job progress schedule (production rate); magnitude of the job; type of materials; availability of space; mobility and availability of equipment; suitability of equipment for other uses; equipment capabilities; number of shifts; distances material must be moved; steepness and direction of grades; weather conditions; hauling restrictions; standby time; and mobilization and demobilization costs.

b. The cost engineer preparing the estimate must be familiar with construction equipment and job-site conditions. The equipment selected should conform to contract requirements and be suitable for the materials to be handled and conditions that will exist on the project.

7-3. Estimating Methodology

The "crew concept" discussed in chapter 5 for construction cost estimates requiring detailed estimating of labor, materials, and equipment is to also be considered in costing equipment. For each significant work task, workers and equipment are expressed in the hourly cost and expected production rate. Where a major piece of equipment serves more than one crew, the total equipment time should be prorated between both crews.

7-4. Production Rate

After determining the type of equipment to be employed, the cost engineer should select the specific equipment size which has a production rate suited to the efficient and economical performance of the work. The size and number of units required will be influenced by equipment production rate, job size, availability of space for equipment operations, the project construction schedule for the various work tasks, number of shifts to be worked, and the availability of equipment operators. Emphasis must be placed on the importance of establishing a reasonable production rate. Production may be based on actual performance data, commercial manufacturer tables and ratings on MCACES historical equipment models and assemblies adjusted for project conditions.

7-5. Mobilization and Demobilization

a. Mobilization costs for equipment include the cost of loading at the contractor's yard, transportation cost from the yard to the construction site, including permits, unloading at the site, necessary assembly and testing, and standby costs during mobilization and demobilization. Trucks for the project capable of highway movement are usually driven to the site and are often used to transport minor items. All labor, equipment, and supply costs required to mobilize the equipment should also be included in the mobilization cost. When the equipment location is unknown, the mobilization and demobilization distance should be based on a circular area around the project site which will include a reasonable number of qualified bidders. Demobilization costs should be based on that portion of the equipment that would be expected to be returned to the contractor's storage yard and may be expressed as a percentage of mobilization costs. Transporting rates should be

obtained periodically from qualified firms normally engaged in that type work.

b. Mobilization and demobilization costs for plant should be based on the delivered cost of the item, plus erection, taxes, and dismantling costs minus salvage value at the end of the project. Maintenance and repair are operating costs and should be distributed throughout work accomplishment.

7-6. Equipment Ownership and Operating Expense Cost Rates

a. The Equipment Ownership Schedule in EP 1110-1-8 determines the hourly rates for equipment ownership and operating expense. These rates are also included in the UPB and will be used in the preparation of all cost estimates for owned equipment. These pamphlets have been developed for different geographic regions in the United States, and the appropriate pamphlet or UPB should be used based upon project location. Rented and leased equipment is also discussed in the EP and is appropriate for inclusion in the estimate at competitive rates if judgment determines this to be a reasonable approach by a prudent contractor.

b. In the event, the cost engineer develops costs for the actual equipment being used at a job site exceeding 40 hours per week, the rates shall be adjusted as described by EP 1110-1-8.

7-7. Plant Cost

In cases of highly specialized plant, 100 percent write-off of the total value of the plant may be justified for a particular project. For less highly specialized plant, some salvage may be anticipated, depending on storage cost, resale value, and probability of sale or reuse in the immediate future. The total project charge including operation, maintenance, and repair should be distributed in proportion to the time and item the plant is used on the various contract items. Cost of plant required for the production of concrete, aggregates, ice or heat for cooling or heating of concrete, etc., should normally be included in the estimate as part of the cost of these materials or supplies manufactured or produced at the site.

7-8. Small Tools

The cost of small power and hand tools and miscellaneous non-capitalized equipment and supplies-should be estimated as a percentage of the labor cost. The allowance must be determined by the cost engineer in each case, based upon experience for the type of work involved. Unit prices based on historical data already include a small tools allowance. The small tool cost will be considered as part of equipment cost. Such allowance can range typically up to 12 percent of direct labor cost. The cost engineer must ensure that this cost is not duplicated in the overhead rate percentages. The crews data base in the UPB does not contain a small tools allowance.

7-9. HTRW Program Specific Requirements

a. Equipment productivity is frequently reduced on HTRW projects due to restricted operator mobility because of unique HTRW Health and Safety requirements. Equipment production rates should therefore be adjusted to coincide with operator efficiency. Additionally, HTRW projects typically have three work zones; exclusion (hot), contamination reduction, and support (clean) zones. Equipment must be decontaminated as it leaves the exclusion zone to enter the support zone. Decontamination is conducted in the contamination reduction zone prior to entering the support zone. Equipment decontamination time must be included in the estimated equipment costs for equipment leaving the exclusion zone.

b. Equipment used for construction at Department of Energy (DOE) or other radioactive sites normally becomes contaminated with ionizing radiation (Alpha, Beta, or Gamma radiation). Threat of radiation to humans is primarily reduced by the use of distance, time, and/or shielding; thus, radiation on the equipment cannot generally be decontaminated, unless the radiation is on the surface only, and can be "wiped" clean by manual decontamination procedures. Only the natural decay process (also known as "half-life") of unstable isotopes or radio nuclides over time, reduces the level of radioactivity. Construction equipment contaminated with

radioactive materials having an extended half-life are not permitted to leave a contaminated area. Equipment contaminated with long-term half-life radio nuclides, is for the most part rendered useless, unless there is some other future construction planned in the same area. As a result, this equipment is either "moth-balled" at a safe distance within the radioactive contaminated area, or buried at the site. It is not uncommon for many types of equipment to be buried including tractors, backhoes, dozers, etc. The cost of equipment (including disposal) that will be working in radioactive contaminated areas must be carefully considered. It may be necessary to purchase the equipment for dedicated use at these sites, rather than to price out depreciated ownership costs by the hour. The cost engineer must review the contract specifications and/or contact a local health physicist to determine the type and degree of radioactive contamination for calculating equipment ownership costs. Hourly operating costs, however, would still need to be included in the estimate. The hourly operating costs should be taken from EP 1110-1-8 and adjusted for higher repair costs of equipment that must be repaired in a “hot zone”.

CHAPTER 8
MATERIALS AND SUPPLIES

8-1. General

a. Materials and supplies are defined below and, for the purpose of estimating, both can be considered materials unless they need to be separated because of different tax rates.

b. Materials. Those items which are physically incorporated into and become part of the permanent structure.

c. Supplies. Those items which are used in construction but do not become physically incorporated into the project such as concrete forms.

8-2. Sources of Pricing Data

a. General. Prices for materials and supplies may be obtained from pricing services, the UPB, catalogs, quotations, and historical data records. Each office should review the source of the pricing contained in these publications and assess the reasonableness prior to use. Standard unit prices from these sources are considered satisfactory only after an applicability determination has been made. Care should be taken when using this type of cost data to make proper allowances for quantity discounts, inflation, and other factors affecting contractor cost.

b. Quotes from manufacturers and suppliers. Quotes should be obtained for all significant materials and installed equipment and for specialized or not readily available items. Quotations may be received either in writing or telephonically. It is preferable to obtain quotes for each project to ensure that the cost is current and that the item meets specifications. If possible, more than one quote should be obtained to be reasonably sure the prices are competitive. The cost engineer should attempt to determine and ensure that contractor discounts are considered in the estimate. Quotes should be kept proprietary to preserve the confidentiality entrusted. A standard telephone quotation data sheet similar to that shown in appendix B should be utilized for recording.

8-3. Waste Allowance

Waste and loss considerations may be included in material unit price computations. This methodology results in a quantity takeoff of work placement which is not altered to reflect material losses. However, the alternative methodology of increasing the measured quantity by waste and loss quantity is acceptable if the excess quantity will not be used for any other purpose. The methodology used by the cost engineer should consider the impact of charging labor on the excess quantity. In either case, a note statement is required in the estimate explaining the methodology used.

8-4. Forward Pricing

Sometimes quotes are requested in advance of the expected purchase date. However, suppliers are reluctant to guarantee future prices and often will only quote current prices. It may, therefore, be necessary to adjust current prices to reflect the cost expected at the actual purchase date. This cost adjustment, if required, should not be included as a contingency, but should be clearly and separately defined in each estimate. Adjust current pricing to future pricing using program specific escalation factors. Computations of adjustment should be clear and should be maintained as cost estimate backup support.

8-5. Freight

a. The cost engineer should check the basis for the price quotes to determine if they include delivery. If they do not include delivery, freight costs to the project site must be determined and included. The supplier can usually furnish an approximate delivery cost. For delivery charge, Free on Board (FOB) refers to the point to which the seller will deliver goods without additional charge to the buyer.

b. If the materials or supplies are FOB factory or warehouse, freight costs to the construction site should be added to the cost of the materials or supplies.

c. If the cost of materials or supplies includes partial delivery, FOB to the nearest rail station, the

cost of unloading and transporting the materials or supplies should be included in the estimate.

d. If the materials or supplies are a large quantity in bulk from which would require extensive equipment for unloading and hauling, it may be desirable to prepare a labor and equipment estimate for the material handling and delivery.

8-6. Handling and Storage

The contractor is usually required to off-load, handle and stockpile, or warehouse materials on site. These costs should be included in the estimate. An item of electronic equipment requiring special low-humidity storage might have this special cost added to the direct cost of the equipment. For common items, such as construction materials or equipment needing secure storage, the cost for the security fencing**,** temporary building and material handling should be considered as an indirect cost and be included in the job-site overhead cost.

8-7. Taxes

When applicable, state and local sales tax should be added to the materials or supplies cost. In some states, material incorporated into Federal construction is exempt, but supplies are not. Care should be taken, therefore, that the sales tax rate is applied as required. The cost engineer should verify the tax rates and the applicability of these rates for the project location. Sales tax is considered to be a direct cost of the materials and supplies, and also should be applied to Government-Furnished Equipment (GFE) and included in the estimate.

8-8. Materials or Supplies Manufactured or Produced at the Site

If it is likely the contractor will manufacture or produce materials or supplies at the project site, a separate estimate component should be developed for this work. This estimate should be detailed equipment, labor, materials, and supplies estimate, and should conclude with a unit cost of material or supply delivered to the stockpile, storage yard, or other end point.

8-9. Government-Furnished Materials (GFM) or Equipment (GFE)

On some projects, the Government may provide some of the project materials. Government-furnished materials and equipment should be estimated in the same manner as other materials, except that the purchase price is not included. The estimate should include an allowance for transporting handling, storage from point of delivery and assembly, sales tax and installation if applicable. There may be special costs associated with Government-furnished materials such as insurance to cover loss until final installation, special storage costs, or special security measures. Note that these materials and procurement costs are normally to be included as part of the total project cost.

CHAPTER 9
SUBCONTRACTED WORK

9-1. General

a. In construction, specialty items such as plumbing, heating, electrical, roofing, plastering, and tile work are usually more effectively performed by subcontract. With so many specialties being performed, subcontract work becomes a very significant portion of the total costs of construction. Since each estimate should be prepared as practically and as realistically as possible, subcontract costs becomes a necessary consideration.

b. The cost engineer must first determine those parts of the work that will probably be subcontracted. When the work to be subcontracted has been determined, those items will be identified in the estimate. The appropriate subcontractor overhead and profit costs should be applied to subcontractor direct cost items in addition to the appropriate prime contractor overhead and profit.

c. The cost of subcontracted work is the total cost to the prime contractor for the work performed. Subcontractor's costs include direct labor, materials and supplies, equipment, second tier subcontracts, mobilization and demobilization, transportation, set-up, and charges for overhead and profit. Particular attention should be given to large items such as turbines, generators, and incinerators. The total subcontract cost is considered a direct cost to the prime contractor.

9-2. Use of Quotations

The cost engineer may utilize quotes for the expected subcontracted work when reviewed and verified as reasonable. In lieu of a quotation, each task of the subcontract should be priced as a direct cost with an appropriate rate of subcontractor's overhead and profit added. Subcontractor installed cost is shown in the UPB “Unit Cost” column. The “Unit Cost” must be a direct cost column in the MCACES cost estimate, or the “Unit Costs” will not be included in the project cost.

9-3. Civil Works Program Specific Requirements

On major rehabilitation projects, such as dams, locks, or power generating facilities, the cost engineer must ensure that costs for mobilization and demobilization, access to site, tear down or demolition work, contractor markup is included with the subcontractor costs or added to the prime contractor. This is particularly important for rebuilt or replacement of turbines for previously constructed projects, where ancillary costs, in addition to the rebuilt costs can exceed $1 million.

CHAPTER 10
OVERHEAD COSTS

10-1. General

a. Overhead costs are those costs which cannot be attributed to a single task of construction work. Costs which can be applied to a particular item of work should be considered a direct cost to that item and are not to be included in overhead costs. The overhead costs are customarily divided into two categories:

(1) Job office overhead, also referred to as General Conditions or Field Office Overhead.

(2) General home office overhead, commonly referred to as General and Administrative (G&A) costs.

b. The cost engineer must be sure that overhead costs are not duplicated between the two categories. Because of the nature of overhead costs, it is not practical to discuss all overhead items. Specific considerations must be carefully evaluated for each project. The cost engineer must use considerable care and judgment in estimating overhead costs. Many indirect cost items are frequently described in the General Requirements Section (CSI Division 01) of the contract specifications. If not related to a specific work task, these costs must be identified and appropriately assigned as overhead costs.

c. The application of a previously determined overhead rate may be used for early design stages, but it is not an accurate or reliable method of forecasting costs. Overhead will vary from project to project and may even vary from month to month within any given project. Job overhead items for the prime contractor should be estimated in detail for all projects at final design requiring a Government estimate. Detailing of overhead costs for subcontract work is recommended when the impact of these costs is significant. A job overhead model is included in the MCACES model data base and should be followed in estimating costs for overhead.

10-2. Job Office Overhead

a. Job overhead costs are those costs at the project site which occur specifically as a result of that particular project. Some examples of job overhead costs are:

(1) Job supervision and office personnel.

(2) Engineering and shop drawings/surveys.

(3) Site security.

(4) Temporary facilities, project office.

(5) Temporary material storage.

(6) Temporary utilities.

(7) Preparatory work and laboratory testing.

(8) Transportation vehicles.

(9) Supplies and maintenance facilities.

(10) Temporary protection and Occupational Safety and Health Administration (OSHA) requirements.

(11) Telephone and communications.

(12) Permits and licenses.

(13) Insurance (project coverage).

(14) Schedules & reports.

(15) Quality control.

(16) Cleanup.

(17) Taxes.

(18) Equipment costs not chargeable to a specific task.

(19) Operation and maintenance of temporary job-site facilities.

b. The costs of mobilization and preparatory work, including the setup and removal of construction facilities and equipment are part of overhead costs unless there is a specific bid item. For large projects, the cost for each part of this initial work should be estimated on a labor, materials, and equipment basis. For smaller projects, these costs may be estimated based on experience.

10-3. General Home Office Overhead (G&A)

a. Home office overhead expenses are those incurred by the contractor in the overall management of business, associated with all costs at the home office. Since they are not incurred for any one specific project, they must be apportioned to all the projects. Many expenses such as interest and entertainment are not allowable. Construction equipment depreciation is included in the EP 1110-1-8, Equipment Ownership Schedule cost rates and should not be included in the G&A rate. An accurate percentage of G&A can only be determined by an audit. On major changes requiring an audit, it is important to request that the G&A rate be determined.

b. Of all the categories of costs, the contractor's G&A costs are the least definable. Each contractor organizes its company differently from any other. Each incurs costs differently from varying sources and manages operations of that home office by itsown methodology. It is important to understand that home office costs are not standard and fixed. Even though the cost for a specific contractor varies from period to period, a rate is normally averaged as a computation of total home office costs over a sufficient period divided by the total volume of business during that specific period. This rate computation methodology allows distribution and projection to future project estimates. When more specific data is not available, the cost engineer may include empirical rates. Empirical G&A rates typically range from three percent for large contractors to ten percent for small contractors. Home office costs are typically included in the estimate of overhead as the product of an average experienced percentage rate times the expected contract amount. Typical categories of home office overhead are:

(1) Main office building, furniture, equipment.

(2) Management and office staff, salary and expense.

(3) Utilities.

(4) General communications and travel.

(5) Supplies.

(6) Corporate vehicles.

(7) General business insurance.

(8) Taxes.

10-4. Duration of Overhead Items

After the overhead items have been listed, a cost must be determined for each. Each item should be evaluated separately. Some items such as erection of the project office may occur only once in the project. The cost engineer should utilize the developed job schedule in estimating duration requirements. Costs reflective of each particular item during the scheduled period should then be applied. The product of duration and unit cost is the overhead cost for the item.

10-5. Sources for Pricing

The cost engineer must rely on judgment, historical data, and current labor market conditions to establish overhead costs. Sources for information can be obtained from current or past contractors bid data and audits. Some contractors will informally discuss and furnish information for overhead items and audit reports of previous similar projects. Other sources include previously negotiated modifications and review of organizational charts of construction firms for staffing and overhead costs evaluation. Overhead salaries should include an allowance for payroll taxes and fringes such as Federal Insurance Contributions Act (FICA), health benefits, and vacation.

10-6. Distribution of Overhead

The prime contractor's overhead costs, which have been costed in an organized format, should be summed and distributed to the various bid items. A proportionate distribution is commonly made by percentage ratio of total direct costs to those direct costs in each item. When additive or split-bid items are included, only those overhead costs which relate directly to the additive work should be distributed to those additive items. Those overhead costs which the contractor will incur regardless of additive or deductive items should be distributed to base bid schedule items only. Selective distribution ensures re-coupment of costs if only the basic contract scope is awarded. Regardless of the method of distribution, the estimates should clearly demonstrate the procedures and cost principles applied. For modification estimates, overhead requirements should be itemized and costed to reflect the actual net change in cost of overhead, that is, costs before and after the modification work. As a refinement to distribution, the cost engineer may reasonably and justifiably reduce the prime overhead distribution on subcontract work items. The balance of the total prime overhead should then be distributed as discussed above to the remaining prime items of work.

10-7. Civil Works Program Specific Requirements

For large cost civil works projects, the various tasks for overhead should be developed for each project, rather than using flat overhead percentage rates. Flat rates may be used during the preliminary studies, or when alternatives must be prepared if design is limited or not available.

10-8. HTRW Program Specific Requirements

a. A detailed checklist of overhead (general requirements) costs for HTRW projects is located under the second level 33 22 of the HTRW RAWBS document. Due to the importance of overhead costs in a HTRW estimate, a detailed listing of overhead should be developed for all remedial action estimates at the 30% design stage and beyond, in lieu of using a flat percent-age overhead rate. Some of the checklist items unique to HTRW projects includes the following:

b. Pollution liability insurance. HTRW contractors must generally insure themselves against causing increased pollution as a result of their construction activities. This requires that they procure adequate protection in the form of pollution liability insurance. However, on some HTRW jobs funded by Environmental Protection Agency (EPA), pollution liability insurance coverage may not be required if EPA indemnifies the contract. Indemnification basically holds the contractor harmless against liability resulting from release of a hazardous substance as a result of the construction activities for a period of 10 years. If the contract is not indemnified, a cost for pollution liability insurance must be included in the estimate (unless the premiums are reimbursed by EPA to the contractor) to cover that portion of the project that may be subject to pollution liability. Rates for pollution liability insurance are generally on a sliding scale with smaller insurance policies requiring a greater premium percentage. Table 10-1 serves as an example of pollution liability premium costs:

Table 10-1. Pollution liability insurance cost

Contract Amount	Pollution Liability Insurance Cost (% of Contract Amount)
Up to $1,000,000	2.0%
$1,000,000 to $5,000,000	1.2%
$5,000,000 to $15,000,000	0.8%
Over $15,000,000	0.7%

Coverage amounts and rates periodically change and should be verified by obtaining quotes from insurance companies.

c. Decontamination facilities. HTRW projects generally require decontamination of personnel and

equipment exiting the exclusion zone. Decontamination facilities commonly reside in the contamination reduction zone, located between the exclusion and support zones. Support costs for personnel, equipment, and supplies for the operation of the decontamination facilities must be included in the estimate. Costs should also be included for proper disposal of contaminated water, chemicals, and supplies/materials.

d. HTRW health and safety. This can be a significant portion of an HTRW project's costs. Some examples of health and safety are costs for a Certified Industrial Hygienist; Industrial Hygiene Technician, Radiation Protection Technologist; Certified Health Physicist; Site Safety and Health Officer; Air monitoring Technician; Chemical Quality Control Manager; Health and Safety Training; Medical Personnel and Exams; Personal Protective Equipment such as protective coverings, respirators, filters, and air supply; emergency equipment such as eye and body wash stations and showers; radioactive contamination protective equipment, etc. All necessary health and safety personnel, equipment such as monitoring equipment for release of hazardous substances, and other requirements must be included in the estimate. Health and safety costs do not however, include the additional cost attributable to production reduction. Additional costs due to reduced productivity are reflected in the labor and equipment direct cost work tasks. The unit price book contains costs for health and safety supplies and equipment. Costs for proper disposal and treatment of contaminated health and safety supplies and equipment must also be included in the estimate.

e. HTRW permits/taxes/fees. Some states require special permits and impose taxes and fees on HTRW waste generation. These would include taxes and fees for land disposal, incineration, treatment, and storage of hazardous wastes. These fees can have a tremendous impact on the ultimate disposal costs hazardous wastes. A USACE report, entitled "Report on Treatment, Storage, & Disposal Facilities," contains a detailed listing of taxes and fees by state and is available in all division and district cost engineering offices.

f. HTRW video monitoring/recording systems and photographs. HTRW projects usually require project photographs and videos throughout the remedial action process. Contract specifications will describe requirements in detail. Costs for photographs and video monitoring and recording systems are included in the UPB.

g. HTRW unique submittal. HTRW projects require some unique pre-construction plans. Costs for these plans should be included in the estimate. Some plans unique to HTRW and the professional level of effort and disciplines required to prepare the plans are shown in the table below. Level of effort depends on the nature and complexity of the project. The UPB contains average production rates and costs for each of the plans listed below. The cost engineer should consult with the appropriate technical personnel for each plan to insure that the correct level of effort is applied to each plan for the project. Some project specifications combine plans. Economies of scale should be considered when costing out combined plans. Also, full-time professional personnel costed out in job overhead may prepare plans as part of their normal salary. In such cases, costs for preparation of plans should not be double counted. Table 10-2 may be used to estimate the level of effort for the principal discipline to prepare each type of plan. It does not include time for secretarial, project manager, or other support personnel and incidentals such as reproduction, and mailing. These costs should be added separately.

Table 10-2. Level of effort per discipline

TYPE OF PLAN	LEVEL OF EFFORT (MH)	DISCIPLINE
Chemical Data Acquisition Plan	50 - 300	Chemist
Spill Control Plan	20 - 40	Environmental Engineer
Pollution Control Plan	40 - 100	Environmental Engineer
Site Safety and Health Plan	24 - 240	Certified Industrial Hygienist
Air Monitoring Plan	24 - 240	Certified Industrial Hygienist
Site Security Plan	8 - 24	Environmental Engineer
Contaminated Water Storage & Treatment Plan	0 - 100	Environmental Engineer
Work Plan	16 - 40	Civil Engineer
Well Installation Plan	8 - 80	Geologist
Soil Sampling Plan	8 - 80	Geologist

CHAPTER 11
PROFIT

11-1. General

Profit is defined as a return on investment. It is what provides the contractor with an incentive to perform the work as efficiently as possible. A uniform profit rate should be avoided.

11-2. Weighted Guidelines Method

a. Reference is made to FAR and EFAR Subparts 15.9 concerning the use of weighted guidelines method for determining profit. EFAR directs the use of the weighted guideline method when price is negotiated. The determination of profit, as appropriate for each procurement action, may be determined and submitted on the sample worksheet identified as figure 11-1. Explanation of the factors to be used in calculating profit, are described below, and shown in table 11-1.

b. The weighted guidelines method yields a reasonable profit value and should be used to determine profit for all contracts that include profit. The methodology is also to be used wherever a detailed direct costing method is used for baseline and control estimates. A rate of profit may be used based on historical experience for early stage estimates prepared for programming, reconnaissance, or concept design.

c. Based on the circumstances of each procurement action, each of the factors listed in table 11-1 will be weighted from 0.03 to 0.12 as discussed in the following text and provided in table 11-1. Statements in sufficient detail to explain the reasons for assigning the specific weights shall be included on the profit computation sheet. The value will then be obtained by multiplying the rate column by the weight column. The value column when totaled indicates the fair and reasonable profit percentage.

(1) Degree of risk. Where the work involves no risk or the degree of risk is very small, the weighting should be 0.03; as the degree of risk increases the weighting should be increased up to a maximum of 0.12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Other things to consider include the portion of the work to be done by subcontractors; the nature of work; where the work is to be performed; the reasonableness of negotiated costs; the amount of labor included in the costs; and whether the negotiation occurs before or after the period of performance of work.

(2) Relative difficulty of work. If the work is difficult and complex, the weighting should be 0.12 and should be proportionately reduced to 0.03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider include technical nature of the work; by whom work is to be done; location of work; and time schedule.

(3) Size of the job. Work not in excess of $100,000 will be weighted at 0.12. Work estimated between $100,000 and $5,000,000 will be proportionately weighted from 0.12 to 0.05. Work from $5,000,000 to $10,000,000 shall be weighted at 0.04 and work in excess of $10,000,000 at 0.03.

(4) Period of performance. Jobs in excess of 24 months are to be weighted at 0.12. Jobs of lesser duration are to be proportionately weighted to a minimum of 0.03 for jobs not to exceed 30 days. No weight is given when additional performance time is not required.

(5) Contractor's investment. Jobs are to be weighted from 0.03 to 0.12 on the basis of below average, average to above average of contractor investment. Things to consider include amount of subcontracting; mobilization payment item; Government-furnished property; method of making progress payments; and front end requirements of the job.

(6) Assistance by Government. Jobs are to be weighted from 0.12 to 0.03 on the basis of below average to above average. Things to consider include use of Government-owned property; equipment and facilities; and expediting assistance.

(7) Subcontracting. Jobs are to be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be 0.03 and such weighting proportionately increased to 0.12 where all work is performed by the contractor's own forces.

d. A separate profit calculation should be performed for the prime contractor and for each subcontractor. When the subcontractor assumes the risk and responsibility for portions of the work, the prime contractor's profit rate on that work should be decreased. As a general rule, profit is applied as a percentage rate to the total of all costs required by the contract or modification scope. For early design stage estimates, a rate of profit may be assumed based on past historical experience.

11-3. Civil Works Program Specific Requirements

a. Contract Award. Profit is not included in civil works Government estimates prepared for contract award. However, profit is included in all estimates prepared for programming of funds for projects and for contract modifications.

b. Work for Others. Profit may be included for projects funded by nonfederal users in work for others.

11-4. HTRW Program Specific Requirements

For HTRW Remedial Action work funded by civil works appropriations, the paragraph above governs concerning profit. However, for HTRW Remedial Action Work funded by HTRW or military appropriations, all CWE's and Government estimates are to include prime contractor profit.

Project: _____ Estimated By: _____

Contract No: _____ Checked By: _____

Change Order No. _____ Date: _____

Profit Objective For: (Prime Contractor, Subcontractor)

Factor	Rate (%)		Weight (0.03 - 0.12)		Value
1. Degree of Risk	20	x	_____	=	_____
2. Difficulty of work	15	x	_____	=	_____
3. Size of Job	15	x	_____	=	_____
4. Period of Performance	15	x	_____	=	_____
5. Contractor's Investment	5	x	_____	=	_____
6. Assistance by Government	5	x	_____	=	_____
7. Subcontracting	25	x	_____	=	_____
	100%		Profit Factor:		_____ %

COMMENTS (Reasons for Weights Assigned):

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Figure 11-1. Weighted guidelines profit sheet

Table 11-1. Guidelines for weighted factors profit determination

Degree of Risk (Judgmental):

Degree	Weight
Small	0.03
High	0.12

Relative Difficulty of Work (Judgmental):

Degree	Weight
Difficult	0.12
Simple	0.03

Size of Job:

Value (x 1000)			Weight	Value (x 1000)			Weight
$ 0	to	100	0.120	$ 2,701	to	2,800	0.081
101	to	200	0.119	2,801	to	2,900	0.800
201	to	300	0.117	2,901	to	3,000	0.079
301	to	400	0.116	3,001	to	3,100	0.077
401	to	500	0.114	3,101	to	3,200	0.076
501	to	600	0.113	3,201	to	3,300	0.074
601	to	700	0.111	3,301	to	3,400	0.073
701	to	800	0.110	3,401	to	3,500	0.071
801	to	900	0.109	3,501	to	3,600	0.070
901	to	1,000	0.107	3,601	to	3,700	0.069
1,001	to	1,100	0.106	3,701	to	3,800	0.067
1,101	to	1,200	0.104	3,801	to	3,900	0.066
1,201	to	1,300	0.103	3,901	to	4,000	0.064
1,301	to	1,400	0.101	4,001	to	4,100	0.063
1,401	to	1,500	0.100	4,101	to	4,200	0.061
1,501	to	1,600	0.099	4,201	to	4,300	0.060
1,601	to	1,700	0.097	4,301	to	4,400	0.059
1,701	to	1,800	0.096	4,401	to	4,500	0.057
1,801	to	1,900	0.094	4,501	to	4,600	0.056
1,901	to	2,000	0.093	4,601	to	4,700	0.054
2,001	to	2,100	0.091	4,701	to	4,800	0.053
2,101	to	2,200	0.090	4,801	to	4,900	0.051
2,201	to	2,300	0.089	4,901	to	5,000	0.050
2,301	to	2,400	0.087	5,001	to	10,000	0.040
2,401	to	2,500	0.086				
2,501	to	2,600	0.085	Over		10,000	0.030
2,601	to	2,700	0.084				

Table 11-1 (continued)

Period of Performance:	Weight
Over 24 Months	0.120
23 to 24 Months	0.116
22 to 23 Months	0.112
21 to 22 Months	0.109
20 to 21 Months	0.105
19 to 20 Months	0.101
18 to 19 Months	0.098
17 to 18 Months	0.094
16 to 17 Months	0.090
15 to 16 Months	0.086
14 to 15 Months	0.082
13 to 14 Months	0.079
12 to 13 Months	0.075
11 to 12 Months	0.071
10 to 11 Months	0.068
9 to 10 Months	0.064
8 to 9 Months	0.060
7 to 8 Months	0.056
6 to 7 Months	0.052
5 to 6 Months	0.049
4 to 5 Months	0.045
3 to 4 Months	0.041
2 to 3 Months	0.038
1 to 2 Months	0.034
Under 30 Days	0.030

Contractor's Investment (Judgmental):

Degree	Weight
Below average	0.03
Average	0.07
Above average	0.12

Assistance by Government (Judgmental):

Degree	Weight
Below average	0.12
Average	0.07
Above average	0.03

Table 11-1 (continued)

Subcontracting :

Subcontracting	**Weight**
80% or more	0.030
70% to 80%	0.042
60% to 70%	0.055
50% to 60%	0.068
40% to 50%	0.080
30% to 40%	0.092
20% to 30%	0.105
10% to 20%	0.118
0	0.120

CHAPTER 12
SURETY BONDS

12-1. General

a. Surety bonds are three-way agreements between a bidder or contractor (the principal), and a second party (the surety), to assure fulfillment of the principal's obligations to a third party (the obligee). If the principal obligations are not met, the bond assures payment to the extent stipulated of any loss sustained by the obligee.

b. In most Government construction contracts, these three parties are as follows:

Three Party:	Under a General Contract:	Under a Subcontract:
The Principal	Contractor	Subcontractor
The Obligee	Government	Contractor
The Surety	Surety	Surety

12-2. Purpose of Bonds

a. The purpose of surety bonds varies with the type of bond.

b. Bid bonds or bid guarantee provide an assurance that the bidder will not withdraw his (her) bid within the specified period for acceptance and will execute a written contract and furnish the required bonds if the bid is accepted.

c. Payment bonds protect subcontractors, suppliers, and laborers against nonpayment by the prime contractor.

d. Performance bonds ensure the contractor will complete the project as specified and for the agreed price. It does not shift responsibility for administering the contract to the surety. A performance bond provides a financial guaranty for the work and provides the contractor with a method of freeing his(her) working capital and other assets which might otherwise be tied up by other forms of security such as certified checks, retainage, or deposits.

12-3. Amount of Required Surety Bonds

The amount included in the estimate should be based on the contract requirements, the bond rules, premium rates, and, if known, the actual contractor bond cost.

Performance and payment bonds are required for all construction contracts of $100,000 or more and some form of payment guarantee for lesser value contracts (FAR 28.102). The cost of all performance, payment bonds, and other types of bonds determined to be appropriate by the cost engineer are allowable costs.

12-4. Rules Governing the Application of Bond Rates

a. Bonds are classified as Class A, Class B, or Class A-1, depending on the type of construction to be performed. If the contract is susceptible to two classifications, normally the higher rate is applicable (table 12-1).

b. Separate contracts take the same classification as a general contract. Neither the classification nor the rate is changed by subdividing the work or by the Government's providing certain materials.

c. Subcontracts take the same classifications and rates as general contracts.

d. For states in conformance (nondeviating) with the Surety Association of America (SAA) rates (table 12-1) where the construction time exceeds the bond stipulated time of 12 months, add 1 percent of the bond premium for each month in excess of 12 months.

e. For states in conformance (nondeviating) with the SAA rates (table 12-1) where the construction time exceeds the bond stipulated time of 24 months, add 1 percent of the basic premium for each month in excess of 24 months.

f. For states not conforming (deviating) with the SAA rates where the construction time exceeds the bond stipulated time of 12 months, add 2 percent of the basic premium for each month in excess

of 12 months up to 24 months and 1 percent of the basic premium for each month in excess of 24 months.

g. If the consent of the surety is not required and given for changes or extras, first and renewal premiums for the additional cost thus caused are computed at manual rates from the date of the bond.

h. If the consent of the surety is required and given for changes or extras, premium for the additional cost thus caused is computed at manual rates from the date of such surety's cost.

12-5. Cost of Performance and Payment Bonds

a. Performance and payment bonds are normally obtained as a single package. The premium is the same as for the performance bond alone. Rates vary with the type of the contract work, the dollar value, and the length of the contract.

b. The coverage limit of performance bonds is specified in each contract and is usually for the full amount of the contract price (bid amount). The premium is adjusted at the completion of the work for any modification changes in the contract price other than changes due to time bonuses or penalties. If the original contract price is increased through change order, the contractor must pay an additional premium. Conversely, if any part of the original work is deleted and the original price thereby reduced, the contractor will receive a refund from the surety.

c. It should be noted the surety industry has become a state regulated industry. The SAA issues advisory rates, but these rates may or may not be accepted by the state involved. Therefore, actual rates charged by surety corporations may vary from state to state.

d. Table 12-2 shows the various types and classes of bonds.

e. Example 12-1 illustrates the calculation of bond premium cost. Since the rates are subject to change and may vary by state, the calculations are to be used as a sample only. The cost engineer is responsible for ensuring the rates used are accurate and current. This example assumes a canal excavation project in Tennessee to be accomplished at an estimated cost of $2.5 million, including profit with a duration of 20 months. From table 12-2 excavation is found in Class B. Referring to the Class B rate schedule in table 12-1, the premium for a performance-payment bond written in the full amount of the contract price (including bond) and by a nondeviating Surety Association Company would be calculated as follows:

Example 12-1 - Bond premium calculation

	Estimated Amount	x	Bond Rate	=	Premium
First	$ 100,000		@ $25.00/M		$ 2,500
Next	400,000		@ 15.00/M		6,000
Next	2,000,000		@ 10.00/M		20,000
Anticipated Estimated Amount (inc. bond)	$2,500,000				$28,500
(20 mos - 12 mos = 8 mos surcharge)					
Eight additional months @ 1%/ MONTH					
	(8 mo x 1% x $28,500)				2,280
TOTAL PREMIUM					$30,780

12-6. Civil Works Program Specific Requirements

Most types of civil works projects are classified as Class B.

12-7. HTRW Program Specific Requirements

The cost of performance bond for HTRW projects is normally higher than for conventional construction projects. This is primarily due to the surety industry concern regarding uncertainties related to changing state-of-the-art design requirements and risk associated with HTRW projects. The SAA does not publish separate pricing guidelines for HTRW

projects. Some surety companies will quote rates to contractors for remedial action contracts. The rates depend on the contractor qualifications such as size of company, past performance, HTRW cleanup experience, and other factors. When preparing a remedial action estimate, the cost engineer should contact surety companies in an attempt to obtain a bond rate for the project. If the cost engineer does not obtain direct information from the surety companies, table 12-3 is a guideline developed by the HTRW CX which may be used to estimate bond cost for HTRW projects.

Table 12-1 Bond Rates

1. Performance and performance-payment bond rates and lump sum and unit fixed -price contracts where the stipulated time for completion is not over 12 months (Bond rates may change and should be verified on an annual basis).

a. Non-deviating SAA advisory rates per $1,000 of contract value for all jurisdictions except South Carolina, Louisiana, Delaware, Hawaii, and Arkansas are as follows:

Amount of Contract Price	Class B	Class A	Class A-1
First $ 100,000	$25.00/M	$15.00/M	$9.40/M
Next 400,000	15.00	10.00	7.20
Next 2,000,000	10.00	7.00	6.00
Next 2,500,000	7.50	5.50	5.00
Next 2,500,000	7.00	5.00	4.50
Over 7,500,000	6.50	4.50	4.00

b. Deviating rates from companies that may or may not belong to the SAA and are dependent on competition and contractor net worth. The following rates per $1000 of contract value are typical of a large contractor having a preferred rate structure:

Amount of Contract Price	Class B	Class A	Class A-1
First $100,000	$10.00/M	$7.50/M	$4.90/M
Next 400,000	8.00	5.50	4.50
Next 2,000,000	7.00	5.00	4.10
Next 2,500,000	6.00	4.40	3.80
Next 2,500,000	5.00	3.80	3.50
over 7,500,000	4.50	3.25	2.95

2. Performance and performance-payment bond rates for lump sum and unit fixed -price contracts where the stipulated time for completion is not over 24 months (Bond rate may change and should be verified on an annual basis). Nondeviating SAA advisory rates per $1,000 of contract value for South Carolina, Louisiana, Delaware, Hawaii, and Arkansas are as follows:

Amount of Contract Price	Class B	Class A	Class A-1
First $ 500,000	$14.40/M	$10.80/M	$7.20/M
Next 2,000,000	8.70	6.72	6.00
Next 2,500,000	6.90	5.28	4.92

Table 12-2 Contract bonds rate classifications

Next 2,500,000	6.30	4.92	4.44
Over 7,500,000	5.76	4.44	3.96

Class A
Unless otherwise stated, the rates on the preceding page apply to contracts for furnishing and installing, or installing only, certain services or equipment such as the following:

Airport runways
Aluminum siding
Athletic fields
Beacon or flood lights
Burial contracts
Ceilings (metal or acoustical tile)
Certain walls (nonstructural)
Coal storage
Ducts (underground power, light, phone)
Elevators/escalators
Glazing
Greenhouses
High-pressure power piping
Janitorial service
Machinery made to special order
Map making
Mill work
Murals
Parking areas
Planting and cultivation of land
Playgrounds and parks
Research contracts
Ski lifts
Sprinkler systems
Stone (furnishing, delivering only)
Storage tanks, metal
Tennis courts
Water carnage of freight
Water proofing (except with gunite)
Wind tunnels

Class B
Unless otherwise stated, the rates on the preceding page apply to contracts such as the following:

Airport buildings
Aqueducts
Atomic energy plants
Breakwaters
Canals and canal lining
Carpentry
Coal stripping
Commercial buildings
Concrete work
Dams
Dikes
Ditches
Docks and dry-docks
Drilling contracts
Educational buildings
Electrical
Embankments
Excavations
Filling stations
Filtering plants
Fountains
Garbage disposal plants
Gasoline cracking plants
Gas compressor stations
Gas mains and laterals
Gas piping
Golf courses
Grain elevators
Gunite contracts
Heating systems
Hospital buildings
Incinerators
Industrial buildings and plants
Jetties
Landscaping
Locks
Masonry
Missile installations
Nuclear reactors
Office buildings
Offshore platforms
Painting
Piers
Piling
Pipelines for water
Plastering
Plumbing
Power plants
Public improvement
Railroad roadbeds
Sand blasting
Sculptures
Sea walls
Sewage disposal plants
Sewers/septic tanks
Shipyards
Spillways
Stone
Subways
Swimming pools
Terminals - buses
Test boring
Tile and terrazzo
Transmission or distribution lines
Tunnels
Underwater cables
Ventilation systems
Water works
Wells
Wharves

Table 12-2 (Continued)

Class A-1

Unless otherwise stated, the rates on the preceding page apply to contracts for furnishing and installing, or installing only, certain services or equipment such as the following:

Arms
Ash conveyors
Automatic stokers
Automatic telephone exchange equipment
Automotive service contracts
Band concerts
Bird control
Boiler re-tubing and repair
Bookbinding
Cataloging
Coal handling machinery
Computers and data processing equipment
Conveyors
Data processing and computer work
Doors/Dynamos
Exterminating contracts
Fire alarm systems
Fire escapes
Flag poles
Floats
Floors
Furnishing food services
Gas tanks
Generators
Grain doors, salvage and disposal
Guard rails
Heating
Incinerator operation
Insulation contracts
Kitchen equipment
Laboratory equipment
Leasing of motor vehicles
lightning rods
Lock gates
Mail handling machinery
Metal windows and shutters
Mosquito control contracts
Movies
Office personnel
Organ repairs
Ornamental iron work
Parking meters
Photogrammetric work
Pipelines for oil or gas
Police alarm systems
Projectiles
Public address and music systems
Radio towers
Radiological equipment
Recapping automobile tires
Repair of automobiles and trucks
Re-smelting old metal
Rip rap stone (furnishing only)
Rolling stock
Scaffolding cost engineer should
Sidewalks
Signaling systems on railroads
Signs (all)
Stack rooms
Stand pipes
Street and subway lighting systems
Temporary personnel services
Thermostat equipment
Toll gates
Track laying
Traffic control systems on highways
Training manuals
Tree trimming and removal
Watchmen and signal services
Water towers
Weather stripping
Weed mowing
Window cleaning
Work and labor
X-Ray inspections

Table 12-3. HTRW bond rates

Contract Amount	**Asbestos Only**	**Asbestos and Lead Only**	**Other HTRW**
Up to $3,000,000	2.0%	3.0%	4.0%
$3 M to $5 M	1.9%	2.8%	3.5%
$5 M to $ 7.5 M	1.8%	2.6%	3.0%
Over $7,500,000	1.7%	2.4%	2.5%

CHAPTER 13
OTHER COSTS

13-1. General

This Chapter provides guidance regarding other costs not specifically identified in previous Chapters, but costs that must be included in the preparation of detailed project cost estimates.

13-2. Contractor Competition and Market Analysis

a. Each Government estimate for procurement will reflect the fair and reasonable cost to a prudent contractor for performing the scope specified. Although contractor bids will reflect the anticipated competitiveness, the Government estimate must remain the "yardstick" against which cost reasonableness is judged. Therefore, Government estimates can contain adjustments due to quotations on direct and indirect costs, but no separate adjustment due to competitiveness or bid strategies.

b. During development of the design-stage CWE, market competitiveness may be considered for funding and design alternatives. When competition is included in the CWE, it should be clearly defined and made known to the program manager.

13-3. Other Project Costs

a. Civil Works. The total CWE includes all Federal and authorized non-Federal costs. Specific components of the TOTAL CWE include lands and damages; construction features; planning, engineering and design; construction management and the appropriate contingencies and escalation through completion of construction. The specific other costs not previously discussed are addressed in the following paragraphs:

(1) Lands and damages. Costs will be included for all Federal and non-Federal real estate activities necessary for implementation of the project after completion of the feasibility study for land acquisition, construction, and completion of crediting lands, easements, right-of-way, relocation, and disposal (LERRD), mitigation requirements, and other items as delineated in the CWBS, along with the appropriate contingencies and escalation.

(2) Engineering and design. Costs will be included for all activities associated with the planning, engineering, and design effort necessary for preparation of each construction contract and for support during construction through project completion. This includes all in-house labor based upon work-hour requirements, material and facility account costs, AE contracts, additional studies, travel and overhead, along with appropriate contingencies and escalation. Costs will be developed in detail in accordance with the established CWBS.

(3) Construction management. Costs will be included for all construction management activities from pre-award requirements through final contract close-out, including in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel, and overhead along with the appropriate contingencies and inflation. Costs will be developed in detail in accordance with the established CWBS.

b. Military. The CWE for military projects include the sum of the costs for construction, other allowable direct projects costs such as communications, plus contingencies, S&A, and EDC.

(1) Construction S&A. An allowance or cost calculation for construction management is normally included in each CWE. Planning estimates may include S&A, a factor expressed as a percentage applied to the subtotal of the construction contract. The rate of S & A and its application is further discussed in the specific program regulation. The current authorized S&A percentages for MILCON projects are 6 percent for CONUS and 6.5 percent for OCONUS. For operation and maintenance projects the current authorized S&A percentages are 8 percent for CONUS and 8.5 percent for OCONUS.

(2) In order that a total project estimate be prepared, other project costs identified in project requirements and in Corps procedures need to be

estimated. These costs, such as EDC, as-built drawing preparation, O & M manual preparation, need to be identified and included as determined by the project manager and specific program requirements.

c. HTRW. The CWE or Total Project Cost for HTRW projects may include cost escalation, design contingencies, construction contingencies, S&A, EDC, as-built, O&M manuals, and Government laboratory Quality Assurance (QA).

(1) These costs are typically funded as part of construction and thus are added at the recap of all remedial action estimates. The cost engineer should coordinate with the project manager to determine whether or not all of these costs are applied to the project. These costs except escalation and design contingencies (in design/build projects) are not added to official Government estimates that are used for comparison with contractor bids or proposals, unless specified to be included with the contractor bid or proposal.

(2) Government laboratory QA costs are costs incurred by the Government for verification of questionable contractor laboratory results and for analysis of samples taken by Government representatives during the course of the remedial action. These costs are normally included as the last cost item to make up a HTRW total CWE. The following percentages will be used for other estimated costs for HTRW remedial action projects. If the cost engineer has an alternative method of determining these costs, then the basis, rationale, and/or calculations shall be shown in the project notes portion of the estimate. Any future guidance from HQUSACE reflecting rate changes will supersede the rates below.

(a) Construction management costs (S&A): S&A costs for EPA projects are charged based on actual costs. If available, actual historical S&A cost information on past similar projects should be used as a basis for S&A, in lieu of the fixed percentage shown below:

EPA Superfund and Other EPA:
8% for contracts up to $2,000,000
6% for contracts over $2,000,000

DOD/DERP and DOE:
8% for all contracts.

(b) Engineering During Construction (EDC):

EPA Superfund and Other EPA:
1.5% for contracts up to $2,000,000
1.0% for contracts over $2,000,000

DOD/DERP and DOE:
0.5% for all contracts.

(c) O&M Manual Costs:

EPA Superfund and Other EPA:
1.5% for all contracts.

DOD/DERP and DOE:
1.5% for all contracts.

(d) As-Built:

EPA Superfund and Other EPA:
0.5% for all contracts.

DOD/DERP and DOE:
0.5% for all contracts.

(e) Government Laboratory Quality Assurance:

EPA Superfund and Other EPA:
1.0% for all contracts.

DOD/DERP and DOE:
1.0% for all contracts.

(3) Operation costs for HTRW projects. For remedial action projects which include treatment or disposal, it is likely that the project will include operation of a plant during construction and following construction. Operation includes labor, equipment, and materials necessary to operate the plant. It includes such items as bulk chemicals, raw materials, fuel and utilities usage, maintenance and repair, etc. Short- term operation of plant is typically included in the construction contract. Long-term operation of plant typically is under a service contract. The cost engineer must check the wage determinations since wage rates for service contracts are generally different than wage rates for construction contracts.

(4) HTRW disposal costs. There are special requirements and costs associated with disposal and transportation of HTRW waste. Disposal of HTRW waste at an offsite Treatment, Storage, or Disposal Facility (TSDF) requires that standards imposed by Federal and State regulatory agencies be met. For instance, the EPA has created specific standards for each of ten types of TSDF regulated under the Resource Conservation and Recovery Act (RCRA). Types of disposal or treatment at these facilities include containers, tanks, surface impoundments, waste piles, land treatment facilities, landfills, thermal treatment units, chemical, physical and biological treatment facilities, and injection wells. As a result, disposal costs for HTRW materials are significantly higher than for other materials. A number of TSDF's are engaged in commercial disposal of hazardous waste. Some of the TSDF's publish fee schedules and will give price quotes for disposal of various categories of hazardous waste. However, because hazardous waste frequently consists of many different types of contaminants, TSDF's sometimes require that a sample of the hazardous material be submitted to them for analysis before they quote a price for disposal, or even agree to accept the waste. A USACE report entitled, A Report on Treatment, Storage, and Disposal Facilities (TSDF) for HTRW has been prepared that lists in detail all operating commercial hazardous waste landfills, incinerators, cement kilns, and deep well injection facilities in the United States. Facility brochures and fee schedules are provided in the report for some of the facilities. The report is available in all Division and District cost engineering offices.

(5) Transportation. Transportation of hazardous waste to TSDF's is also subject to special charges. Licensing is required by both Federal and State authorities for intrastate and interstate hauling of hazardous waste. Manifests must accompany transportation of the waste material. Specialized containers and packaging are often required to transport hazardous waste, such as roll-off containers, rubber or poly-lined containers, drums and drum over-packs. Costs incurred for transportation and disposal of hazardous waste should be included in HTRW estimates. Division 2 of the UPB contains unit price costs for transportation packaging. Division 13 contains unit prices for landfill disposal costs and disposal fees and taxes. The report on TSDF's also includes transportation fees for hazardous waste.

13-4. Cost Escalation

a. Cost estimates, when finalized, must reflect the total cost during the entire duration of construction. These costs will reflect cost inflation beyond the effective pricing level (date) of the baseline estimate. Such escalation must be identified as a separate element within the cost estimate. This allows the cost engineer the ability to easily adjust the estimate to reflect schedule changes. The methodology for developing cost escalation varies with each program.

b. Civil Works. EM 1110-2-1304 will be used to update unit prices and various project cost features to current price levels. Inflation factors for use in predicting future costs will be those developed by the Office of Management and Budget (OMB). The OMB factors are published by HQUSACE, Programs Division (CECW-B), in an Engineer Circular (EC) for the Annual Program and Budget Request for Civil Works Activities.

c. Military Programs. The Tri-Service Military Construction Program (MCP) Index will be used to project escalation due to inflationary factors. The Tri-Service indexes are based on forecasts of anticipated escalation for the future fiscal years issued by the Comptroller of the Department of Defense. The MCP index is updated annually and available through EIRS Bulletins and PAX System Newsletters.

d. HTRW. The Tri-Service MCP Index will be used to project escalation costs for all military HTRW remedial action estimates.

13-5. Contingencies

a. Contingencies are used to cover unknowns, unforeseen uncertainties, and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared, but must be represented by a sufficient cost to cover the identified risks.

Contingencies relate to a known and defined project scope and are not a prediction of future project scope or schedule changes.

b. Contingencies are normally separated into two elements for incremental analysis - design contingencies and construction contingencies.

(1) Design contingencies are assigned to cover construction cost increases due to design incompleteness, detail changes, alternative design changes, and associated costing inaccuracy. Design contingencies will normally decrease as design information becomes known.

(2) Construction contingencies are a reserve for construction cost increases due to adverse or unexpected conditions such as unforeseeable relocations; foundation conditions; utility lines in unknown locations; quantity overruns; or other unforeseen problems beyond interpretation at the time of or after contract award.

c. When considerable uncertainties are identified, cost risk analysis can establish the areas of high cost uncertainty and the probability that the estimated project cost will or will not exceed the actual cost. Cost risk analysis is a process to consider costs and risks as follows:

(1) Identify risks within a project that could result in cost change.

(2) Measure this change impact on the estimated cost.

(3) Manage these risk elements to avoid their negative consequences. This type of analysis is an in-depth approach that replaces a simple percentage rate contingency assignment. Computer programs are commercially available to perform cost risk analysis and are discussed in appendix E.

13-6. Application of Contingencies

a. Contingency allocations are specifically related to the project uncertainties and should not be reduced without appropriate supporting justification. The decision to reduce these uncertainties and improve the cost estimate through additional investigations or studies, or to proceed with the higher cost estimate, is a management decision.

b. Civil Works.

(1) The goal in contingency development is to identify the uncertainty associated with an item of work or task, forecast the risk/cost relationship, and assign a value to this task that will limit the cost risk to an acceptable degree of confidence. Consideration must be given to the details available at each stage of planning, design, or construction for which a cost estimate is being prepared. During development of the project cost estimate, sufficient contingencies should be added at the lowest title or detail level where the risks or uncertainties have been identified. Contingencies may vary throughout the cost estimate and could have a significant impact on overall costs. The reasons for final contingency development and assignment must be included in the cost estimate as a part of the project narrative. When the contingency factors shown in table 13-1 are applied to any portion of the cost estimate up to the feature level, the statement "Normal design variances are expected - normal contingency values used" is acceptable in addressing that specific portion.

(2) The contingency factors in table 13-1 are based on percentage and represent a reasonable guide for the construction features of the cost estimate. The table provides a guide for contingency development and is not intended to restrict or limit contingencies to these values. If the overall contingency value developed through a detailed analysis exceeds these guidelines, additional site analysis and/or design should be considered in those areas where uncertainties may be reduced.

(3) At construction contract award, a minimum contingency of five percent of the contract amount must be available for contract modification. This contingency is not included in the Government estimate, but must be available in accordance with ER 5-7-1 (FR). As a project nears completion, this contingency must be reduced accordingly.

c. Military Programs.

(1) The design contingency covers component items that cannot be analyzed or

evaluated at the time the estimate is prepared; however, such items are susceptible to cost evaluation as engineering and design progresses. The magnitude of design contingency is determined by the level of technical complexity of the project for which the estimate is being prepared.

(2) The following design contingency factors in table 13-2 represent a reasonable guide for the component items of the estimate. Non-Army programs should be checked for other specific guidance provided by the agency responsible for criteria concerning design specifically related to contingencies.

(3) Construction contingencies. Contingency percentages for military projects should be determined in accordance with ER 1110-3-1300 and/or Army latest guidance. The current authorized construction contingency percentages are 5 percent for new construction and 10 percent for renovation/alteration for projects within the boundaries, continental United States (CONUS). Construction contingencies more than the authorized percentages should be fully justified and supported by a risk analysis.

d. HTRW. Contingency percentages for HTRW projects should be determined for and applied at each second (system) level WBS cost in the HTRW remedial action estimate as structured by the HTRW RAWBS. The total HTRW contingency is the sum of the design contingency plus construction contingency. HAZRISK is the statistical cost risk analysis system that will be used to determine contingencies.

(1) Design contingencies represent construction cost unforeseen when the estimate is prepared due to incomplete design. The extent of site characterization and assessment that has been accomplished to compute project quantities must be considered when determining design contingencies for HTRW construction costs. For example, estimates of groundwater volume and concentration are often possible only after field pump tests are completed. Many feasibility study estimates are prepared prior to these tests and so must rely on assumed volumes and concentrations. Unit price history is also lacking for many of the newer remedial technologies. Design contingencies should be higher for new or emerging state-of-the-art remedial action systems than for systems with well-documented histories. Design contingencies should be developed using cost risk analysis prediction tools or a design/cost team group analysis. Design contingencies may need to be included in estimates at the as-advertised project stage for those remedial action treatments for which the design is not available to the cost engineer such as design-build or performance specification processes/ treatments where the remedial action (construction) contractor performs the design. The design contingency percentages in table 13-3 represent a reasonable guide for design contingencies for remedial action projects.

(2) Construction contingencies should be higher for new state-of-the-art remedial action systems than for well-documented systems. Considerations will include the technological, geotechnical, and other unknowns applicable to the construction or remedial action phase. Construction contingencies are applied to all pre-design estimates and on CWE during the design stages. Official Government estimates which are used for comparison with contractor bids or proposals will not include an amount for construction contingencies. Generally, fifteen percent is the recommended percentage to use for construction contingencies, unless there is a basis for a different percentage such as a risk analysis prediction or a design/cost team group analysis.

Table 13-1. Contingency factors for construction features

Phase of Project Development	Factors: Const. Cost ≥$10,000,000	Factors: Const. Cost <$10,000,000
Reconnaissance/ Feasibility	20%	25%
Project/Feature Design Memorandum	15%	20%
Plans and Specifications	10%	10%

Table 13-2. Technical complexity levels and design contingency factors for military construction projects

Technical Complexity Level		Design Contingency Factor	
Level	Description	Pre-Concept	Concept
LOW	Site adapted, repetitive standard design project involving routine technology	1.050	1.025
MEDIUM	Unique design involving complex technology	1.100	1.050
HIGH	Unique design involving highly complex technology	1.150	1.100
ULTRAHIGH	Unique design involving extremely complex or innovative technology	1.250	1.150

Table 13-3. Design contingencies for remedial action projects (The following design contingencies represent construction costs, unforeseeable at the time of estimate preparation, which are likely to become known as project design proceeds.)

Remedial Action Technology (RAWBS)	Project		Design	Stage	
	0%	30%	60%	90%	100%
Soil Excavation (33.08.)	15-55%	10-40%	5-25%	0-10%	0%
Groundwater Treatment (Multiple) (33.12.)	15-35%	10-25%	5-15%	0-5%	0%
On-Site Incineration (33.14.)	15-35%	10-25%	5-15%	0-5%	0%
Extraction Wells (33.06.)	10-30%	5-20%	5-15%	0-5%	0%
Vertical Barriers (33.06.)	10-30%	5-20%	5-15%	0-5%	0%

Table 13-3. (continued)

On-Site Storage (33.05.,33.06.,33.09.)	15-20%	10-15%	5-10%	0-5%	0%
Synthetic Cap (33.08.)	10-20%	5-15%	5-10%	0-5%	0%
Sludge Stabilization (33.15.)	10-20%	5-15%	5-10%	0-5%	0%
Off-Site Disposal (33.18.,33.19.)	5-15%	5-10%	0-5%	0%	0%
Off-Site Incineration (33.14.)	5-15%	5-10%	0-5%	0%	0%
Drum Processing (33.10.)	5-15%	5-10%	0-5%	0%	0%
Bulk Liquid Processing (33.09.)	5-15%	5-10%	0-5%	0%	0%
Groundwater Treatment (Single) (33.12)	5-10%	5-10%	0-5%	0%	0%
Clay Cap (33.08.)	5-10%	5-10%	0-5%	0%	0%
Surface Grading/Diking (33.05.)	5-10%	5-10%	0-5%	0%	0%
Revegetation (33.20.)	5-10%	5-10%	0-5%	0%	0%

CHAPTER 14

CONTRACT MODIFICATIONS AND OTHER NEGOTIATED PROCUREMENT

14-1. General

a. FAR/ EFAR, Part 36 requires an independently prepared Government estimate for modifications in excess of $100,000. Normally, estimates are not required for changes less than $100,000, but are required by the Contracting Officer for unilateral modifications. For contract modifications, the amount refers to the sum of the absolute value of increases and decreases. For example, a modification containing an increase of $60,000 and decrease of $45,000 has an absolute value of $105,000, and a Government estimate would be required.

b. The cost engineer should become familiar with the modification and claim processes. Training relevant to construction modifications is included in the prospect program.

14-2. Directives

Those responsible for the preparation of cost estimates for contract modifications should be thoroughly familiar with the requirements set forth in FAR, DFAR, AFAR, EFAR, and the appropriate ER. The acronyms for the Federal Acquisition Regulations are listed in the Glossary

14-3. Negotiated Procurement and Contract Modifications

a. The cost engineer has several important tasks to perform prior to actually preparing the estimate. The cost engineer will prepare a technical analysis of the proposed procurement action or contract modification. Some of the major activities to be considered in preparing the technical and cost analysis in addition to labor, material, equipment and construction techniques include:

(1) *Reviewing available documents and becoming thoroughly familiar with the scope and requirements of the changed work.* This will perhaps entail a comparison and analysis and discussions with the designer or field office to ensure common understanding of the scope of work. The cost engineer must assure that the proposed modification or procurement action is clearly defined with regard to specified work requirements, proposed measurement, and payment.

(2) *Determining the status of construction and the effect the changed work will have impact on the construction schedule*. This will require obtaining progress reports, schedules, and discussion with the field office responsible for the construction. For major or complex changes, a visit to the construction site is required.

(3) *Becoming fully aware of the contractor's existing methods, capabilities, and rates of accomplishment.* The estimate should not arbitrarily include methods and capabilities different from the method in which the contractor is performing the ongoing work. The cost engineer should base the change on existing contractor operations for similar work. When work is anticipated to be subcontracted, the estimate should be prepared to include subcontractor costs.

(4) *Obtaining current labor and equipment rates for the work force and work actually ongoing.* These rates are usually available from labor reports or from the contractor upon request. Suppliers for materials should be contacted for quotes. The price which the contractor is expected to pay should be the basis for estimating material costs. A list of equipment on the job should be obtained and equipment rates be determined in accordance with EP 1110-1-8, Equipment Ownership Schedule.

b. As a team member working with the negotiator, coordinate with the contractor to agree on scope of work and format prior to preparation of the Government estimate and submittal of the contractors proposal. This discussion will assist both the Government and contractor in reaching a mutually accepted scope of work to eliminate unnecessary effort for both parties during negotiations.

14-4. Preparation of Cost Estimates and Negotiation

a. The estimate can be prepared after all the information has been collected and analyzed, and the cost engineer decides upon the format to present the change. It is important to have a prior agreement and discussion as previously indicated with the contractor. Generally, successful negotiations depend on agreement in scope of work and accurate quantity take-off and a detailed estimate supported by accurate cost data for all elements. General guidance for the calculation of direct costs are noted as follows:

b. For additional work, items and format should be priced similar to a new contract as performed by the known contractor. New work should be priced at the rates anticipated to be in effect at the time the work will be performed.

c. For changed work, a separate quantity takeoff for each item directly affected will be required for both before and after the change. Each item should be priced at the rates which would be in effect at the scheduled time of accomplishment. Typically, each item of changed original work is priced, and each comparable item of revised work is priced at the applicable rates. The net cost (or credit) would be obtained by subtracting the total of the original work from the total of the revised work. It is important that the cost engineer maintain a comparable scope of work for both estimates. When an item of work will be performed as originally specified, except for a revision in quantity, the net quantity may be estimated directly for that item.

d. For deleted work, the item and format should be priced similar to a new procurement as performed by the current contractor. Rates in effect at the time the work would have occurred should be used. In addition to the direct cost of the work, overhead, profit, and bond costs should be included for credit on the deleted work.

e. Impact related costs, if applicable, should be clearly described and included as a part of each cost estimate.

f. The cost estimate for a modification should be prepared in as much detail as required to clearly cost the change for negotiations. In many instances, even more detail is required to negotiate the lowest reasonable price. The estimate should, however, be modified to reflect a negotiated procurement in lieu of an advertised procurement. It should include a general summary sheet relating the major categories of cost of the modification, both for increases and decreases. Revised construction drawings and specifications are included in the modification supporting documents. When the cost engineer prepares the estimate, the effort should be the same as the contractor acting prudently under the given conditions. The results will generally provide an accurate estimate which can be used as a firm basis for negotiation. The Government estimate should not rely on past generalized rates and settlements unless actually appropriate to the specific modification under consideration.

14-5. Cost Considerations

The estimate should be based on the data actually collected and experienced from the project. Time motion studies are important, and periodic field visits and log records can provide this data. Previous modifications can also provide valuable data. Valuable cost data is often available from past audit reports on other modifications. With the assistance of the auditor, many costs can be readily obtained and may be directly applicable to the present modification. The cost engineer must exercise judgment in the use of audit information from a specific report which may not be released.

14-6. Timeliness of Preparation

Timeliness of the estimate for modification is as important as its accuracy. Procurement requirements stress the importance of settlement prior to commencing the work. Therefore, the cost engineer should immediately proceed to obtain the necessary data for the modification and notify the appropriate authorities of the earliest date that the estimate can be completed. It is generally understood that the larger and more complex the change, the longer the time requirement for the initial preparation of a accurate cost estimate.

14-7. Impact Costs

a. When a modification is initiated, the settlement of that modification includes not only the cost and time change of the work directly affected but also the cost and time impact on the unchanged work. The impact portion of a modification is very important to be estimated accurately. The scope of impact may be broad and susceptible to a large variety of situations. The following discussion will provide guidance and understanding of impact cost considerations.

b. Generally, the greatest portion of impact costs results from acceleration and/or delays due to changes. When delays due to a change can be minimized, impact costs are reduced. Impact costs are normally determined on a case-by-case basis for each particular situation. The determinations have been based on interpretation of the Contract Clauses and on Board of Contract Appeals and court decisions.

c. Impact costs are generally presented by the contractor as part of the proposal. The existing construction schedule furnished by the contractor must be analyzed to determine the actual construction and the extent of the impact at the time of the change. The modification work must be superimposed upon the original schedule in such a position to determine and minimize the delay. The revised plan must then be thoroughly reviewed relative to the existing job plan. This comparative review should indicate those areas which have been affected by the modification.

d. Once the extent of impact has been determined, each cost claimed must be classified as either factual or judgmental. The factual costs are those which are fixed and established and can be determined directly from records. These include rental agreements, wage rate agreements, and purchase orders. Once the item has been determined valid as a factual impact, the item cost may be directly calculated. The amount of cost change is stated on the certified document or can be determined from the scheduled time change of the construction progress plan. Judgmental costs are those which are dependent on variable factors such as performance, efficiency, or methodology and cannot be stated factually prior to actual accomplishment. These must be negotiated and based upon experienced judgments. In actual practice, most factual costs are based to varying degrees upon judgment.

e. The estimate of impact should be prepared for each activity affecting the change. In some cases, the impact items are typically so interrelated that it is often best to develop a detailed plan for accomplishing the remaining work. Each item in this plan would be estimated at the productivity and rate in effect at the time the work is to be accomplished. The same items of work under the original plan would also be estimated at the productivity and rate in effect at the originally scheduled time. The comparison of the these two estimates yields the cost of impact. Impact costs determined to be valid must be estimated by the most accurate method available and included in the modification.

f. The following impact factors or conditions play a recurring role in determining impact costs. Each modification must be evaluated separately and impact costs considered specially for the implications of the particular change.

(1) Impact costs considered factual include escalation of material and labor wage rates, and change in equipment rates.

(2) Impact costs considered judgmental include change of efficiency resulting from rescheduling; loss of labor efficiency resulting from longer work hours; loss of efficiency caused by disruption of the orderly existing processes and procedures; inefficiency from tearing out completed work and the associated lowering of morale; loss of efficiency during rescheduling of manpower; inefficiency incurred from re-submittal of shop drawings, and sample materials; additional costs resulting from inability to transfer manpower expertise to other work; and change in management for the revised work.

(3) Impact costs considered factual but should be based on judgmental decisions including increase from extending the storage period for

materials and equipment; increase from extending the contract for labor cost and subsistence; increase from a longer period of equipment rentals or use; increase from a longer period of utilizing overhead personnel, materials, and utilities; and increase from a longer period of providing overhead and project office services.

g. Impact costs should only be included by detailed itemization and only after having been found to be valid.

14-8. Support for the Negotiations

a. Before participating as part of a negotiating team, the cost engineer must become thoroughly familiar with negotiating requirements and techniques. The expertise and support of the cost engineer can be very beneficial in major and complex changes.

b. Many of the costs that are presented in the contractor's proposal breakdown must be reviewed for allowability. Of those costs found allowable, each item must further be reviewed for applicability for that portion relevant to the particular change. The auditor has primary responsibility for this determination and should advise the negotiation team accordingly. For those cases where the auditor is not directly involved, the negotiation team must base their decisions on regulatory guidance and the best expertise available. In accomplishing the review of the proposal, the cost engineer should remain constantly aware of the contractor's profit motivation. The Government must consider all reasonable costs anticipated to be incurred by the contractor.

c. In some cases, portions of the cost estimate may be revealed only to the extent determined necessary by the negotiator to settle disputed items of work. The total of the Government estimate will not be released during negotiations. On occasion, important information has been revealed through negligence by allowing the estimate to lay open upon the negotiation table. The "For Official Use Only" designation will be removed after issuance of a signed modification.

d. Revision of the Government estimate may be necessary as a result of an error, changed conditions, or additional information. Approval authority for revisions to the estimate remains the responsibility of the Contracting Officer or authorized original estimate approving official. When the Government estimate is changed during or subsequent to conferences or negotiations, the details of the basis for the revision or changes in price shall be fully explained and documented in the price negotiation memorandum, see EFAR 36.203(102). A copy of each estimate that has been approved should be included in the official modification file along with the details and circumstances causing the revisions.

14-9. HTRW Program Specific Requirements

a. Special types of contracts have been developed to accomplish work for HTRW remediation. The following list discusses these contracts in very broad terms to aid the cost engineer to be aware of the various special contracts and significant features and intended use of each. These contracts are not necessarily available for use by all divisions and districts. This summary is not intended to aid in a decision as to the appropriateness of a specific type for a specific remediation, but only to aid the cost engineer in awareness of the type of contracts that may be available for use. The list includes contracts for studies and investigations, remedial design, and remedial action (construction). As new technologies and methods of clean-up are developed, it is expected that new specific remediation contracts will be developed; therefore, the following list will likely change over time.

b. Environmental Compliance Assessment System Contracts (ECAS). These are Cost-Plus Award Fee (CPAF), Architect Engineer Indefinite Delivery Type (AEIDT) contracts for environmental assessments at installations or facilities (Army Installations, Air Force Bases).

c. Rapid response contracts. These are Cost-Plus (CP), Indefinite Delivery Type contracts, one year plus four one-year options to perform time-

critical removal actions as defined by CERCLA. Work on-site is typically initiated within 45 days. Either Service Act rates or Davis-Bacon wage rates are paid based on the nature of the work. This contract provides on-site remedial action and minimal design services.

d. Immediate response contracts. These contracts provide immediate response to cleanup, remove, stabilize, etc., of hazardous substances. The contracts are CP type that require the contractor to respond within 72 hours of notice to clean up a site. These are not the Emergency Response Actions contracts that perform within 24 hours to an incident or spill. The Immediate Response contract provides a permanent solution to the incidence.

e. Pre-placed Remedial Action Contracts (PPRA). These are preplaced contracts to accomplish remedial action. No provisions are included for design. These are indefinite delivery order contracts with a base plus four one-year options and either firm-fixed price or cost reimbursable delivery orders.

f. Preplaced Architect-Engineer Indefinite Delivery Type contracts. These are preplaced design contracts with base plus four one-year options.

g. Total Environmental Restoration Contracts (TERC). These are Indefinite Delivery Type contracts to accomplish design, investigations, and construction for HTRW remediations.

h. Disposal or environmental contracts. These are typically preplaced Indefinite Delivery Type contracts. Disposal contracts can be HTRW or Naturally Occurring Radioactive Materials (NORM) type contracts which provide for long-term disposal at approved sites. Environmental contacts can be for the transportation or collection of HTRW type wastes.

CHAPTER 15
PREPARATION OF DREDGE COST ESTIMATES

15-1. General

a. This chapter provides guidance for estimating the dredging portion of a project.

b. Associated work items, such as clearing and grubbing, dike or weir construction, disposal area operation and maintenance, drilling and blasting, and environmental protection, are not included and should be estimated separately in accordance with other parts of this manual.

c. Each cost engineer should be aware of various techniques that have proven to produce the most accurate results for specific projects in their district/MSC.

d. Estimates will be prepared in accordance with the software program entitled, "Cost Engineering Dredge Estimating Programs (CEDEP)" and will contain a narrative documenting reasons for decisions and selections made by the cost engineer. Figure 15-1, Dredge Prism, indicates project dimensions and quantity of material considerations to determine pay items.

15-2. Definitions

a. Allowable down time. "Allowable down time" is "Non-effective working time" (see Noneffective working time).

b. Allowable over depth not dredged. "Allowable over depth not dredged" is the volume of "Allowable over depth volume" that is estimated and will not be dredged.

c. Allowable over depth volume. "Allowable over depth volume" is the volume of material between the required pay prism and the maximum pay prism.

d. CEDEP. CEDEP is the acronym for the three Cost Engineering Dredge Estimating Programs that operate on Microcomputers. The three software programs developed are Pipeline; Mechanical CEDEP; and Hopper CEDEP.

e. Dredging time. "Dredging time" is "Operating time" plus "Allowable downtime."

f. Effective working time. "Effective working time" is time during the dredging operation when actual production is taking place, such as material moving through the pipeline. "Effective working time" is chargeable to the cost of work.

g. Gross production cost. "Gross production cost" is the cost of dredging the gross volume. It is determined by multiplying the total monthly cost by the dredging time in months and adding the fixed and indirect costs.

h. Gross volume. "Gross volume" is the "Net pay volume" plus the "Nonpay volume."

i. Lost time. "Lost time" is downtime, which is not operational, normally due to a lack of required crew, major repairs and alterations, dry-docking, cessation, and collisions. "Lost time" is not chargeable to the cost of work.

j. Maximum pay volume. "Maximum pay volume" is the sum of the "Required volume" and the "Allowable over depth volume."

k. Net pay volume. "Net pay volume" is the "Maximum pay volume" minus the "Allowable over depth not dredged."

l. Non-allowable downtime. "Nonallowable downtime " is " Lost time" (See "Lost Time").

m. Noneffective working time. "Noneffective working time" is time during the dredging operation when the dredge is operational but no production is taking place, such as making changes to pipelines, cleaning trash from the suction head, minor operating repairs, and moving between locations. "Noneffective working time" is chargeable to the cost of work.

n. Nonpay volume.

(1) "Nonpay volume" based on excavation measurement is the volume of material estimated to be removed from outside the maximum pay prism.

(2) "Nonpay volume" based on fill measurement is the volume of material that results in overfill and/or washes away.

o. Operating time. "Operating time" is the "Effective working time" (See "Effective working time").

p. Percentage of effective working time. (See "Time efficiency.")

q. Required volume.

(1) "Required volume" based on excavation measurement is the volume of material to be removed from within the required pay prism.

(2) "Required volume" based on fill measurement is the volume of material to be placed within the pay prism.

r. Time efficiency. "Time efficiency" is the ratio of the "Operating time" to the "Dredging time," and is expressed as a percentage. Also known as "Percentage of effective working time" (% of EWT).

15-3. Development of Dredging Estimate

a. It is the general policy of the Corps of Engineers that dredging estimates be performed by cost engineers. The method of development of dredging estimates, in descending order, are as follows:

b. Historical information. The simplest and most reliable approach for estimating production for all types of dredges is to rely upon dredging records for the same or similar type work performed by the same or at least a similar dredge. The dredging records include the daily dredging reports. If project conditions have changed, for example, a different horsepower or haul distance, historical production information must be adjusted and documented for use in the estimate. Using such adjustments is a valid method for obtaining production rates when historical data is not available. Some valuable sources of historical dredging data include daily reports of operations, operations personnel, other districts, and regional dredge teams. Cost and pricing data may be obtained from audits and contract modifications. Adjustments should be made to this data reflecting current pricing levels.

c. Similar projects. Information may be obtained from similar projects with similar characteristics to prepare a dredging estimate.

d. Regional dredge teams. The use of regional dredge teams is recommended. Members of regional dredge teams can be contacted for guidance on production rates, effective times, cost data, or other pertinent information.

e. Combining Methods. A combination of the methods, as previously described, may be used at the discretion and judgment of the cost engineer.

f. Computer programs. When historical data is not available, CEDEP may be used to compute a production rate, or the production rate may be computed using recognized commercially generated programs or industry generated programs. The cost engineer should include in the estimate a complete statement of the source of computer program used in the estimate.

15-4. Project Overview

a. The cost engineer should review the known project conditions and scope of work for the following items and determine which items are judgmental and which are factual at the time the estimate is prepared.

b. Location of work. This information is necessary to make a determination of availability of historical data, plant availability, mobilization distances, disposal areas, and restraints placed on the various types of dredge operations.

c. Type of material to be dredged. Information may be obtained from geotechnical investigations, expert opinion, historical data of specific site or adjoining areas, site visits, or similar projects with similar characteristics.

d. Placement area. Information should be obtained on location, size, type, regulatory and permit requirements.

e. Project dimensions. Project dimensions may include such items as length, width, depth, and channel alignment.

f. Site restrictions. This may include such items as waterway usage, vessel traffic, as well as time, weather, noise, and environmental restraints. Many areas are subject to restricted dredging seasons. To minimize environmental impacts creating scheduling conflicts, higher costs may occur and must be considered and documented in the cost estimate.

15-5. Selection of Equipment

a. An economical dredge shall be selected. Dredge type and size depend mainly on availability, job duration, type of material, exposure to the elements, disposal area restraints, environmental restraints, and production requirements. The narrative will include the rationale used by the cost engineer for equipment selection.

b. Pipeline Dredging. The term "pipeline" refers to the discharge method through on-board pumps. The common types are cutterhead, suction, and dustpan dredges which refer to the intake method. Pipeline dredges are sized by the inside diameter of the dredge discharge flange, and they are effective in dredging densely packed materials. Although they are best suited for low-traffic areas and sheltered waterways such as rivers, bays, harbors, and canals, some pipeline dredges are equipped to operate in calm to moderate seas offshore. Pipeline dredges lend themselves well to shore disposal operations.

c. Hopper Dredging. Hopper dredges are sized or classed by their hopper capacity. However, a particular size dredge is actually limited by its weight carrying capacity and the environmental restrictions of the project. Hopper dredges operate in cycles, and they normally cover the length of the total dredging area, deepening it gradually. They are the most efficient type dredge for excavating loose, unconsolidated material and are used mainly in exposed harbors and shipping channels where traffic and operating conditions rule out the use of stationary dredges.

d. Mechanical Dredging. Mechanical dredges include bucket, bucket-ladder, clamshell, and dragline dredges. Transportation of the dredged material is made by additional plant, tug and barge, or scow. Mechanical dredges are classified by bucket size and are best adapted for dredging fine-grained material. They are the most efficient dredge for working near bridges, docks, wharfs, piers, or breakwater structures.

e. Specialty Dredging. Some dredging projects have unusual conditions or unique project requirements that cannot readily utilize standard dredge plant. There are a variety of specialized dredge plant which must be considered under these circumstances.

15-6. Production

a. In calculating production rates for dredging, effective time is commonly used. Lost time due to major repairs and alteration, cessation, and collisions is not used in dredging time calculations. Whenever possible, the production rate used in CEDEP should be based on historical data. When historical data is not available, the sequence described in this chapter shall be used.

b. Pipeline Dredging. Production is determined by the pumping rate and the effective time.

(1) Pumping rate is affected by items such as water depth, density of material, distance discharged, available horsepower, bank height, wave climate, disposal area restraints, environmental restraints, and dredge configuration, such as spud carriage, ladder pump, degassers, and hoffa valve.

(2) The effective time is affected by items such as weather, handling pipeline, moving swing wires, minor operating repairs, vessel traffic, repositioning the dredge, and surveys.

c. Hopper Dredging. Hopper dredge production is best evaluated in terms of its cycle components and the effective time.

(1) The hopper dredge cycle consists of excavation time, transport time, and disposal time.

Excavation time per load may be limited to pumping to overflow only, due to environmental concerns, or may be continued beyond overflow to obtain an economic or a maximum load. Transport time may be affected by items such as ship traffic, weather, distance, and tides. Disposal consists of either gravity dumping or pumping out the material. The time required to gravity dump the material in open water depends on the type of material and the dredge. If the material is pumped out, the time becomes a function of pump size, discharge diameter, and pipeline length, similar to a pipeline dredge. The volume per load depends on the hopper size, the dredge's load carrying capability, type and characteristics of material, distance to the placement area, and environmental concerns.

(2) The effective time is affected by items such as vessel traffic, minor operating repairs, and refueling.

d. Mechanical Dredging. To determine mechanical dredge production, the cost engineer must calculate both a dredge excavation cycle time and a haul cycle time. Effective time is considered separately for each cycle. The longer of these two cycle times determines the production rate. When the haul cycle time is longer than the dredge excavation time, the dredge is sitting idle while waiting on scows. Normally, when this occurs, the number of scows required is increased to achieve the most efficient cost.

(1) The dredge excavation cycle consists of excavating the material and loading scows. This cycle is affected by items such as bucket size, type of material, operator efficiency, and size of dredge. Effective time is affected by items such as weather, vessel traffic, repositioning of dredge, and minor operating repairs.

(2) The haul cycle consists of transport time and disposal time. This cycle is affected by the size, type, and number of scows available, as well as the size, type, and number of towing vessels available. Effective time is affected by items such as weather, vessel traffic, and minor operating repairs.

e. Specialty Dredging. The cost engineer will have to investigate in detail the method, equipment, and expected production on a case-by-case basis.

15-7. Monthly Costs

a. The monthly costs for all types of dredges are based on labor, equipment, and other monthly costs.

b. Labor costs consist of wages, fringe benefits, taxes, and insurance. Labor consists of personnel necessary for the operation of the dredge, attendant plant and equipment with required supervision, and shore personnel used for the dredging work.

c. Equipment costs consist of ownership costs and operating costs. Costs for dredge plant will be based on historical data. In the absence of valid historical data, the CEDEP will be the basis for cost of dredge plant. Other equipment costs shall be obtained from EP 1110-1-8, Equipment Ownership Schedule.

d. Indirect costs are to be determined by the cost engineer. In addition, such things as surveys, environmental monitoring, and navigation aids may need to be included.

15-8. Fixed Costs

The fixed costs for all types of dredges are project specific. They are one-time costs for the project that are not included elsewhere.

15-9. Pay Items

a. Mobilization and demobilization. The cost estimate for this item consists of the following:

(1) Preparing dredge and attendant plant for transfer. Costs incurred may consist of such items as preparing laid-up equipment for use, re-inspection, and stocking equipment and supplies.

(2) Mobilization transfer costs. This item includes the cost to move all plant and equipment and the return of the tug or towing vessels(s).

(3) Preparing the plant for work. This item includes preparation costs which are incurred to set up the equipment to start work, assemble, and place discharge line and boosters.

(4) Construction support site. Establishing a work yard at or near the project site may be necessary and is a part of mobilization cost.

(5) Demobilize plant. This item includes preparing the dredge and attendant plant for transfer.

(6) Demobilization transfer costs. This item is similar to mobilization transfer costs. Mobilization and demobilization distances may not necessarily be the same. Reasons for using different distances must be documented.

(7) Prepare plant for lay-up. This item includes all costs to secure machinery and equipment for storage.

(8) Indirect costs. Indirect costs must be included in the mobilization and demobilization pay item. They should be the same as those used for the dredging pay item.

b. Dredging. Pay for unit price contracts may be based on volume, area, time, scow or bin measure, or lump sum as described in ER 1130-2-307. To determine the unit cost of dredging, divide the gross production cost by the number of pay units.

(1) Pipeline dredge gross production costs consist of costs associated with dredging time and are not separated by elements of work.

(2) Hopper dredge and mechanical dredge gross production costs consist of costs associated with excavation time, transportation time, and disposal time.

(3) Specialty dredging gross production costs will be determined on a case-by-case basis.

c. Total Dredging Costs. Total dredging cost includes mobilization and demobilization cost plus dredging cost as previously discussed.

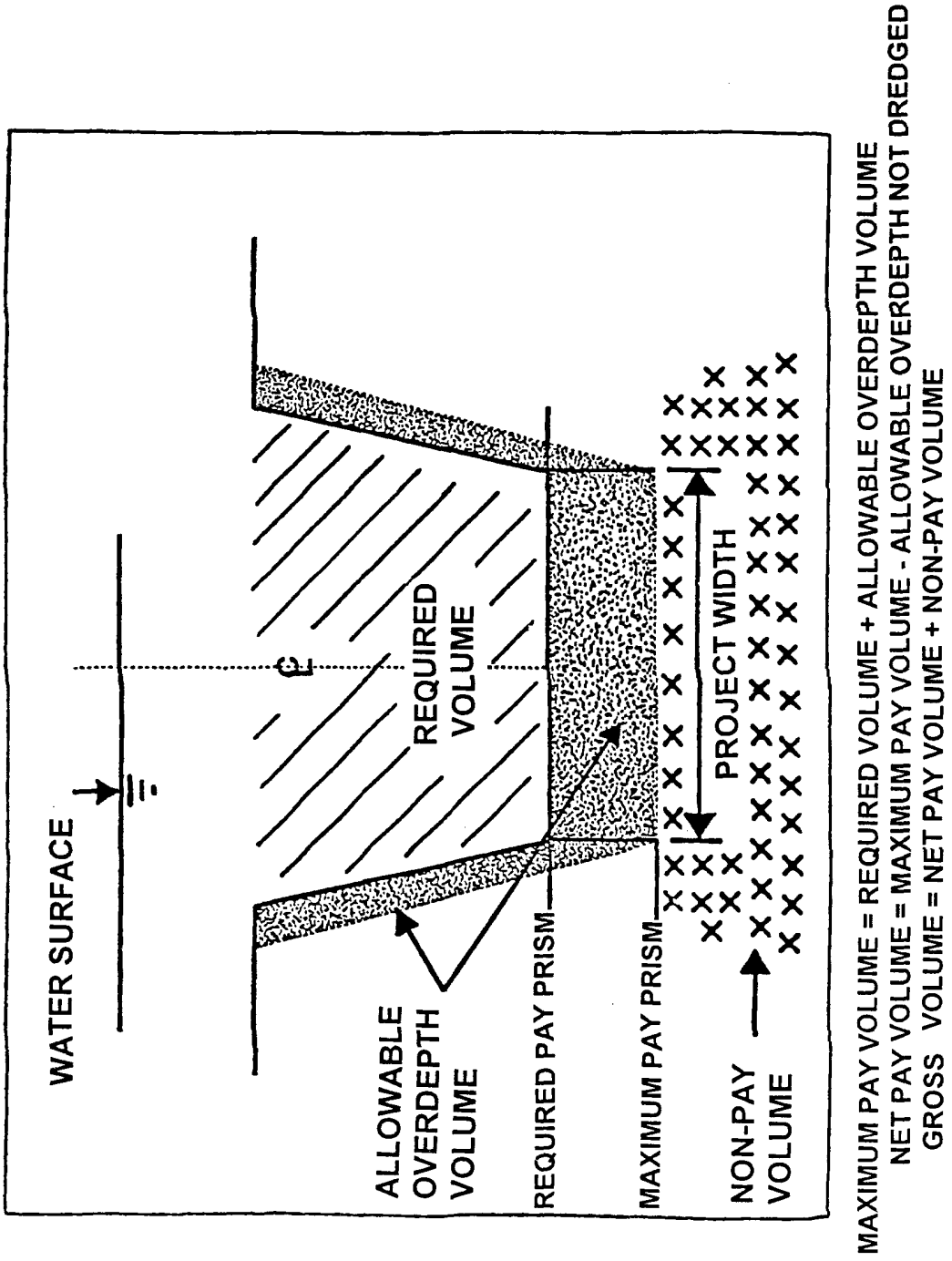


Figure 15-1. Dredging pay prism

CHAPTER 16
PROTESTS OR LITIGATION CONCERNING THE GOVERNMENT ESTIMATE

16-1. General

a. There are two major situations when the cost engineer may become involved in litigation concerning the Government estimate.

(1) Either a bid protest when bids are opened,

(2) Or if a proposed change order/ modification is not accepted by a contractor, and the contractor pursues the dispute.

b. The procedure to process the issues are the same for all types of projects or contracts associated with military, civil works or HTRW programs. When either of the above occurs, the cost engineer has a major role in reviewing the Government estimate and evaluating the Government's position.

c. Bid protests. During the bidding process, and upon receipt of bids, if all bids are sufficiently higher than the Government estimate, any one of the proposer/offerers can protest the unreasonableness of the Government estimate by stating it contains errors or omissions; too low and not fair and reasonable. A major concern occurs for a bid opening in Civil Works as the contract cannot be awarded to the low bidder if the low bid exceeds the Government estimate by 25 percent; and 15 percent for military programs. In such a case, a bid protest will delay all further contractual action to award until either the bid protester withdraws the protest; the Government estimate is revised; or a determination is made through the judicial process.

d. Contract modifications/change orders. During the on-going construction, changes will occur, including overruns of quantities, and disagreements may occur between the contractor and the Government. If a dispute does arise, it generally concerns a disagreement between what the government considers a fair and reasonable cost as compared to the proposal offered by the contractor. In the event agreement can be reached between the contractor and the Government, a dispute, or claim may result.

16-2. Preparation of Technical and Cost Analysis by Cost Engineer

a. The cost engineer should prepare a technical and cost analysis evaluation for documentation of the contract file. Major factors in the analysis include:

(1) The technical analysis will consist of an in-depth, point-by-point response to all issues raised on the cost estimate by the protestor or contractor.

(2) The cost analysis will consist of a review of the Government estimate, including all backup and supporting data, and assumptions made which support the estimate.

b. Additional information concerning factors to be considered in the technical and cost analysis are presented in chapter 14. Reference is made to FAR sub-part 15.608 for proposal evaluation.

16-3. Review of the Government Estimate

a. Bid protests. If there is a bid protest concerning the reasonableness of the Government estimate, i.e., a bidder is claiming the estimate is too low, the cost engineer should conduct an independent review of the Government estimate.

(1) The cost engineer should review the estimate to be sure that it does not contain mistakes. This evaluation must be completed as soon as possible to provide timely advice to the District staff to preclude delay in award. If the Government estimate is revised, and the revised estimate brings an offeror's price within the range of a fair and reasonable price**,** award will be made provided funds are available. The revised estimate requires the same approval authority as the original Government estimate.

(2) When the Government estimate is reviewed and has been determined to be fair and reasonable for the intended scope of work, unless the protestor withdraws the bid protest, the usual procedure will require a Contracting Officers

Decision (COD) in the form of a (letter) memorandum of denial of the protest unless the protestor withdraws the bid protest.

(3) Meetings may be held with the apparent low bidder or contractor prior to issuance of the COD memoranda to ensure that both the Government and the protestor have the opportunity to review the project and agree to the scope of work as specified by the plans and specifications. Meetings will also allow discussion whether there are unusual conditions or circumstances that may affect or complicate the work. If a meeting reveals an error or omission in the Government estimate, it may be revised as previously discussed.

(4) The protest/dispute may take several months to resolve. The Government's position may be reviewed and evaluated at the district, MSC, and HQUSACE, as well as by the General Accounting Office, a court, or a board of contract appeals. During each of these reviews, questions will arise, and the cost engineer will be called on to support the estimate. The cost engineer(s) responsible for preparing the Government estimate are most familiar with the estimate, and as such, should be prepared to assist counsel, contracting, and other staff to resolve the issue; and be prepared to testify in court and certify the validity of the estimate.

b. Contract modifications/change orders. The cost engineer may also be required to prepare cost estimates for major or complex changes; or design change orders for on-going construction projects; major or extensive quantity overrun bid items; or even assisting in evaluating claims occurring during construction whereby an Government estimate is required.

(1) Prior to the cost engineer finalizing the Government estimate, it is important to meet with the contractor to agree on the scope of work concerning change orders for on-going construction. The cost engineer will prepare the cost estimate as detailed in chapter 14. On occasion, disputes arise between the Government and the contractor, primarily due to a very wide variance between the value of work estimated by the contractor and the Government estimate being on the low side. When a dispute arises, meetings are necessary in an attempt to resolve the difference in cost between the contractor and the Government. Even when the scope may be in general agreement, the cost may be in dispute. The Contracting Officer may issue a unilateral modification establishing the cost and the modification may result in litigation. The procedure upon encountering an impasse, generally results in the Government issuing a COD, and the process is the same as previously discussed for a bid protest.

(2) It is possible that not all of the facts of a claim, change, or major overrun of quantities have been provided or verified by the cost engineer. In those cases where the cost engineer has prepared a Government estimate, but due to circumstances has not met with the contractor, and if additional facts are revealed, the cost engineer may revise the Government estimate as appropriate. The revised Government estimate requires the same approval authority as the original Government estimate. Upon revising the Government estimate and mutual agreement by the contractor and Government, a modification is processed.

(3) In May 1995, EFAR was revised as follows, "When the Government estimate is changed during or subsequent to conferences or negotiation, the basis for the revision or changes in price shall be fully explained and documented in the price negotiation memorandum or Business Clearance Memorandum (EFARS 36.203.102). Judgment in making this type of decision should be based on the circumstances of a particular issue, not all encompassing, and recommendations should be made to the Contracting Officer. For major differences in cost, disputes or claims not resolved, a revised Government estimate is recommended, supported by a technical and cost analysis of the dispute in litigation.

16-4. Security and Disclosure of Government Estimates

Security and disclosure of the revised Government estimate should be handled in the same manner as the original Government estimate. Procedures for handling the Government estimate are described in chapter 2.

16-5. Mistake in Bids

a. General. After the opening of bids, contracting officers shall examine all bids for mistakes. In cases of apparent mistakes and in cases where the contracting officer has reason to believe that a mistake may have been made, the contracting officer shall request from the bidder a verification of the bid, calling attention to the suspected mistake. Any clerical mistake, apparent on its face in the bid, i.e., obvious misplacement of a decimal point, may be corrected by the contracting officer before award, after first receiving verification of the bid intended.

b. For other mistakes disclosed before award in sealed bidding, the bidder must provide clear and convincing evidence to establish both the existence of the mistake and the bid actually intended. The contracting officer must make a determination as to the circumstances to verify the mistake; to allow the bidder to withdraw the bid; or make a determination that the bid be neither withdrawn nor corrected. The cost engineer may be part of the team of specialists to provide an analysis and a recommendation to the contracting officer. For the cost engineer, the evaluation could be the verification of a quantity as related to a unit price bid item; or determination of a fair and reasonable cost for a service or product. The cost engineer may refer to FAR part 14 for the appropriate definitions, discussions, and overview of the acquisition requirements pertaining to sealed bidding.

c. The process for determination of a mistake in bid when the solicitation of a project is contracted by negotiated procurement is similar to the procedure as for sealed bidding. Additional tools are available to the Government to amend a solicitation before award as compared to sealed bidding. Clarification may be used to communicate with an offerer for the sole purpose of eliminating minor irregularities, informalities, or apparent clerical mistakes in the proposal. In negotiated procurement, discussions means any oral or written communications between the Government and an offeror that involves information essential to determine the acceptability of a proposal or provides the offeror an opportunity to revise or modify its proposal. When, either before or after receipt of proposals, the government changes, relaxes, increases, or otherwise modifies its requirements, the contracting officer shall issue a written amendment to the solicitation. In the event evaluation factors are selected to evaluate proposals, price or cost to the Government shall be included as an evaluations factor in every source selection. If a mistake in a proposal is suspected, the contracting officer shall advise the offeror or otherwise identifying the area of the proposal where the suspected mistake is and request verification. If the offeror verifies its proposal, award may be made. If an offeror alleges a mistake in its proposal, the contracting officer shall advise the offeror that it may withdraw the proposal or seek correction by submitting clear and convincing evidence and a determination is made by agency. The cost engineer may also be involved in providing support to the contracting officer if any mistake concerns scope, quantity or prices in the Government estimate. The cost engineer may refer to FAR part 15 for the appropriate definitions, discussions and overview of the acquisition requirements pertaining to negotiated procurement. In the event negotiations are conducted with offerors in the competitive field, the cost engineer should be a member of the negotiation team.

16-6. Civil Works Program Specific Requirements

a. Statutory cost limitations. In accordance with 33 U.S.C. 622 and 624, no civil works construction shall be awarded if the contract price exceeds the Government estimate prepared in accordance with 36.203.100 by more than 25 percent. This limitation does not apply to change orders or contract modifications.

b. Special problems.

(1) For special cost engineering dredging problems or concerns, the use of the Corps' Regional Dredge Teams are recommended. These teams are composed of cost engineering and construction-operations personnel most experienced in dredging and established for the East Coast, West Coast, Gulf Coast, the Great Lakes, and Mississippi River and tributaries. The appropriate team is convened at the request of the District Engineer. The chairman of the regional dredge teams shall be appointed by HQUSACE, Chief, Cost Engineering Branch, CECW-EC, and

Chief, Operations Branch, CECW-OM, and is responsible to ensure that the teams are maintained with competent cost engineering and construction operations personnel and that requests for assistance are promptly fulfilled.

(2) The regional dredge teams are designed to provide assistance to all districts in the evaluation of bid protests, mistakes in bids, or other unique issues that may be required to validate the estimate for the Government. Further, the teams are available to support districts that seldom do large dredging contracts and, therefore, may have little expertise or historical cost data that is needed to prepare accurate planning estimates and/or Government estimates for contract award. The teams' role in all cases is to act in an advisory capacity with the requesting district having the responsibility and authority to make all final decisions.

(3) The regional dredge teams are represented in geographical areas and the office of the chairman of each team is located in North Atlantic Division; Seattle District; New Orleans District, and Detroit District.

CHAPTER 17
STANDARD ESTIMATING FORMS

17-1. General

a. This chapter contains a discussion of the standard estimating forms with a brief explanation of their use in presenting manually prepared construction cost estimates. A project narrative will be provided for each cost estimate prepared using these forms. Refer to chapter 4 for factors to be considered when preparing the narrative.

b. Completed examples of these forms are provided in this chapter. Estimates developed using these forms may be prepared in an electronic format, however, pencil format is the preferred method. For uniformity in form completion, the following general guidance is given:

(1) Each original sheet should be in reproducible quality.

(2) Once the estimate has been completed, checked, and approved, the desired number of copies should be reproduced from the original.

(3) For A-E prepared estimates, the original should be forwarded with the final submittal.

(4) Pencil originals should normally be retained by the cost engineering office preparing the estimate.

(5) Each sheet should be initialed by both the preparer and the reviewer.

17-2. Standard Forms

a. Civil Works Program. The following standard estimating forms will be used in preparing cost estimates when the use of the MCACES software is exempted by ER 1110-2-1302. These forms have been designated as a guide in the development of a reasonable cost estimate for civil works.

(1) Reasonable Contract Estimate, ENG Form 1738-R (figure 17-1), is used to summarize the total cost estimate by tabulating the required work items and the corresponding unit prices and lump sum amounts developed on the detail summary sheets. The last page of this form, or the page that shows the estimated total cost, will include the appropriate signatures necessary to support the type of cost estimate being prepared.

(2) Reasonable Contract Estimate Detail Summary Sheet, ENG Form 1739-R (figure 17-2), is used to summarize the various direct cost components and to allocate distributed costs in developing the unit or lump sum prices for the various work items being estimated. It is useful for showing the equipment, labor, material, and supply costs for the whole job as general information and can be used for comparison with the records on other jobs of a similar nature. The work item and quantity data shall be entered in the first four columns. Mobilization and demobilization costs and the total equipment, labor, material, and supply costs, as determined from the supporting worksheets (ENG Forms 1741-R, 1741a-R, 1741b-R, or 1741c-R) or from the Worksheet Summary (ENG Form 1740-R) will be entered in the appropriate columns provided. The total distributed cost, including bond costs and profit when appropriate, will be added to the subtotal direct cost for each work item on a proportional basis. The unit cost for each unit price item will then be determined by dividing the total cost by the quantity for that item. The adjusted unit cost column will be used to round off the unit cost or lump sum amounts to avoid the use of decimals. The adjusted unit costs and amounts should be transferred to ENG Form 1738-R or other similar type tabulation sheet.

(3) Reasonable Contract Estimate Worksheet Summary, ENG Form 1740-R (figure 17-3), is used to summarize the cost of equipment, labor, materials, and supplies for a specific construction task prior to transfer to the Detail Summary Sheet (ENG Form 1739-R) for those work items which require more than one set of worksheets.

(4) Reasonable Contract Estimate Worksheets, ENG Forms 1741-R, 1741a-R, 1741b-R, and 1741c-R (figures 17-4, 17-5, 17-6, and 17-7) are used in developing the costs of equipment, labor, materials, and supplies necessary to accomplish a specific construction task. ENG Form 1741 should define the plan of operation for performing the work for the specific construction task. It should include a clear description of the scope of the construction task and any parameters that may influence productivity. Equipment or labor output controlling the rate of production should be stated along with the calculations to show the time required to perform the work. ENG Forms 1741a-R and 1741b-R

provide a step-by-step procedure in developing the total equipment, labor, materials, and supply costs to support the construction task plan of operations described on ENG Form 1741-R. ENG Form 1741c-R combines the information described on ENG Forms 1741a-R and 1741b-R and may be used when the equipment, labor, material, and supply requirements for the work item are small.

(5) Telephone quotation sheet (Figure 17-8), example shown in appendix B, is used to identify and record costs obtained from subcontractors or vendors in developing an estimate.

(6) Wage Rate Calculations, DA Form 5420-R (figure 17-9), will be used to develop the total hourly rate for the various classifications of labor required for the job. The "Effective Period" block on the form should show the dates the wage rates are applicable. The basic hourly wage rate should be a reasonable estimate of the average wage the contractor would expect to pay during the construction period. In an estimate for a construction contract modification, the actual wage rates paid by the contractor should be used if available. Enter the number of shifts per day, hours per shift and days per week in the "Operational Shifts" block to support the overtime factor used. For example, 2/8's 5 days, indicates two 8-hour shifts per day, 5 days per week. Details and procedures for developing the costs for each item identified in the column headings are described in chapter 5, table 5-1.

b. Military Program. Although no forms are mandatory for use in preparing early design estimates, it is recommended that the cost engineer consider using forms expressing unit price and extended price in columns. The following standard estimating forms will be used in preparing detailed construction cost estimates for military projects.

(1) Estimate Detail Summary Sheet, DA Form 5417-R (figure 17-10), is used to summarize project costs, to relate the method of distribution of overhead and profit to the various bid items, and to determine the overall price for each bid item. For unit price bid items, calculations, results, and rounding may be shown on the line following the total bid item price calculation. Rounding of Lump Sum bid items may also be shown similarly. The total cost, or adjusted cost, should be transferred to the bidding schedule.

(2) Cost Estimate Analysis, DA Form 5418-R (figure 17-11), is used to itemize and quantify work tasks and to calculate the direct cost for each task. The form follows, column-by-column, the format shown in the UPB. It is also intended as the direct cost summary sheet for each bid item. Items of significant cost should relate to other detailed backup sheets of analysis or quotations.

(3) Construction Cost Estimate Worksheet, ENG Form 150a (figure 17-12), is used for miscellaneous cost items. Common uses include quantity take-off, description and discussion pages, and price quotations.

(4) Crew and Productivity Worksheet, DA Form 5419-R (figure 17-13), is used to develop a crew analysis and task unit cost for labor and equipment. This is necessary for significant and unusual construction tasks. The "CREW REF NO" can be completed similar to the crew names described in the UPB.

(5) Wage Rate Calculations, DA Form 5420-R (figure 17-9), is the same form as used for civil works.

c. HTRW. For HTRW estimates which are prepared manually, the DA Form 5400 Series and/or the ENG Form 1700 Series estimating forms may be used.

REASONABLE CONTRACT ESTIMATE
(ER 1110-2-1302)

SHEET 1 OF 1

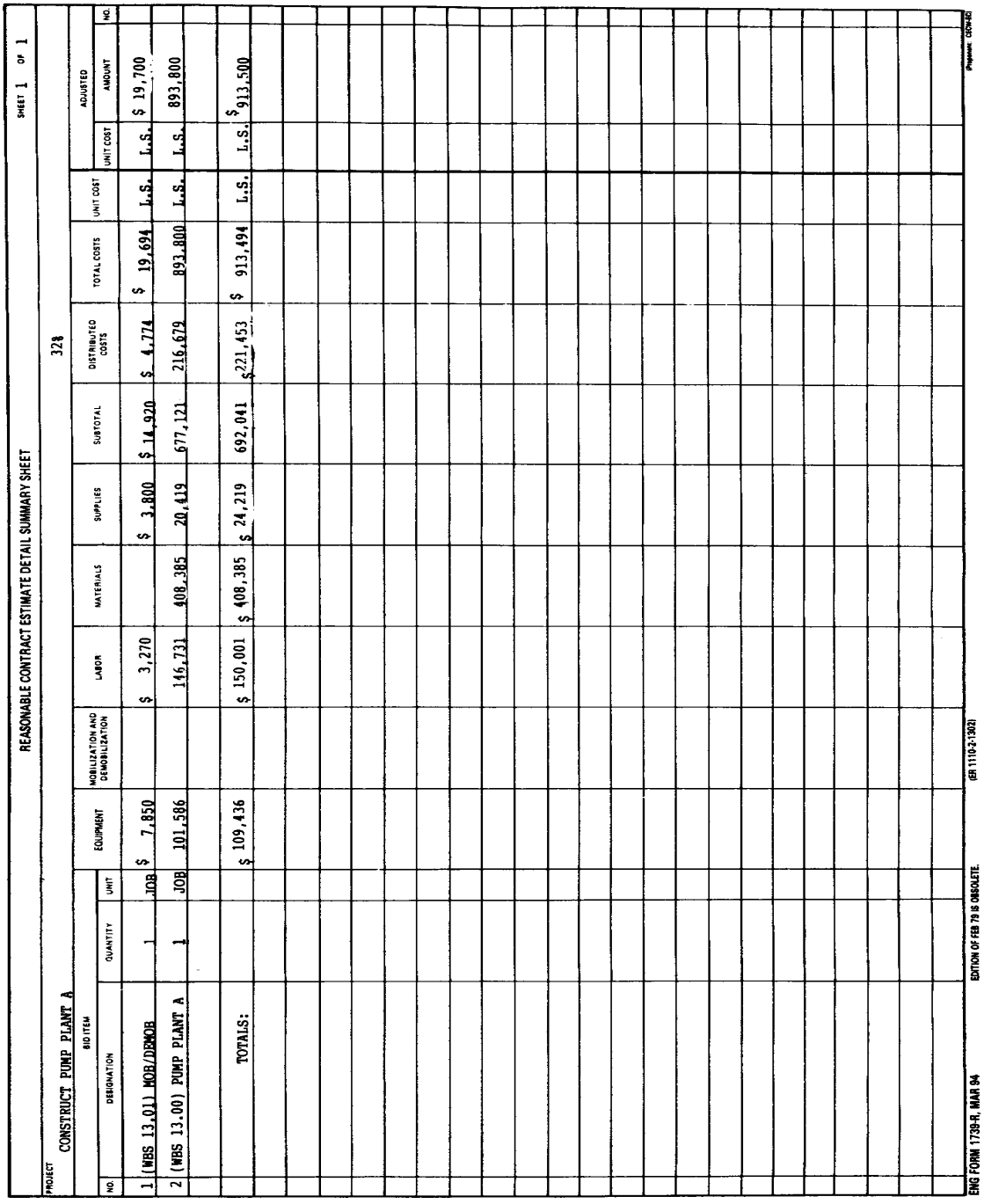
PROJECT
CONSTRUCT PUMP PLANT A

INVITATION NO.
DACW97-01-0001

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1	MOBLIZATION/DEMOBLIZATION (WBS 13.01)	1	JOB	L.S.	$19,700.00
2	PUMPING PLANT A (WBS 13.00)	1	JOB	L.S.	$893,800.00
		TOTAL			$913,500.00
	APPROVED:				
	CHIEF COST ENGINEERING BRANCH				
	DATE ----------				
	EFFECTIVE PRICE DATE ----------				

ENG FORM 1738-R, MAR 94 EDITION OF APR 67 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-1. Example reasonable contract estimate
(ENG Form 1738-R)



REASONABLE CONTRACT ESTIMATE DETAIL SUMMARY SHEET

SHEET 1 OF 1

PROJECT: CONSTRUCT PUMP PLANT A

328

BID ITEM NO.	BID ITEM DESIGNATION	QUANTITY	UNIT	EQUIPMENT	MOBILIZATION AND DEMOBILIZATION	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	DISTRIBUTED COSTS	TOTAL COSTS	UNIT COST	ADJUSTED UNIT COST	ADJUSTED AMOUNT	ADJUSTED NO.
1	(WBS 13.011) MOB/DEMOB	1	JOB	$ 7,850		$ 3,270		$ 3,800	$ 14,920	$ 4,774	$ 19,694	L.S.	L.S.	$ 19,700	
2	(WBS 13.00) PUMP PLANT A	1	JOB	101,586		146,731	408,385	20,419	677,121	216,679	893,800	L.S.	L.S.	893,800	
	TOTALS:			$ 109,436		$ 150,001	$ 408,385	$ 24,219	692,041	$ 221,453	$ 913,494	L.S.	L.S.	$ 913,500	

ENG FORM 1739-R, MAR 84 EDITION OF FEB 79 IS OBSOLETE. (ER 1110-2-1302)

Figure 17-2. Example reasonable contract estimate detail summary sheet
(ENG Form 1739-R)

REASONABLE CONTRACT ESTIMATE WORKSHEET SUMMARY — SHEET 1 OF 29

PROJECT
CONSTRUCT PUMPING PLANT

SUBJECT
BI 02. (WBS 13.00) PUMP PLANT A

QUANTITY
1-JOB

SUBITEM	EQUIPMENT	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	REF.PG.
.01-(WBS 13.03) CARE& DIVERSION OF WATER	$35,200.00	$7,800.00	$900.00	$1,000.00	$44,900.00	4
.02 (WBS) 13.10) EARTHWORK FOR STRUCTURE	$45,100.00	$6,200.00	$0.00	$490.00	$51,790.00	7
.03 (WBS 13.74) SUBSTRUCTURE	$3,806.00	$51,581.00	$26,785.00	$12,809.00	$94,981.00	11
.04 (WBS 13.75) SUPERSTRUCTURE	$780.00	$35,600.00	$65,100.00	$1,300.00	$102,780.00	15
.05 (WBS 13.76) MACHINERY & APPT.	$12,800.00	$28,300.00	$265,000.00	$4,320.00	$310,420.00	18
.06 (WBS 13.77) GATES & VALVES	$2,200.00	$12,400.00	$38,100.00	$400.00	$53,100.00	22
.07 (13.78) AUXILIARY EQUIPMENT	$500.00	$1,200.00	$8,400.00	$100.00	$10,200.00	24
.08 (WBS 13.98) ASSOCIATED ITEMS	$1,200.00	$3,650.00	$4,100.00	$0.00	$8,950.00	26
NOTE: BID ITEM 01 & SUBITEMS 02.01 THROUGH						
02.08 HAVE DETAILED COSTS DEVELOPED SIMILIAR						
TO THOSE SHOWN FOR ITEM 02.03. THE DETAILED						
ESTIMATING SHEETS AND BACK-UP SHEETS ARE						
EXCLUDED FROM THIS EXAMPLE TO MINIMIZE PRINTING.						
TOTALS	$101,586.00	$146,731.00	$408,385.00	$20,419.00	$677,121.00	

ENG FORM 1740-R, MAR 94 *(ER 1110-2-1302)* EDITION OF AUG 69 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-3. Example reasonable contract estimate worksheet summary
(ENG Form 1740-R)

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*	SHEET 8 OF 29
PROJECT CONSTRUCT PUMP PLANT	
SUBJECT BI 02.03 (WBS 13.74) SUBSTRUCTURE	QUANTITY 165 M3
	SHIFTS PER DAY 1 / HOURS PER SHIFT 10

PLAN OF OPERATIONS

USE READY-MIX SUPPLIER FOR 20.7 MPA CONCRETE

1. PLACE CONCRETE - 164M3 @ 7.5M3/HR = SAY 22 HRS

   USE: HYD S.P. CRANE - 30T C7522000

   CONCRETE BUCKET - 2CY B30Z1055

   AIR COMPRESSOR - 250CFM A15Z0140

   CONCRETE VIB - 2.5 IN AIR C65XX001

   LAB 4/M

   5 LABORERS

   1 CARPENTER

2. FINISH WORK -

   FLOAT 2 CEMENT FIN - 293M2/16.3M2/HR = SAY 18 HRS

   STEEL TROWEL - 109M2/7.3M2/HR = SAY 15 HRS

   USE 1 CEMENT FIN

   1 EA. POWER TROWEL

3. INSTALL WATER STOP - 8"

   1 CARP @ 2M/HR = 53/2 = SAY 27 MHRS

4. CURE CONCRETE -

   USE 2 LABORERS - 4HR/DAY X 14 DAYS = 56 HRS

ENG FORM 1741-R, MAR 94 EDITION OF NOV 81 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-4. Example reasonable contract estimate worksheet
(ENG Form 1741-R, Sheet 1 of 2)

REASONABLE CONTRACT ESTIMATE WORKSHEET
(ER 1110-2-1302)

SHEET 9 OF 29

PROJECT
CONSTRUCT PUMP PLANT A

SUBJECT
BI 02.03 (WBS 13.74) SUBSTRUCTURE

QUANTITY 165 M3

SHIFTS PER DAY 1

HOURS PER SHIFT 10

PLAN OF OPERATIONS

5. USE SUBCONTRACT QUOTE FOR RESTEEL 7.4 MT

6. FORMING - USE 1 CARP 4/M + 4 CARP

A. BLDG. WALL FORMS - 2 USES - 315M2/2 = 158M2

BLDG @ 3.9M2/CREW HR = 40.5 CREW HRS

B. SET & STRIP -

WALLS @ 3.9M2/CREW HRS = 314M2/3.9 = 80.5 HRS

SLAB EDGE @ 7M2/CREW HRS 53/7 = 7.6 HRS

ELEVATED SLAB @ 3M2/CREW HRS = 109/3 = 36.3 HRS

SET/REMOVE SHORING @ 2M2/HR = 109/2 = 54.5 HRS

TOTAL CREW HRS. BLDG/SET/STRIP = 219.4

SAY 220 HRS

C. FORM LUMBER -

SLAB @ 30BF/M2 = 30 (53) = 1590 BF

WALL @ 35BF/M2 = 35 (153) = 5530 BF

ELEV SLAB @ 40BF/M2 = (109) = 4360 BF

TOTAL 11,480 BF

ENG FORM 1741-R, MAR 94 EDITION OF NOV 81 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-4. Example reasonable contract estimate worksheet
(ENG Form 1741-R, Sheet 2 of 2)

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*					SHEET 10 OF 29
SUBJECT ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74)					QUANTITY 165M3
EQUIPMENT					
UNIT OF EQUIPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
1. PLACE CONCRETE					
HYD S.P. R.T. CRANE - C75Z2000	30T	1	22.00	$42.61	$937.42
CONCRETE BUCKET - B30Z1055	2CY	1	22.00	$0.56	$12.32
AIR COMPRESSOR - A15Z0140	250CFM	1	22.00	$8.66	$190.52
CONCRETE VIBRATOR - C65XX001	2.5"	2	22.00	$0.85	$37.40
AIR HOSE - 100LF - A20Z0430	1.5"	2	22.00	$0.56	$24.64
2. FINISH CONCRETE					
STEEL POWER TROWELL - C25Z1560	46"	1	15.00	$1.63	$24.45
EQUIPMENT RATES TAKEN FROM EP-1110-1-8					
VOL.#8, AUG 95. RATES HAVE BEEN ADJUSTED					
FOR 50 HR. WORK WEEK.					
				SUBTOTAL	$1,226.75
**NOTE: USE WORKING HOURS*	SMALL TOOLS			5.0 % OF LABOR	$2,579.00
				TOTAL EQUIPMENT COST	$3,805.75
LABOR					
OPERATIONS	CRAFT	NO.	HOURS	RATE	AMOUNT
1. PLACE CONCRETE	4/M X - LABOR	1	22	$32.56	$716.32
	X-LABOR	5	22	$29.51	$3,246.10
	X-CARPENTER	1	22	$35.76	$786.71
	X- EQOPRMED	1	22	$38.15	$839.30
2. FINISH CONCRETE					
FLOAT	X-CEMTFINR	2	18	$33.63	$1,210.68
STEEL TROWELL	X-CEMTFINR	1	15	$33.63	$504.45
3. INSTALL WATER STOP	X-CARPENTER	1	27	$35.76	$965.52
4. CURE CONCRETE	X-LABOR	2	56	$29.51	$3,305.12
6. FORMWORK	4/M X-CARPENTER	1	220	$38.81	$8,538.20
	X-CARPENTER	4	220	$35.76	$31,468.80
				TOTAL LABOR COST	$51,581.20

ENG FORM 1741a-R, MAR 94 EDITION OF NOV 81 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-5. Example reasonable contract estimate worksheet
(ENG Form 1741a-R)

REASONABLE CONTRACT ESTIMATE WORKSHEET
(ER 1110-2-1302)

SHEET 11 OF 29

SUBJECT
ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74)

QUANTITY
165 M3

MATERIALS

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
* READY MIX CONCRETE 20.7 MPA (INCLUDES WASTE)	M3	175	$78.60	$13,755.00
* WATER STOP 9" PVC X 3/8" THK	M	53	$11.75	$622.75
SUBTOTAL: $14,378				
SALES TAX: 6%				$863.00
RESTEEL SUBCONTRACTOR	MT	7.4	$1,560.00	$11,544.00
			TOTAL MATERIALS COST	$26,784.75

SUPPLIES

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
CURING SUPPLIES	M2	476	$0.50	$238.00
FORM PLYWOOD 1/2"	M2	56	$7.00	$392.00
FORM PLYWOOD 3/4"	M2	267	$10.00	$2,670.00
FORM LUMBER	MBF	12	$375.00	$4,500.00
FORM TIES & OIL	M2	476	$9.00	$4,284.00
SUBTOTAL: $12,084				
SALES TAX 6%				$725.00
			TOTAL SUPPLIES COST	$12,809.

SUMMARY FOR TRANSFER TO ENG FORM 1739-R OR 1740-R

EQUIPMENT	$3,806.00
LABOR	$51,581.00
MATERIALS	$26,785.00
SUPPLIES	$12,809.00
TOTAL	$94,981.00

REMARKS: (Indicate by askerisk (*) prices on items which are based on quotations from manufacturers or suppliers.)

DATE
03 01 97

PREPARED BY
J. SMITH

CHECKED BY
J. DOE

ENG FORM 1741b-R, MAR 94 EDITION OF NOV 81 IS OBSOLETE. (Proponent: CECW-EC)

Figure 17-6. Example reasonable contract estimate worksheet
(ENG Form 1741b-R)

REASONABLE CONTRACT ESTIMATE WORKSHEET — SHEET 12 OF 29

SUBJECT: ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74) — QUANTITY: 165 M3

EQUIPMENT

UNIT OF EQUIPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
HYD S.P. R.T. CRANE - C752000	30	1	22	$42.61	$937.42
CONCRETE BUCKET - B30Z1055	2CY	1	22	$0.56	$12.32
AIR COMPRESSOR - A15Z0140	250CFM	1	22	$8.66	$190.52
CONCRETE VIBRATOR - C65XX001	2.5"	2	22	$0.85	$37.40
AIR HOSE - 100LF - A20Z0430	1.5"	2	22	$0.56	$24.64
STEEL POWER TROWEL - C25Z156	46"	1	15	$1.63	$24.45
				SUBTOTAL	$1,226.75
*(*NOTE: USE WORKING HOURS)*				MOBILIZATION AND DEMOBILIZATION	
				SMALL TOOLS 5.00 % OF LABOR	$2,579.00
				TOTAL EQUIPMENT COST	$3,805.75

LABOR

OPERATION	CRAFTS	NO.	HOURS	RATE	AMOUNT
1. PLACE CONCRETE	4/M X-LABOR	1	22	$32.56	$716.32
	X-LABOR	5	22	$29.51	$3,246.10
	X-CARPENTER	1	22	$35.76	$786.71
	X-EQOPRMED	1	22	$38.15	$839.30
2. FINISH CONCRETE	X-CEMFINR	1	51	$33.63	$1,715.13
3. INST WATER STOP	X-CARPENTER	1	27	$35.76	$965.52
4. CURE CONCRETE	X-LABOR	2	56	$29.51	$3,305.12
6. FORMWORK	4/M X-CARPENTER	1	220	$38.81	$8,538.20
	X-CARPENTER	4	220	$35.76	$31,468.80
				TOTAL LABOR COST	$51,581.20

MATERIALS

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
* READY MIX CONCRETE - 20.7 MPA	M3	175	$78.60	$13,755.00
* WATER STOP 9" X 3/8 THK	M	53	$11.75	$622.75
SUBTOTAL: $14,378				
SALES TAX 6%		1	$863.00	$863.00
* RESTEEL SUBCONTRACTOR	MT	7.4	$1,560.00	$11,544.00
			TOTAL MATERIALS COST	$26,784.75

SUPPLIES

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
CURING FORM TIES & OIL	M2	476	$10.07	$4,793.32
PLYWOOD 2IN	M2	56	$7.42	$415.52
PLYWOOD 3/4 IN	M2	267	$10.60	$2,830.20
FORM LUMBER	MBF	12	$397.50	$4,770.00
			TOTAL SUPPLIES COST	$12,809.04
TOTAL FOR TRANSFER TO ENG FORM 1739-R OR 1740-R				$94,981.00

REMARKS: *(Indicate by asterisk (*) prices on items which are based on quotations from manufacturers or suppliers.)*

DATE: 3 Jan 97

PREPARED BY: J. SMITH

CHECKED BY: J. DOE

ENG FORM 1741c-R, MAR 94 EDITION OF NOV 81 IS OBSOLETE. *(ER 1110-2-1302)* (Proponent: CECW-EC)

Figure 17-7. Example reasonable contract estimate worksheet
(ENG Form 1741c-R)

SHEET 13/29

TELEPHONE QUOTATION SHEET

CSI NUMBER: BI 02.03

FIRM QUOTING & ADDRESS: STRONG STEEL
ANY TOWN, ANY STATE

RFP/CONTRACT NO.: DACW 97-01-0001

PROJECT: PUMP PLANT

PHONE (503) 326-3864

LOCATION: RM 13, SPRUCE RIVER

PERSON QUOTING: JOE JONES

ESTIMATOR: J. SMITH

ITEM QUOTED: RESTEEL QUOTED

DATE: 1/1/97

TOTAL QUANTITY QUOTED:

AMOUNT: 7.4 MT @ $1560/MT = $11,544

DESCRIPTION: FURNISH & INSTALL ALL RESTEEL

INCLUDES SALES TAX YES X NO __

PER PLANS & SPECS YES __ NO X

EXCEPTIONS:

EXCEPT USING #4 BAR ILO #3

EXCLUDES SCAFFOLD & HOOK SERVICE

FREIGHT INCLUDED TO:

____ FAS PORT _____ FOB FACTORY _____ OTHER __X__ FOB JOB

TOTAL QUOTATION $

ALLOWANCE FOR WASTE AND LOSS _____ $

WEIGHT

EXPORT PACKING $

VOLUME

US INLAND FREIGHT $

QUOTE VALID FOR _____ DAYS

TOTAL MATERIAL COST $_____

REMARKS

telephone quotation sheet

Figure 17-8. Example telephone quotation sheet

WAGE RATE CALCULATIONS
For use of this form, see TM 5-800-2; the proponent agency is USACE.

EFFECTIVE PERIOD: OCT 94 - SEP 95

PROJECT: CONSTRUCT PUMP PLANT

OPERATIONAL SHIFTS: 1/10-5 DAY WEEK

LOCATION: RT. BANK, RM 13, SPRUCE RIVER

ESTIMATOR: J. SMITH

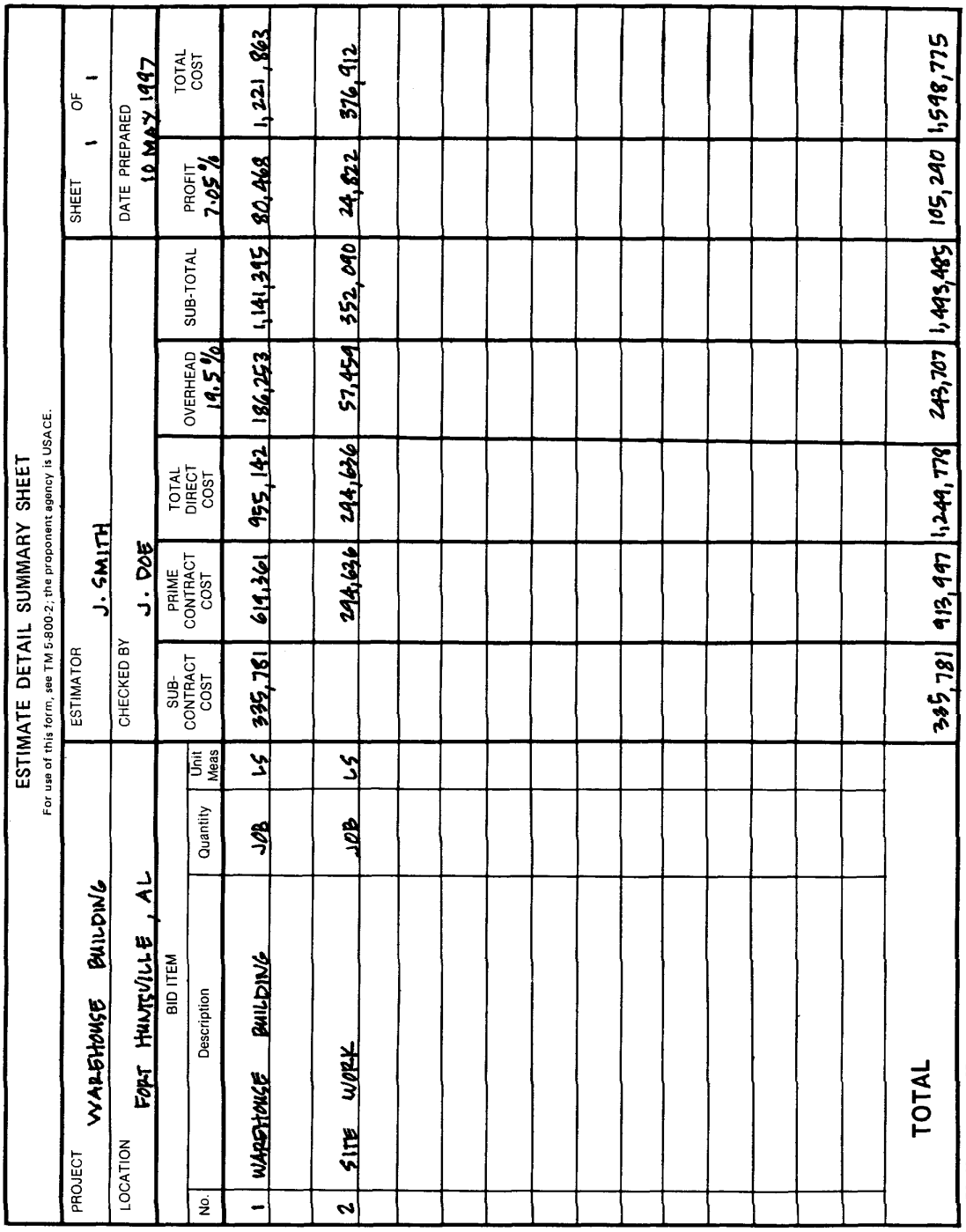
CHECKED BY: J. DOE

LABOR COST

CRAFT DESCRIPTION	BASIC HOURLY WAGE RATE	OVERTIME % OF (b)	OVERTIME AMT.	SUB-TOTAL (b + d)	TAXES & INS % OF (e)	TAXES & INS AMT.	SUB-TOTAL (e + g)	FRINGE BENE-FITS	TRAVEL OR SUB-SIST	TOTAL HOURLY COST (h + i + j)
a	b	c	d	e	f	g	h	i	j	k
X-CARPENTER 4/M	20.49	10	2.05	22.54	38.7	8.72	31.26	5.55	2	38.81
X-CARPENTER	18.49	10	1.85	20.34	38.7	7.87	28.21	5.55	2	35.76
X-LABOR 4/M	16.47	10	1.65	18.12	38.7	7.01	25.13	4.43	3	32.56
X-LABOR	14.47	10	1.45	15.92	38.7	6.16	22.08	4.43	3	29.51
X-EQOPRMED	18.97	10	1.90	20.87	29.7	6.20	27.07	6.08	5	38.15
X-EQOPOIL	14.80	10	1.48	16.28	29.7	4.84	21.12	6.08	5	32.20
X-CEMTFINR	17.91	10	1.79	19.70	29.7	5.85	25.55	5.08	3	33.63
USE "ANY STATE"	DAVIS	BACON	WAGE	AGREEMENT	#AS970004	ADM #2	2/20/97 ***			
50 HR WORK WEEK	(5 -	10's)	- O.T. = 10% (PER O.T. TABLE)							
USE 4/M PREMIUM	=		$2.00/HR							
FICA & FED UNEMPLOYMENT			7.7%							
STATE UNEMPLOYMENT			3.0%							
WORKMAN COMP										
CARPENTER			28%							
LABOR			28%							
OPERATORS			19%							
CEMENT FINISHER			19%							
*** LOCAL PREVAILING WAGES ARE LESS THAN DAVIS BACON WAGES										

DA FORM 5420-R, Apr 85

Figure 17-9. Example wage rate calculations
(DA Form 5420-R)



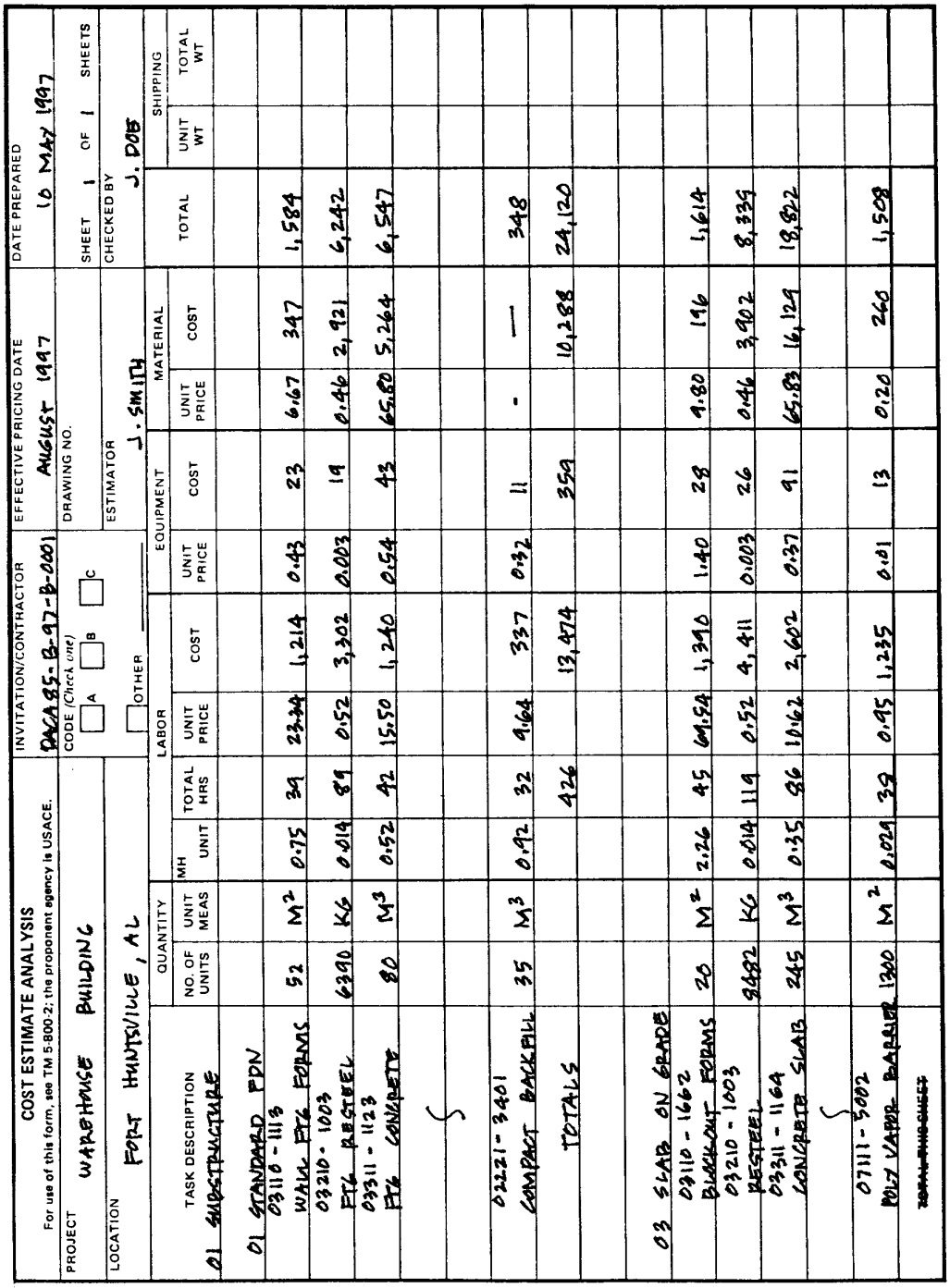
ESTIMATE DETAIL SUMMARY SHEET
For use of this form, see TM 5-800-2; the proponent agency is USACE.

PROJECT: WAREHOUSE BUILDING
ESTIMATOR: J. SMITH
SHEET 1 OF 1
LOCATION: FORT HUNTSVILLE, AL
CHECKED BY: J. DOE
DATE PREPARED: 10 MAY 1997

No.	BID ITEM Description	Quantity	Unit Meas	SUB-CONTRACT COST	PRIME CONTRACT COST	TOTAL DIRECT COST	OVERHEAD 19.5%	SUB-TOTAL	PROFIT 7.05%	TOTAL COST
1	WAREHOUSE BUILDING	JOB	LS	335,781	619,361	955,142	186,253	1,141,395	80,468	1,221,863
2	SITE WORK	JOB	LS		294,636	294,636	57,459	352,095	24,822	376,917
	TOTAL			335,781	913,997	1,249,778	243,707	1,493,485	105,240	1,598,775

DA FORM 5417-R, Apr 85

Figure 17-10. Example estimate detail summary sheet
(DA Form 5417-R)



COST ESTIMATE ANALYSIS
For use of this form, see TM 5-800-2; the proponent agency is USACE.

INVITATION/CONTRACTOR: DACA85-B-97-B-0001
EFFECTIVE PRICING DATE: AUGUST 1997
DATE PREPARED: 10 MAY 1997

PROJECT: WAREHOUSE BUILDING
CODE (Check one): ☐ A ☐ B ☐ C
DRAWING NO.
SHEET 1 OF 1 SHEETS

LOCATION: FORT HUNTSVILLE, AL
☐ OTHER _____
ESTIMATOR: J. SMITH
CHECKED BY: J. DOE

TASK DESCRIPTION	QUANTITY NO. OF UNITS	QUANTITY UNIT MEAS	LABOR MH UNIT	LABOR TOTAL HRS	LABOR UNIT PRICE	LABOR COST	EQUIPMENT UNIT PRICE	EQUIPMENT COST	MATERIAL UNIT PRICE	MATERIAL COST	TOTAL	SHIPPING UNIT WT	SHIPPING TOTAL WT
01 SUBSTRUCTURE													
01 STANDARD FDN													
03110 - 1113 WALL FTG FORMS	52	M²	0.75	39	23.34	1,214	0.43	23	6.67	347	1,584		
03210 - 1003 FTG RESTEEL	6390	KG	0.014	89	0.52	3,302	0.003	19	0.46	2,921	6,242		
03311 - 1123 FTG CONCRETE	80	M³	0.52	42	15.50	1,240	0.54	43	65.80	5,264	6,547		
02221 - 3401 COMPACT BACKFILL	35	M³	0.92	32	9.64	337	0.32	11	-	—	348		
TOTALS				426		13,474		359		10,288	24,120		
03 SLAB ON GRADE													
03110 - 1662 BLACKOUT FORMS	20	M²	2.26	45	64.54	1,290	1.40	28	9.80	196	1,614		
03210 - 1003 RESTEEL	8482	KG	0.014	119	0.52	4,411	0.003	26	0.46	3,902	8,339		
03311 - 1164 CONCRETE SLAB	245	M³	0.35	86	10.62	2,602	0.37	91	65.83	16,129	18,822		
07111 - 5002 POLY VAPOR BARRIER	1300	M²	0.029	39	0.95	1,235	0.01	13	0.20	260	1,508		
TOTAL PHYSICS													

DA FORM 5418-R, Apr 86

Figure 17-11. Example cost estimate analysis
(DA Form 5418-R)

CONSTRUCTION COST ESTIMATE WORKSHEET	DATE PREPARED 10 MAY 1997	SHEET 1 OF 1

PROJECT: WAREHOUSE BUILDING

LOCATION: FORT HUNTSVILLE, AL

PLAN NO.	ESTIMATOR	CHECKED BY
	J. SMITH	J. DOE

SITE WORK

QUANTITY TAKE-OFF CALCULATIONS SHOULD BE PREPARED IN A MANNER THAT IS CONSISTENT WITH THE DISTRICT'S ESTABLISHED PROCEDURE.

ENG FORM 1 AUG 59 150a (EM 1110-345-730) REPLACES EDITION OF 1 AUG 58, WHICH MAY BE USED.

Figure 17-12. Example construction cost estimate worksheet
(ENG Form 150a)

CREW AND PRODUCTIVITY WORKSHEET
For use of this form, see TM 5-800-2; the proponent agency is USACE.

DATE PREPARED: 10 MAY 1997

PROJECT: WAREHOUSE BUILDING	PREPARED BY: J. SMITH	CREW REF NO.: B-25
LOCATION: FORT HUNTSVILLE, AL	CHECKED BY: J. DOE	

CREW COMPOSITION

WORK TYPE: PLACE CONCRETE | WORK SCHEDULE: 1-10 HR; 5 DAYS/WK | SPECIAL INFORMATION:

CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST: HOURLY* RATE ($/HR)	LABOR COST: TOTAL FOR CREW ($/HR)	EQUIPMENT COST: HOURLY RATE ($/HR)	EQUIPMENT COST: TOTAL FOR CREW ($/HR)
HYD, SPCRANE 30T, C757200	1			42.61	42.61
CONC BKT, 2 CY, B3071055	1			0.56	0.56
CONC VIB, 2 1/2" A, C65XX00	1			0.35	0.35
AIR COMP, 250 CFM, A1570140	1			8.66	8.66
AIR HOSE, 1 1/2" X 100', A2070480	2			0.56	1.12
X- EQOPR MED	1	38.15	38.15		
X- LABOR A/M	1	32.56	32.56		
X- LABOR	4	29.51	118.04		
X- CEMTFNR	1	33.63	33.63		
TOTALS — MANHOURS	7	LABOR COST	222.38	EQUIPMENT COST	53.80

CREW PRODUCTIVITY

WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR: MH/UNIT	LABOR: $/UNIT	EQUIPMENT $/UNIT	COMMENTS
PLACE CONCRETE	7.5 M3/HR	0.93	29.65	7.17	
EQUIP RATES HAVE BEEN ADJ FOR 50 HR WORK WEEK					
AND RATES TAKEN FROM EP 1110-1-8 VOL 3, AUG 95					
LABOR RATES TAKEN FROM DAVIS BACON AGREEMENT					
# AS970004, ADM # 2, 2/20/97					

*Including fringe benefits

DA FORM 5419-R, Apr 85

Figure 17-13. Example crew and productivity worksheet
(DA Form 5419-R)

APPENDIX A
REFERENCES

GOVERNMENT PUBLICATIONS

Public Law:	
PL No. 74-403	Davis Bacon Act
PL No. 95-269	Rivers and Harbors - Improvements
Department of Labor:	
29 CFR 1910.120	Occupational Safety and Health Standards
29 CFR 1926.65	Safety and Health Regulations for Construction
Department of Defense:	
FAR Sub-part 28.102	Performance and Payment Bonds for Construction Contracts
FAR, Part 36	Construction and Architect-Engineer Contracts
Department of Army:	
AR 25-55	Department of Army Freedom-of-Information Act Program
AR 415-15	Army Military Construction Program Development and Execution
US Army Corps of Engineers:	
TM 5-800-4	Programming Cost Estimates for Military Construction
TM 5-802-1	Economic Studies for Military Construction Design-Applications
EFAR, Part 36	Construction and Architect-Engineer Contracts
EFAR Sub-part 36.203 (102)	Revision of Government Estimate
ER 5-7-1(FR)	Project Management
ER 1110-1-1300	Cost Engineering Policy and General Requirements
ER 1110-2-1150	Engineering and Design for Civil Works Projects
ER 1110-2-1302	Civil Works Cost Engineering
ER 1110-3-1300	Military Programs Cost Engineering

ER 1110-3-1301	Cost Engineering Policy and General Requirements for Hazardous, Toxic, and Radioactive Waste Remedial Action Cost Estimates
ER 1125-2-304	Plant Inspection, Maintenance, Operation and Repair
ER 1130-2-307	Dredging Policies and Practices
EM 1110-2-1304	Civil Works Construction Cost Index System (CWCCIS)
EP 415-1-2	Modification and Claim Guide
EP 1110-1-8	Construction Equipment Ownership and Operating Expense Schedule

OTHER:

Architect-Engineer Instruction (AEI)	Project Engineering with Parametric Estimating

APPENDIX B
SAMPLE ESTIMATE PAGES

B-1. General

The information contained in this appendix is described in chapters 2 and 4. The information applies to all types of projects. This appendix contains sample estimate pages, figures B-1 through B-5. A current and complete MCACES example estimate for each program (military, civil works, and HTRW) is included in the electronic data bases as part of MCACES.

CONTROL RECORD FOR GOVERNMENT ESTIMATE

Date Received: Date of Document: No. of Copies: Copy No.:

_____ _____ _____ _____

From: Engineering Division

SUBJECT:

_____

_____

Number & Description of Inclosures: _____

GOVERNMENT ESTIMATE

INTRA-OFFICE ROUTING DATA

Division or Branch	Date	Division or Branch	Date

NAME OF ALL PERSONS HANDLING THE ATTACHED DOCUMENT OR WHO HAVE BEEN INFORMED OF ITS CONTENT

Name	Date	Name	Date

Figure B-1. Sample control record for Government estimates

GOVERNMENT ESTIMATE

FOR

Furnishing all plant, labor, materials, and equipment and performing all work for

_____ in strict accordance with the specifications schedules, drawings, and amendments. (DACA _____ - ____ -B - ____)

See attached Price Schedule for Items.

The project manager has budgeted adequate funds to cover estimated price of this project as contained in this Government estimate.

SUBMITTED:

REVIEWED AND CONCUR:
Chief, Cost Engineering Branch
Engineering Division
Dated:

APPROVED:
Chief, Engineering, Engineering Division
Dated:

PROTECTIVE MARKINGS ARE CANCELED AFTER THIS ESTIMATE HAS BEEN PUBLICLY OPENED, READ, AND RECORDED.

_____ _____
Date Canceled Signature Division

(NOTE: Completed signature page and all pages of the Government estimate should be marked "FOR OFFICIAL USE ONLY")

Figure B-2. Sample signature page for Government estimates

IFB No. DACA _____ - ____ - B

PRICE SCHEDULE

FY _____ Contingency Communications Element Facility and Vehicle Maintenance Facility

CLIN	Contract Line Item No. (description of bid item)	UOM	UNIT	QUANTITY	TOTAL PRICE
0001	All work for the Contingency Communications.	LS	1,000,000.00	1	$ 1,000,000.00
0002	All work for the Vehicle Maintenance Facility.	LS	600,000.00	1	$ 600,000.00
0003	All work for the decorative screening contained in the contingency Communications Element Facility project.	LS	100,000.00	1	$ 100,000.00
0004	Site Preparation	SM	5.00	10,000	$ 50,000 .00
TOTAL AMOUNT OF CLIN ITEMS 0001 THROUGH 0004					**$ 1,750,000.00**

(Additives/deductives will also be shown on the price schedule)

NOTES TO BIDDERS (May vary according to the District and/or type of project, military, civil or HTRW)

1. The low bidder for purpose of award will be determined on the basis of the bidder offering the lowest total of Contract Line Items Numbers (CLIN) 0001 through 0004.

2. The bidders are required to bid on all items or their bid will be rejected.

3. Bidders are reminded that they must bid on the issued plans and specifications, as amended. Any deviations, conditions or attachment made by the bidder himself thereto may render the bid non-responsive and be cause for its rejection.

4. Any bid which is materially unbalanced as to prices for each Contract Line Item Number, may be rejected. An unbalanced bid is one which is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

Figure B-3. Sample price schedule

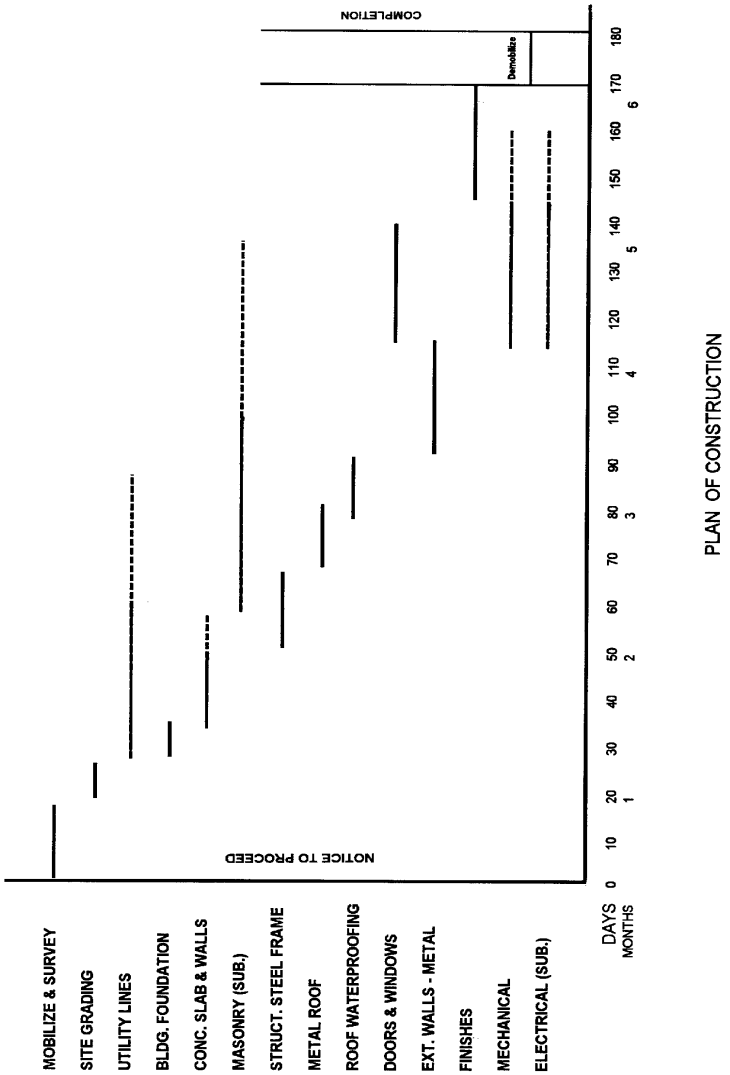


Figure B-4. Sample construction schedule

TELEPHONE QUOTATION SHEET

CSI NUMBER:

FIRM QUOTING _____ RFP/CONTRACT NO _____
ADDRESS:

PROJECT: _____

PHONE: _____ LOCATION:

PERSON QUOTING: _____ ESTIMATOR:

ITEM QUOTED/DATE: _____ TOTAL QUANTITY QUOTED: _____ AMOUNT:

DESCRIPTION:

INSTALLED: YES ____ NO

INCLUDE SALES TAX: YES ____ NO

PER PLANS/SPECIFICATIONS: YES ____ NO ____ (EXPLAIN EXCEPTIONS)

FREIGHT INCLUDED TO:

_____ FAS PORT _____ FOB FACTORY _____ FOB JOB
OTHER

TOTAL QUOTATION $ _____

WEIGHT _____ EXPORT PACKING _____ $ _____

VOLUME _____ US INLAND FREIGHT _____ $ _____

QUOTE VALID FOR _____ DAYS **TOTAL MATERIAL COST** $ _____

REMARKS

Figure B-5. Sample telephone quotation sheet

APPENDIX C
WORK BREAKDOWN STRUCTURE

The information contained in this appendix is to aid in presentation of cost estimates for civil works, military, and HTRW programs. The structure outlined in this appendix is described in chapter 2. A current and complete WBS for each program is provided in the models data base of the latest version of MCACES.

a. Civil Works Work Breakdown Structure. The civil works WBS format follows the feature description in table 2-1.

b. Military Construction Work Breakdown Structure. See table C-1, Military Programs Work Breakdown Structure.

c. HTRW Remedial Action Work Breakdown Structure. See table C-2, HTRW Work Breakdown Structure (to second level*).*

Table C-1. Military Programs Work Breakdown Structure

(Systems Level)

SYSTEM	SUBSYSTEM	TITLE	UOM
01		SUBSTRUCTURE	M^2
02		SUPERSTRUCTURE	M^2
03		EXTERIOR CLOSURE	M^2
04		ROOFING	M^2
05		INTERIOR CONSTRUCTION	M^2
06		INTERIOR FINISHES	M^2
07		CONVEYING SYSTEMS	M^2
08		PLUMBING	M^2
09		HVAC	M^2
10		FIRE PROTECTION SYSTEMS	M^2
11		ELECTRIC POWER AND LIGHTING	M^2
12		ELECTRICAL SYSTEMS	M^2
13		EQUIPMENT	M^2
14		FURNISHINGS	M^2
15		SPECIAL CONSTRUCTION	M^2
16		SELECTIVE BUILDING DEMOLITION	M^2
17		SITE PREPARATION	M^2
18		SITE IMPROVEMENTS	M^2
19		SITE CIVIL/MECHANICAL UTILITIES	M^2
20		SITE ELECTRICAL UTILITIES	M^2

Table C-2. HTRW WORK BREAKDOWN STRUCTURE (Levels 1 and 2)

RAWBS Number	Description of Item
(*) 331XX	HTRW REMEDIAL ACTION (CONSTRUCTION)
01	MOBILIZATION AND PREPARATORY WORK
02	MONITORING, SAMPLING, TESTING, AND ANALYSIS
03	SITE WORK
04	ORDNANCE AND EXPLOSIVE- CHEMICAL WARFARE MATER (OECWN) REMOVAL AND DESTRUCTION
05	SURFACE WATER COLLECTION AND CONTROL
06	GROUNDWATER COLLECTION AND CONTROL
07	AIR POLLUTION/GAS COLLECTION AND CONTROL
08	SOLIDS COLLECTION AND CONTAINMENT
09	LIQUIDS/SEDIMENTS/SLUDGE COLLECTION AND CONTAINMENT
10	DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL
11	BIOLOGICAL TREATMENT
12	CHEMICAL TREATMENT
13	PHYSICAL TREATMENT
14	THERMAL TREATMENT
15	STABILIZATION/FIXATION/ENCAPSULATION
16	RESERVED FOR FUTURE USE
17	DECONTAMINATION AND DECOMMISSIONING (D&D)
18	DISPOSAL (OTHER THAN COMMERCIAL)
19	DISPOSAL (COMMERCIAL)
20	SITE RESTORATION
21	DEMOBILIZATION
22	GENERAL REQUIREMENTS (OPTIONAL BREAKOUT)
9x	OTHER (use numbers 90-99)
332XX	ENGINEERING DURING CONSTRUCTION (EDC)
333XX	SUPERVISION AND ADMINISTRATION (S&A - CONSTRUCTION MANAGEMENT)

(*) The first 3 digits are from the USACE Superfund Accounting System. The last 2 digits are user-defined for estimating flexibility. Account 33 includes Remedial Action, O&M during Construction, Engineering during Construction (EDC), and Supervision and Administration (S&A) (Construction Management)

APPENDIX D
SAMPLE CHECKLIST FOR COST ESTIMATE PREPARATION

1. Comply with applicable guidance (ER 1110-1-1300, ER 1110-2-1302, ER 1110-3-1300, and ER 1110-3-1301).

2. Prepare cost estimate using MCACES, as appropriate, and structured using the appropriate Work Breakdown Structure for military programs, civil works and HTRW.

3. Prepare narrative with statement summarizing purpose of estimate and brief statement and description of the project.

4. Identify stage of estimate (reconnaissance, pre-design**,** 30%, 60%, 90%, 100%, and bid).

5. Clearly identify and define assumptions, identify significant features upon which the cost estimate is based.

6. Identify significant findings during preparation

7. Develop notes throughout the estimate, particularly to identify sequencing of construction activities and crew productions and include in the MCACES notes reference.

8. Separate subcontract work from prime contract work.

9. Identify separate markups for subcontractors and prime contractor.

10. Identify sources of unit prices and vendor or subcontractor quotes.

11. Include design contingencies and construction contingencies in the cost estimate, if appropriate.

12. Include cost growth (escalation) from the date of the estimate to the mid-point of construction and/or operation. Identify source of index used for escalation (Tri-service, CWCCIS, etc.)

13. For Military and HTRW projects, the Current Working Estimates (CWE) includes amounts for Construction Management (S&A), Engineering During Construction (EDC), O&M Manuals, As-Built, and Government Laboratory Quality Assurance (QA) as applicable for the particular project.

14. For Civil Works, the TOTAL CWE includes all Federal and authorized non-Federal costs. Ensure the project manager provides costs for land and damages; engineering and design; construction management; and construction features are coordinated with CWBS. The cost engineer will incorporate these costs into the TOTAL CWE utilizing MCACES as appropriate. The cost estimate becomes fully funded when inflation is added to the estimate. An estimate for profit is included in the reconnaissance and feasibility phases to ensure costs represent the total cost of the project; however, profit is not included in the Government estimate for authorized civil work contracts for award. Profit is included in construction contracts for modifications and change orders.

15. Minimize use of lump sum pricing. If used, the lump sum description must indicate in detail what is included in the price and whether or not it is based on a quotation.

16. Use prevailing current location-specific wage rates in the estimate. Consider market rates for labor to ensure there is reasonable competition on-going in the area where the construction is being performed and/or may be competing with the domestic projects being constructed.

17. Check derived unit costs with historical data when available. Override UPB labor and/or material unit prices as required, to fit project-specific conditions.

18. Complex or Major features of a project should include a detailed breakdown for labor, equipment and material.

19. Calculate home office overhead as a percentage of total contract cost.

20. Include bond costs in estimate.

21. Calculate prime and subcontractor profit by Weighted Guidelines method.

22. Provide Cost Engineering Branch point of contact and telephone number.

23. For HTRW projects, identify and calculate productivity factors for level of protection.

24. For HTRW projects, include costs for all specification Division I Health and Safety requirements and personnel, and itemize prime contractor overhead items for estimates prepared at the 30% design stage and after in lieu of using a flat rate overhead percentage.

25. Include all applicable costs for permits, licenses, taxes, and fees.

APPENDIX E
AUTOMATION

E-1. General

a. General. Cost engineer regulations for civil works, military programs, and HTRW direct the use of automation in developing cost estimates. This appendix provides general information on using this automation and an overview of existing systems. Detailed guidance on the use of each system can be found in the appropriate system user manual for each software program.

b. Use of cost engineering automated systems. The use of cost engineering automated systems enhances the efficiency, accuracy and credibility of project cost estimates. Automation assists in the standardization of estimating procedures and provides estimates that are easily reviewed, revised and adapted to new projects or situations. Standardization assists in collection and analysis of historical costs that can be used to develop budget estimates, for cost comparison purposes, for reporting and tracking of project cost data, and for the building of parametric models.

c. Software updates and new systems. Automation continues to develop at a rapid pace. Minor upgrades may occur annually and major system changes can occur every two or three years. Major new systems may be fielded at any time. Cost engineers should insure that they are using the latest available version of the software as directed by HQUSACE.

d. Limitations on the use of automation. Automation is just a tool and cannot take the place of professional cost engineering knowledge or judgment. The cost engineer should always be knowledgeable of the system's capabilities and limitations in relation to a project. The cost engineer must be especially careful in using models and in adapting existing estimates to new projects to insure that there are neither duplications or omissions in the estimate. Output should be checked for reasonableness and assumptions and methodology should be verified and documented. The best cost automated system is not a replacement for good estimator judgment.

e. Automation proponents. HQUSACE is the proponent for all cost engineering systems with providing software support for system development.

E-2. Overview of Tri-Service Automated Cost Engineering System (TRACES)

a. TRACES is the Tri-Services umbrella linking all automated cost engineering systems and their associated data bases. The entire system seeks to provide a user friendly cost engineering platform in a standard environment that will provide the cost engineer the tools to prepare, review, and maintain all types of cost estimates. Software for scheduling construction projects is also linkable to TRACES. Figure E-1 depicts the overall components of TRACES.

b. TRACES includes the following systems/ modules: a detailed quantity take-off, cost engineering system (MCACES); a parametric system for the preparation of less than fully detailed design estimates; a dredge cost engineering system (CEDEP); a cost estimating system for preparation of programming cost estimates (PC Cost); a life-cycle cost (LCC) module for analysis of system design alternatives; a historical cost analysis generator (HAG) to collect, store, and analyze historical cost data for facilities, and sitework. Other system/modules in TRACES include the scheduling interface module and risk analysis systems.

(1) Micro Computer-Aided Cost Engineering System (MCACES). The MCACES is a multi-user software program used for the preparation of detailed construction cost estimates for military, civil works, and HTRW programs. The system also includes a project data base and supporting data bases. The supporting data bases include UPB, crews, assemblies, labor rates, equipment ownership schedule costs and models. All data bases work in conjunction with each other to produce a detailed cost estimate. The data bases are described in the MCACES users manual.

(2) Parametric system. The parametric system provides the capability to prepare cost estimates based on past designs on less than fully detailed design information. It uses the appropriate Work Breakdown Structure (WBS), a data base of models and assemblies from historic projects, and a series of detailed linking algorithms used to develop a cost estimate. The estimate can then, if desired, be transferred to MCACES for task-by-task analysis of the cost estimate.

(3) Cost Engineering Dredge Estimating Program (CEDEP). CEDEP is a stand-alone program used for the preparation of pipeline, hopper, and mechanical dredge estimates. Two support data files are also provided within CEDEP. The Check rate support program also included in the CEDEP is a computerized version of the Dredge Ownership and Operating Rate Worksheet, chapter 4 of EP 1110-1-8.

(4) PC-Cost. PC-Cost is the personal computer version of the DD Form 1391 Processor cost estimate generator. It is a comprehensive software package that allows the user to prepare and submit programming or budgetary construction cost estimates based on historical costs. PC-Cost also allows the user to create an estimate from an existing detailed or parametric cost estimate, download a DD Form 1391 cost estimate for revisions, or create a new DD Form 1391 estimate from a template. PC-Cost provides a mechanism for a user interface access capability with MCACES data bases, historical module data bases, and TRACES parametric system data bases.

(5) LCC module. The LCC module is a stand-alone program designed primarily to conduct life-cycle cost (LCC) analyses among competing design alternatives for a given project providing a record of the results. The program comes with an extensive maintenance and repair (M&R) data base tailored for Army buildings. Estimates of construction/acquisition costs can be transferred electronically into the LCC module from any MCACES Gold project estimate. The most prominent capabilities are: (a) to conduct LCC analyses in accordance with the provisions of statutes, regulations, and requirements; (b) to calculate the present worth of individual building or facility components; and (c) to compare M&R costs for building components in the M&R data base.

(6) Historical Cost Analysis Generator (HAG). The HAG is a stand-alone software module which is used to collect and display historical cost data from awarded projects. The HAG uses the standard WBS structure to track historical bid costs by type, location, size and time, and has the capability of automatically normalizing and adjusting awarded costs. The HAG system also provides a vehicle to retrieve selected statistical cost information from the historical cost data base for use in the preparation of programming or budgetary cost estimates.

(7) Scheduling Interface module. The MCACES Scheduling Interface (SI) module is a stand-alone program that provides project scheduling capabilities for MCACES cost estimates. The SI module produces a pure logic sequencing of project activities for scheduling purposes. The module also allows export of this data to various scheduling software packages for the development of more detailed scheduling functions. The scheduling data produced by the SI module is stored with the MCACES estimate (Project Data Base) and can be saved as a master template or as a model for future use by other projects.

(8) Risk Analysis Systems. The risk analysis module is a stand-alone program to help identify high elements of risk in a project, to measure their impact on the cost of the project, and to manage these risks through contingency assignments. Software is being developed that will be used for civil works and military projects. HAZRISK is an HTRW risk analysis program which develops a statistical model utilizing project specific information to predict both design contingency and construction contingency requirements for each of the HTRW RAWBS second level (system) work breakdown elements used in a project.

(9) DD Form 1391 Processor (DD 1391). The DD Form 1391 Processor is an interactive computer program which assists users in preparing the programming construction cost estimate shown on the DD Form 1391, Military Construction Project Data. The DD Form 1391 is used by DOD agencies to justify the need of a military project and serves as a funding request for the Authorization and Appropriation of Military Construction funds by Congress. The cost estimate generator of the DD Form 1391 Processor has capabilities for automatic computation of area cost factor adjustments, size factor adjustments, and automatic escalation computation. It uses the cost data from HAG to generate costs of facilities. PC cost is recommended over this main frame module.

E-3. Overview of TRACES Data bases and Files

a. Data bases and files used by the TRACES modules are as follows:

b. UPB data base. The UPB data base is a collection of common construction detail line item tasks used in developing project estimates for military, civil works, and HTRW programs. The UPB is organized in accordance with the Construction Specification Institute (CSI) numbering system. These material costs can be modified to reflect localized costs for other locations. Each task listed provides unit costs for labor, equipment, and materials. Localized UPB's can be developed by modifying the key rates in the national UPB.

c. Models data base. This data base contains groupings of assemblies for a whole facility or sitework entity. Linkage between assemblies and assemblies to tasks are by WBS or as exists in a historic estimate. Linkage algorithms are provided to the cost engineer for project-specific estimate refinement. At the heart of the detail pricing is the UPB task costs. Using models can reduce the time for estimate preparation but relies heavily on past designs using default linkages.

d. Assemblies data base. The Assemblies data base stores common groupings of related work tasks, each representing a composite cost required to create a larger piece of a project rather than a single task. The individual cost items within each assembly are either extracted from the UPB or from the labor and equipment data bases. The data base is broken down according to the WBS. Each assembly includes parameter worksheets, requiring only that you input the parameters appropriate for your specific job. Using assemblies can greatly reduce the amount of data entry required to build a project or model.

e. Other data bases. Other TRACES data bases include the crews data base, labor rates data base, and equipment rates data base.

f. Work Breakdown Structure. This data file provides a separate hierarchical work breakdown master structure for use as a template in formatting cost estimates for civil works, military, and HTRW projects.

g. Cost escalation index. The cost escalation index provides a historic and projected cost index for cost escalation adjustment due to inflationary factors. These index values are national average which applies to construction costs.

h. Area Cost Factor (ACF) index. The ACF index is used in adjusting estimated costs to a specific geographical area. The factors reflect the average surveyed difference for each location in direct costs between that location and the national average location.

i. Facility cost ($/SF). This index is a listing of facility unit costs normalized to a geographical location factor of 1.00. Unit prices reflect costs forecast on the basis of an assumed midpoint of construction date.

j. Historical Cost Analysis System (HCAS). HCAS is a stand-alone system to store historical cost data for HTRW remedial action projects. Project costs are stored in the program using an HCAS-developed category code and the Remedial Action Work Breakdown Structure (RAWBS). The user

may search the data base by using the query function and specifying the type of media, type of contaminant and type of technology. The search can also be narrowed by additional criterion such as contract types, geographic location, award date, HTRW RAWBS, etc. Project cost can be printed or exported to other programs.

E-4. Assigned Agency

The Assigned Responsible Agency (ARA) for TRACES is the U.S. Army Engineering and Support Center, Automated Systems Branch, TRACES group, Huntsville, Alabama. The ARA serves as the focal point for support usage of these software programs by providing operation, maintenance, and "Hot-Line" telephone support.

E-5. Cost Engineers Bulletin Board System (CEBBS)

The CEBBS gives the cost engineers an opportunity to exchange information between districts, divisions, and authorized commercial vendors. Data such as programs, files, messages, project cost estimates, or any other computerized data can be transmitted over the telephone lines. The system contains four on-line conferences, MCACES Gold, Historical Cost Analysis Generator , Cost Engineers Phone List (CE LIST,) and Training Information. The CEBBS and its system operators (SYSOP) are physically located at the ARA.

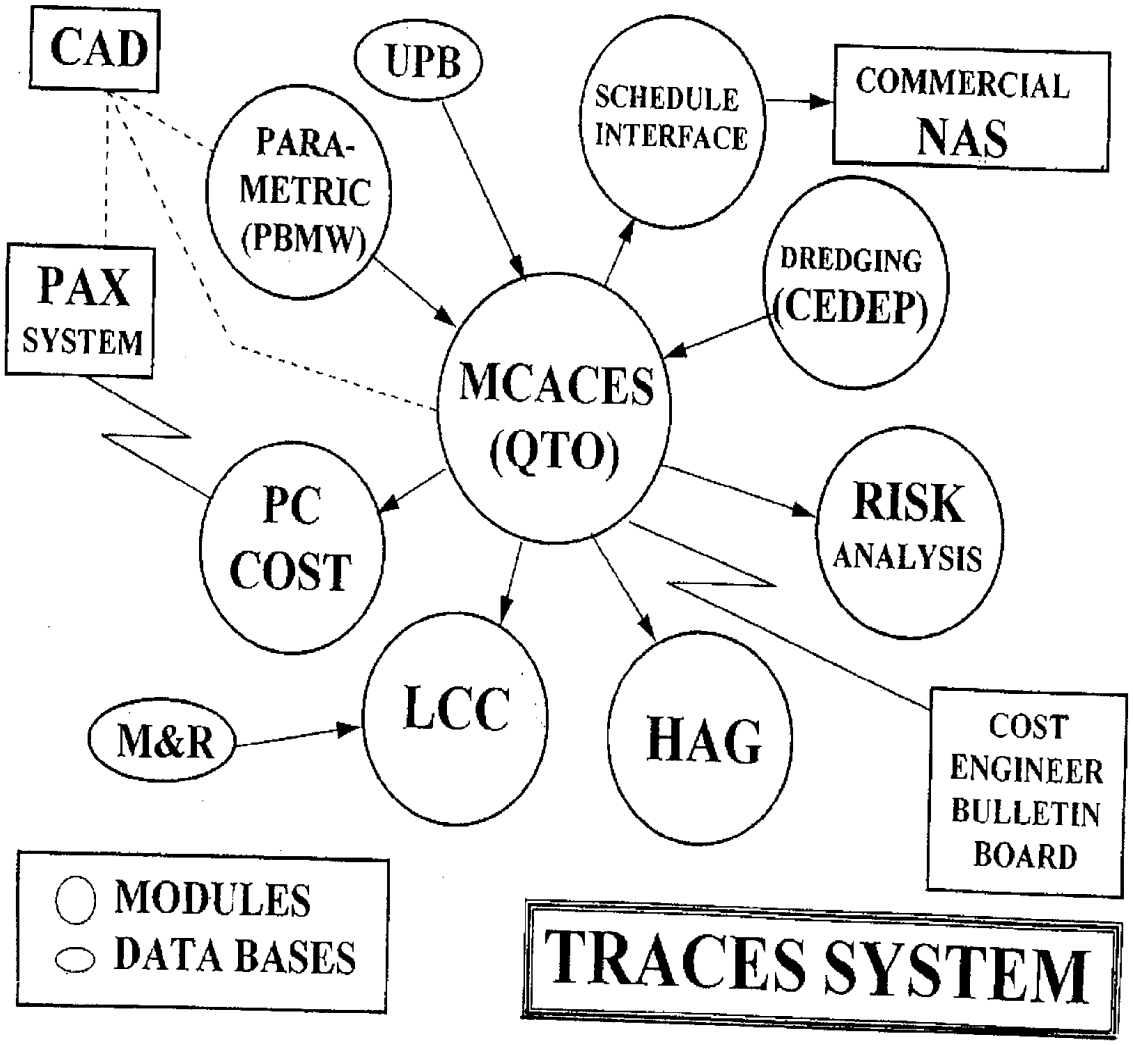


Figure E-1. TRACES system

Glossary
Abbreviations and Acronyms

ACO	Administrative Contracting Officer
ACF	Area Cost Factor
A-E	Architect-Engineer
AFAR	Army Federal Acquisition Regulation
AR	Army Regulation
ASA(CW)	Assistant Secretary of the Army (Civil Works)
BCE	Baseline Cost Estimate
BCO	Biddability, Constructibility, and Operability
CACES	Computer Aided Cost Engineering System
CAP	Continuing Authorities Program
CEBBS	Cost Engineers Bulletin Board System
CECW-B	Headquarters, Civil Works Program Division
CECW-OM	Headquarters, Civil Works Operations Division
CEDEP	Cost Engineering Dredge Estimating Program
CEHNC	Corps of Engineers Engineering and Support Center
CERCLA	Comprehensive Environment Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CP	Cost Plus
CPAF	Cost Plus Award Fee
CSI	Construction Specification Institute
CWBS	Civil Works Breakdown Structure
CWCCIS	Civil Works Construction Cost Index System
CWE	Current Working Estimate (for Military and HTRW) (for Civil Works see TOTAL CWE)
DA	Department of the Army
DERP	Defense Environmental and Restoration Program
DFAR	Defense Federal Acquisition Regulation
DM	Design Memorandum
DOD	Department of Defense
DOE	Department of Energy
DPR	Detailed Project Report
EC	Engineer Circular
ECAS	Environmental Compliance Assessment System
E&D	Engineering and Design
EDC	Engineering During Construction
EFAR	Engineer Federal Acquisition Regulation

EM	Engineer Manual
EP	Engineer Pamphlet
EPA	Environmental Protection Agency
ER	Engineer Regulation
FAR	Federal Acquisition Regulation
FOA	Field Operating Activity
FOB	Freight on Board
FOIA	Freedom of Information Act
FOUO	For Official Use Only
FS	Feasibility Studies
FULLY FUNDED	This term is used to indicate that the costs presented include allowances for cost growth due to inflation through project completion. Certain estimates by definition include cost growth and are considered fully funded.
G&A	General Home Office Overhead
GE	Government Estimate
GFE	Government Furnished Equipment
GFM	Government Furnished Material
HAG	Historical Analysis Generator
HCAS	Historical Cost Analysis System
HQUSACE	Headquarters, U. S. Army Corps of Engineers
HTRW	Hazardous, Toxic and Radioactive Waste
IDLH	Immediately Dangerous to Life or Health
IDT	Indefinite Delivery Type
IFB	Invitation for Bid (Sealed Bidding)
IPMP	Initial Project Management Plan
LCC	Life Cycle Cost
LERRD	Land, Easement, Right-of-way, Relocation and Disposal
MCA	Military Construction, Army
MCACES	Microcomputer Aided Cost Engineering System
MCP	Military Construction Program
MILCON	Military Construction
MSC	Major Subordinate Command
MWBS	Military Work Breakdown Structure
NORM	Normally Occurring Radioactive Materials
OMB	Office of Management and Budget
O&M	Operation and Maintenance
OMRR&R	Operation, Maintenance, Repair, Rehabilitation and Replacement
OMSC	Operating Major Subordinate Command
PA	Preliminary Assessment
PED	Preconstruction Engineering and Design

PES	Project Executive Summary
PL	Public Law
PM	Project Manager
PMP	Project Management Plan
PPE	Personal Protective Equipment
PPRA	Preplaced Remedial Action Contracts
QA	Quality Assurance
RA	Remedial Action
RAWBS	Remedial Action Work Breakdown Structure
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFP	Request for Proposal
RI	Remedial Investigation
ROD	Record of Decision
S &A	Supervision and Administration
SAA	Surety Association of America
SCBA	Self Contained Breathing Apparatus
SI	Scheduling Interface
SI	Site Inspection
SOP	Standard Operating Procedure
TERC	Total Environmental Restoration Contracts
TOTAL CWE	Total Current Working Estimate (for Civil Works). A term used to indicate all Federal and non-Federal costs, LERRD, construction features, E&D, construction management, contingencies, and inflation through project completion.
TRACES	Tri-Service Cost Engineering System
TSDF	Treatment Storage Disposal Facility
UPD	Unit Price Book
USACE	U. S. Army Corps of Engineers
VE	Value Engineering
WBS	Work Breakdown Structure
WLRC	Washington Level Review Center
WRDA	Water Resources Development Act

ESTIMATE DETAIL SUMMARY SHEET

For use of this form, see TM 5-800-2; the proponent agency is USACE.

PROJECT	ESTIMATOR	SHEET OF
LOCATION	CHECKED BY	DATE PREPARED

BID ITEM				SUB-CONTRACT COST	PRIME CONTRACT COST	TOTAL DIRECT COST	OVERHEAD	SUB-TOTAL	PROFIT	TOTAL COST
No.	Description	Quantity	Unit Meas							
TOTAL										

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COST ESTIMATE ANALYSIS

For use of this form, see TM 5-800-2; the proponent agency is USACE.

PROJECT	CODE *(Check one)* ☐A ☐B ☐C ☐OTHER	DRAWING NO.	SHEET OF SHEETS
LOCATION		ESTIMATOR	CHECKED BY

TASK DESCRIPTION	QUANTITY		LABOR				EQUIPMENT		MATERIAL		TOTAL	SHIPPING	
	NO. OF UNITS	UNIT MEAS	MH UNIT	TOTAL HRS	UNIT PRICE	COST	UNIT PRICE	COST	UNIT PRICE	COST		UNIT WT	TOTAL WT
TOTAL THIS SHEET													

DA FORM 5418-R, Apr 85

CREW AND PRODUCTIVITY WORKSHEET

For use of this form, see TM 5-800-2; the proponent agency is USACE.

PROJECT	PREPARED BY	DATE PREPARED
LOCATION	CHECKED BY	CREW REF NO.

CREW COMPOSITION

WORK TYPE	WORK SCHEDULE	SPECIAL INFORMATION

CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST	
		HOURLY* RATE ($/HR)	TOTAL FOR CREW ($/HR)	HOURLY RATE ($/HR)	TOTAL FOR CREW ($/HR)
TOTALS MANHOURS		LABOR COST		EQUIPMENT COST	

CREW PRODUCTIVITY

WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT $/UNIT	COMMENTS
		MH/UNIT	$/UNIT		

*Including fringe benefits

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GPO : 1959 O - 516203

CONSTRUCTION COST ESTIMATE WORKSHEET

DATE PREPARED

SHEET OF

PROJECT

LOCATION

PLAN NO.

ESTIMATOR

CHECKED BY

ENG FORM 150a
1 AUG 59

(EM 1110-345-730) REPLACES EDITION OF 1 AUG 58, WHICH MAY BE USED.