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	Engineering and Design CIVIL WORKS COST ENGINEERING	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

ER 1110-2-1302

CECW-EC

Regulation
No. 1110-2-1302

31 March 1994

Engineering and Design
CIVIL WORKS COST ENGINEERING

1. Purpose

This Engineer Regulation (ER) provides policy, guidance, and procedures for cost engineering responsibilities for all Civil Works projects assigned to the U.S. Army Corps of Engineers (USACE).

2. Applicability

This regulation applies to all HQUSACE elements, major subordinate commands (MSC), districts, laboratories, and field operating activities (FOA) having civil works responsibilities.

3. References

References are included in Appendix A.

4. Policy

All cost estimates required to support Civil Works projects will be prepared in accordance with this regulation.

5. General Definitions

Various acronyms are commonly used in this regulation to describe phases, types, and parts of estimates. For commonality, and to ensure understanding, definitions used in this regulation are described in Appendix B.

This regulation supersedes ER 1110-2-1300, 18 March 1988; EM 1110-2-1301, 31 July 1980, and EM 1110-2-1302, 15 January 1982. Also changes ENG Forms 1738, 1739, 1740, 1741, 1741a, 1741b, and 1741c to ENG Forms 1738-R, 1739-R, 1740-R, 1741-R, 1741a-R, 1741b-R and 1741c-R, respectively.

6. General

The Water Resources Development Act (WRDA) of 1986, Public Law 99-662, made numerous changes in the way potential new projects are funded. It established a new role for the Federal Government and the non-Federal sponsors in project planning and the cost sharing responsibilities for Civil Works projects. Furthermore, it established guidelines to limit the total cost of projects.

a. USACE is committed to a greater role of effective management by increased accountability for scope, quality, cost, and schedule for each project. An integral part of this challenge requires that the cost engineering staff be part of the project team and the project cost estimate be recognized as a major management tool for establishing and monitoring costs from the study phase, through project completion.

b. Cost estimates shall reflect the experience, judgment, and expertise of the cost engineer, along with input from the other team members.

7. Civil Works Cost Estimates

a. Cost Engineer. The Cost Engineer is a principal member of the project team. The Cost Engineer is held accountable for a reliable and well documented construction cost estimate. The cost estimate, including assumptions and schedule, is a major tool of project management. The efforts of all project team members will be coordinated to ensure that sufficient project information, including assumptions, is made available to the Cost Engineer. The construction cost estimate will be prepared to a level of detail commensurate with the information provided. Project schedules shall reflect the Cost Engineer's requirement to receive all pertinent design information to complete the estimate.

b. Cost estimates. The Cost Engineer will prepare cost estimates for the construction features on all projects from the planning phases through construction and rehabilitation. Requirements for cost estimates at different phases of project development are discussed in Appendix C. In addition, the Cost Engineer will prepare cost estimates for the maintenance of facilities as requested by Operations Division. The two major types of estimates used in Civil Works construction are the Total Current Working Estimate (TOTAL CWE) and the Government estimate. The technical details and procedures for the preparation of civil works cost estimates are provided in Appendix D. The TOTAL CWE consists of all project costs and will vary as design details are refined at each phase in project development. The Baseline Cost Estimate (BCE), developed to support the recommended scope and schedule in the Feasibility Report, is the TOTAL CWE at this specific point in time. The Government estimate is an independent construction cost estimate prepared as if the Government were in competition for the contract award.

8. Total Current Working Estimate (TOTAL CWE)

The TOTAL CWE includes all Federal and authorized non-Federal costs. It must be developed using the Microcomputer Aided Cost Engineering System (MCACES) software and formatted in accordance with the Civil Works Breakdown Structure (CWBS). The CWBS is further described in subsequent paragraphs of this regulation. The estimate is based upon the level of design and the project schedule at the time it is prepared or updated. It is prepared with an identified price level date and each contract and/or element is then escalated for inflation according to the schedule. A narrative is required addressing contingency development, general project assumptions, additional investigations, quantity variations, and refinements in design. Specific components and requirements of the TOTAL CWE are addressed in the following paragraphs:

a. Lands and damages. Costs will be developed 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. Lands and damages costs, including contingencies, will be estimated based on each phase or construction contract. The Project Manager (PM), in coordination with Engineering Division, will determine the need for phased construction contracts and advise the Chief of Real Estate and the Cost Engineer. The development of lands and damages costs and contingencies will be the responsibility of Real Estate Division. The cost estimate for all lands and damages activities will be formatted in the CWBS by Real Estate Division and forwarded to the PM to ensure all schedules and commitments are fulfilled for project development. This portion of the cost estimate is then provided to the Cost Engineer for incorporation into the TOTAL CWE utilizing MCACES.

b. Construction features. Estimated costs will be developed using MCACES in accordance with the CWBS for all construction features associated with each construction contract within the total project. Contingencies will be applied at the appropriate level within the CWBS where the risks or uncertainties are identified. Notes supporting the basis for the assigned contingency will be prepared for related groupings of elements and included in the cost estimate. Each cost estimate will be prepared in detail for labor, equipment, and materials with related productivity to the extent possible based upon the available design detail. Descriptive statements regarding methods of construction, material sources and prices, type of equipment required, access, haul distances, estimated production rates, placement procedures, environmental restrictions, crew sizes and labor rates, dewatering, job conditions, and other assumptions used in developing the cost estimate will be included as appropriate in MCACES as estimate notes. The development and preparation of the cost estimate for the construction features is the responsibility of the Cost Engineer. Policy, general information, and handling of the Government estimate are contained in ER 1110-1-1300, Cost Engineering Policy and General Requirements.

c. Engineering and design. Costs will be developed 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 will include in-house labor based upon work-hour requirements, material and facility costs, Architect-Engineer (A-E) contracts with breakdown of services, additional studies, travel, overhead, and contingencies. Costs will be developed in detail for each product in accordance with the CWBS. All costs for these activities will be developed by the appropriate office, e.g., Planning, Engineering, and Program/Project

Management, and forwarded to the PM to ensure all schedules and commitments are fulfilled for project development. The PM will provide this portion of the cost estimate to the Cost Engineer for incorporation into the TOTAL CWE utilizing MCACES.

d. Construction management. Costs will be developed for all construction management activities from preaward requirements through final contract closeout, including in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel, overhead, and contingencies. Costs will be developed in detail in accordance with the CWBS. Costs for all construction management activities will be developed by Construction Division and forwarded to the PM to ensure that all schedules and commitments are fulfilled for project development. The PM will provide this portion of the estimate to the Cost Engineer for incorporation into the TOTAL CWE utilizing MCACES.

e. Price escalation for inflation. Since the components of each estimate are prepared with an identified common price level date, inflation factors must be utilized to adjust pricing to the project schedule to fully fund the estimate. The PM is responsible for ensuring that this process is complete and the estimate is escalated for inflation in accordance with the approved project schedule using the total project cost summary sheets specified in ER 5-7-1(FR). With inflation added to each major component previously described, the TOTAL CWE is developed.

9. Government Estimate

The Government estimate is the formal, approved construction cost estimate prepared to support contract award. A Government estimate is required for all contracts, or modifications exceeding $25,000 (FAR 36.203). It is used to evaluate bids or proposals, assist in negotiations, and serve as a guide in establishing a schedule for partial payments during contract execution. The Government estimate is based on final plans and specifications. Profit, contingencies, and Government costs associated with the contract award and execution are not included in the Government estimate. Government estimates prepared for contract modifications will include profit based on the factors as determined by use of the weighted guidelines.

10. Informal Cost Terms

Terms such as control estimates, study estimates, alternative or comparability estimates, budget estimates, "scratch" estimates, and project estimates are sometimes used for special purposes such as budget forecasting; making "rough" estimates based on sketches at the early stages of project development, or during construction. Normally, the Cost Engineer will provide cost data appropriate to the situation. These costs are sometimes based on historical data and unit prices from similar projects previously constructed. Terminology, as described above, is presented for general information, but their use is limited and not recognized as formal documentation for contract award or modifications.

11. Civil Work Breakdown Structure (CWBS)

The CWBS identifies all project products beginning with the reconnaissance phase and continues through project completion. It provides a standard product related format to identify all costs throughout the project life cycle necessary to accomplish the work required under each Civil Works feature shown in Table 1. A Cost Engineer checklist, included in the MCACES model database as a template, groups these CWBS products by feature and further expands the levels of detail as necessary to assist in recognizing all the specific work items which may be required. The TOTAL CWE is then prepared by the Cost Engineer by incorporating all the feature costs into a single document as follows.

a. The construction features identified as 02 through 20 in Table 1 are a part of the overall checklist and provide the standard format for developing cost estimates associated with each of the construction features.

b. The checklist further groups all established CWBS products for the nonconstruction features into the appropriate feature categories for Lands and Damages, Planning, Engineering and Design, and Construction Management. The cost data related to these products will be supplied in the checklist (CWBS) format by the organization having the particular expertise or responsibility, e.g., Real Estate Division, Planning Division, Engineering Division, Construction

Table 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

Division, Programs/Project Management Division through the PM to Cost Engineering to ensure all project requirements identified in the Project Management Plan (PMP) are included.

c. The cost estimate is developed with an identified price level date by cost engineering incorporating all the construction feature costs developed by cost engineering and the nonconstruction feature costs obtained through project management. The structure of the cost estimate permits identification of costs by feature for each product defined in the CWBS to the level of detail required by the type of estimate being prepared.

d. The CWBS further provides an identical structure for managing and capturing the actual costs. With this interrelationship, the cost estimate structure provides the hierarchy that becomes the library or storage system for the collection of cost data on each project and is the basis for the development and maintenance of the cost engineering historical database.

12. Contingencies

a. Project cost estimates will be prepared with an appropriate amount of contingencies, depending on the level of investigation data and design detail available, to support each stage or milestone of project development. Contingencies represent allowances to cover unknowns, 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 are not a means of adding costs to the project for possible schedule slippage or to cover items which are thought to be a project requirement but are not specifically being considered in the current scope.

b. Contingency allocations are specifically related to the project uncertainties and will 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.

c. At construction contract award, a minimum contingency allowance of five percent of the contract amount must be available at the project level in accordance with ER 5-7-1(FR). As a project nears completion, this contingency allowance must be reduced accordingly.

13. Price Level Update/Forecast

a. CWCCIS. The Civil Works Construction Cost Index System (CWCCIS), 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 the Engineer Circular (EC) for the Annual Program and Budget Request for Civil Works Activities.

b. Update of cost estimates. For projects with cost estimates more than two years old without an update in pricing, special consideration is required. In these situations, it is the responsibility of the Cost Engineer to perform an appropriate analysis to ensure that the project estimate is based on the current design and schedule. The construction cost estimates for major

or unique projects will be repriced using current labor and material rates. For other projects, it is acceptable to use the cost indices to update the estimate for projects that have been inactive for two years. This decision should be based on the judgment and experience of the Cost Engineer.

14. Cost Risk Analysis

Cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties on the estimated total project cost. It should be accomplished as a joint analysis between the Cost Engineer and the designers or appropriate project team members that have specific knowledge and expertise on all possible project risks.

a. To accomplish this process, it is vital to identify those areas that significantly contribute to cost uncertainty. Historically, 80 percent of the cost of a project is contained in 20 percent of the estimated work elements. The object is to focus on the uncertainties associated with these so called 20 percent "critical" elements. Variables such as quantity, productivity, and unit cost, which are related to the critical elements affecting the cost, should be evaluated to determine their range of values (lowest and highest) and probability for the outcome. Computer programs are commercially available to perform these tasks.

b. Cost risk analysis provides a graphic display of the risks associated with the cost estimate and the probability of having a cost overrun. Cost risk analysis identifies the amount of contingency that must be added to a cost estimate to reduce the uncertainties to an acceptable level. It should be noted that the use of cost risk analysis will not reduce the uncertainties associated with the project cost estimate or solve the problems of cost variance due to insufficient investigations or design data. This process more readily identifies areas in the study or design where additional effort could reduce the uncertainties and provide a more reliable cost estimate.

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 be exceeded. This gives the management team an effective additional tool to assist in the decision making process associated with project planning and design. It does require additional funds, time, and effort to develop the cost estimate. The added benefits obtained should be identified and compared with the extra cost. The management team should review the possible use of cost risk analysis techniques for projects with considerable uncertainties.

15. Computer Software for Cost Estimates

MCACES is the required software for the preparation of Civil Works cost estimates throughout USACE. The software was developed by Building Systems Design, Inc., of Atlanta, GA.

a. MCACES has six title levels that support the CWBS. The goal is to have a hierarchy of titles that describe the type of work and will allow the costs to be "rolled up" in a uniform manner.

b. This regulation recognizes that there are some exceptions to the use of the MCACES software program for certain types of projects which are listed in the appropriate paragraphs of this regulation.

16. Project Development

The traditional and most common way for the Corps to help a community solve a water resource problem is to conduct a study and, if shown by the study to be feasible, construct a project. This approach uses a six-step process and requires that Congress provide the authority to both study and construct a project. The process is: A local community perceives or experiences a water resource problem that is beyond its ability to alleviate or solve alone. The community asks its congressional delegation for assistance, and Congress authorizes the Corps to study the identified problem in a reconnaissance study/report. The Corps studies the identified water resource problem and reports its findings in a Feasibility Report. A project may be recommended for construction if it is feasible and meets certain requirements. The Feasibility Report is reviewed at the Washington level by the Corps, the Assistant Secretary of the Army, Civil Works (ASA(CW)), and OMB. When approved, the report is sent to Congress and Congress may authorize the Corps to construct the project. If authorized, the Corps designs the project and a Project Cooperation Agreement (PCA) is signed by the non-Federal project sponsor and the ASA(CW). The project is then built and turned over to the non-Federal sponsor for ongoing use, including operation and maintenance.

a. Close coordination is required between the Project Manager, Technical Manager, Planning and Programs offices, and the Cost Engineer in managing the process from the study phases through project completion. The TOTAL CWE evolves in structure and detail during the initial study phases, based on preliminary design concepts to the final design and completed plans and specifications. It is essential to maintain the Governments credibility that the design, award, and contract execution as a quality product, leading to completion within scope, budget, and schedule. The sponsor must be kept aware of the current and forecasted total cost of the project.

b. The PM will coordinate inputs from the functional elements during formulation of the TOTAL CWE to ensure interdisciplinary teamwork during preparation of the total project cost estimate. For budgetary purposes, the preparation and submission of the Project Cost Estimate, PB-3, will be the responsibility of the Programs/Project Management Division. The Cost Engineer will develop the cost estimate for the construction features and assemble the TOTAL CWE.

c. The Chief of Engineers furnishes the ASA(CW), OMB, and Congress with an annual budget request. The budget request includes information on which to base a decision for the appropriation of funds for individual studies and projects that make up the overall Civil Works program. The requirements for development of the budget request are set forth in the EC for the Annual Program and Budget Request for Civil Works Activities issued by HQUSACE, Programs Division, CECW-B, which reflects directives and criteria supplied by ASA(CW) and OMB. Accurate cost estimating and scheduling is a prerequisite to dependable programming, and the portrayal of such information is an important part of the overall budget submission. The PB-3 is a summary of the features and accounts of the total project cost estimate. It provides basic cost information necessary for preparation of budget requests, project reports, allocation, project cost sharing, and serves as a historical tracking document. The Detailed Project Schedule (PB-2a) is prepared for scheduling, lands and damages, engineering and design, construction, and management activities, determining funding requirements, and reporting on the disposition of funds previously made available for each project.

d. As a project progresses through design and construction, Schedule and Cost Change Requests (SACCR) will be fully documented with accurate records maintained by the PM. Cost changes on the Project Executive Summary (PES) must be supported with an approved SACCR justifying the changes. Where changes affect the construction features, the Cost Engineer will provide a revised estimate to the PM for developing the required SACCR. Cost data presented on a PES must agree with that shown on a PB-3.

e. WRDA 86, Section 902, established a maximum project cost. Guidance for developing the maximum project limit is described in ER 1105-2-100 and is the responsibility of the PM.

17. Project Phases

The major phases of project development are briefly reviewed in the following paragraphs, describing the responsibilities of the Cost Engineer throughout each phase, including the appropriate interface with the other team members. A timeline, denoted "Civil Works Project Development," has been developed to indicate the major steps used in accomplishing a typical Civil Works project and is attached as Appendix E.

a. Reconnaissance phase.

(1) The purpose of the reconnaissance phase is to determine Federal interest and whether an identified problem has a practicable, economically feasible, and environmentally consistent solution acceptable to a local sponsor, and if so, whether the sponsor is willing to cost share in the feasibility phase. The reconnaissance phase begins when the responsible district obligates appropriated Federal funds to conduct the study and ends with either the execution of a Feasibility Cost Sharing Agreement (FCSA) or the issuance of the District Commander's report recommending no further Federal action. The reconnaissance phase is 100 percent Federally funded and is completed within 12 months.

(2) The major documents prepared during the reconnaissance phase include the Reconnaissance Report, which describes the results of the study with a preliminary project cost estimate for the proposed solution, and the FCSA, which includes an Initial Project Management Plan (IPMP) and describes the scope, tasks, cost and schedule, and Federal and non-Federal responsibilities for the feasibility phase.

(3) During the reconnaissance phase, Planning Division assesses potential alternatives to determine if

they will function safely, reliably, efficiently, and economically. The project cost estimate is the responsibility of the Cost Engineer and will be prepared to support this effort, for potential solutions.

b. Feasibility phase.

(1) During the feasibility phase, the study team evaluates alternative plans to identify the National Economic Development (NED) plan. The feasibility study is usually cost shared equally between the non-Federal sponsor and the Federal Government except for inland waterway projects. This phase begins after the FCSA has been signed and the District Engineer receives both the sponsor funds and the Federal funds needed to initiate the study. The phase ends when the ASA(CW), submits the Feasibility Report to the OMB. After receiving OMB clearance, the ASA(CW) submits the report to Congress for authorization to construct the recommended project. The Feasibility Report contains an engineering appendix, which includes the TOTAL CWE for the NED plan. On occasion the sponsor may request a plan different from the NED plan. When this occurs, the engineering appendix will contain the cost estimate for both the NED plan and the locally preferred plan.

(2) Upon completion of a Feasibility Report recommending Congressional authorization of a project or a project modification, a PB-3 will be prepared within 90 calendar days from the issuance of the public notice by the Division Engineer. The PB-3 will update the constant dollar project cost estimate to a 1 October of the budget year minus one price level. Thereafter, each PB-3 will be updated annually based upon the current MCACES developed cost estimate to 1 October of the budget year minus one price level in accordance with ER 11-2-240 and the annual program and budget request EC for Civil Works activities until the project is financially completed, as long as it remains in the active category. This effort will assure that all projects which are recommended for construction funding in the budget year have a common cost estimate base. PB-3's will normally be prepared by the Programs/Project Management Division at each district.

c. Planning, engineering, and design phase.

(1) The first stage in this process is the Preconstruction Engineering and Design (PED) phase which consists of completing all detailed technical studies and design needed to initiate construction of the project. PED begins after the Division Commander's public notice is issued and funds are allocated, and ends with completion of plans and specifications for the first construction contract.

(2) The second stage is the completion of all design for the remaining contracts and the design to support ongoing construction required during the construction phase (Engineering During Construction).

(3) As the project design documents are prepared and the design is refined, the baseline cost estimate must be used as a guide in managing the engineering and design process. The effect of changes to the design and progress schedule developed in the feasibility study must be reflected in appropriate revisions to the TOTAL CWE. The BCE that was developed in MCACES software will be the basis for maintaining the updated TOTAL CWE.

(4) With the completion of the plans and specifications, a Government estimate for construction award is prepared. As engineering and design continues for the remaining plans and specifications for multicontract projects, the total project cost must be updated. The update is based on actual contract costs, completed contracts, design of future contracts, and the Government estimate for new contract awards.

(5) Each milestone establishes a more realistic update on actual expenditures and the total estimated costs required for completing the remaining portions of the project and provides a management tool for evaluating the project schedule and authorized costs.

d. Construction phase.

(1) The construction phase for the project begins when funds for project authorization are appropriated for a new construction start, permitting the initial construction contract award. This phase is considered complete when the project has been inspected and accepted from the contractor.

(2) Changes. All design changes developed in Engineering Division during construction will be supported by a cost estimate prepared by cost engineering using MCACES and formatted in the CWBS. The Cost Engineer should also be a member of the negotiating team for major design and value engineering change orders.

(3) Government estimates for changes, modifications and claims less than $100,000, that occur

during construction may be prepared in the field office and approved by the Administrative Contracting Officer (ACO). The cost estimate may be prepared in MCACES or a suitable format (see Appendix F) based on the experience and judgement of the preparer. The field office must ensure that the selected format follows the appropriate CWBS for adequate accounting and tracking of the TOTAL CWE by the PM.

(4) Government estimates for changes, modifications and claims exceeding $100,000, may also be prepared by the field office using a suitable format and the appropriate CWBS as described in paragraph 17d(3) above. In this case the Cost Engineer will be consulted or involved in the review process and the final approval of the estimate will be made by the Chief, Engineering Division or the Chief, Construction Division (as appropriate). The Government estimate will be included in the contract modification documentation and is subject to the approval of the Contracting Officer or ACO. Depending on workload and availability of personnel, the Cost Engineer will participate in these negotiations.

(5) When the Government estimate is changed during or subsequent to conferences or negotiations, the details of the basis for the revisions or changes in price shall be fully explained and documented in the price negotiation memorandum, see FAR 36.203(102).

e. Operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) phase.

(1) Guidance. This project phase is managed by the Operations Division and the following guidance is applicable to Corps constructed facilities after completion of the construction phase. Additional funds are required to operate, maintain, repair, rehabilitate and/or replace all completed Corps projects. In some cases, responsibility for this work is assigned to a non-Federal sponsor via a PCA, while in others this responsibility is retained by the Corps. When retained by the Corps, this work is divided into two categories, Major Rehabilitation and all other work, e.g., O&M General and maintenance dredging.

(2) Major rehabilitation. Major rehabilitation work is specifically defined in guidance provided by HQUSACE, Operations Division (CECW-OM-O), for Major Rehabilitation Evaluation Reports. This work falls into two major categories, (a) reliability and (b) efficiency improvement, which are subject to qualitative and quantitative criteria including minimum capital outlays. The development of these projects is based on an Evaluation Report which is similar in purpose to the Feasibility Reports developed for "traditional" Civil Works projects. This similarity extends to economic justification, the evaluation of alternatives and identification of a recommended plan. The study/project is managed using the Corps' project management system and a technical project team with Operations Division acting as both team member and user. In addition, a PMP must be developed to accompany this report. The report is submitted to HQUSACE and ASA(CW) where it competes for available funds with other types of new construction projects. Cost estimates developed to evaluate alternatives considered in the report may be accomplished based on historical data using standard forms and techniques. The cost estimate for the recommended plan shall be developed using MCACES in the detail commensurate with the level of design and formatted in the CWBS.

(3) Operations and maintenance projects. Projects not meeting criteria for Major Rehabilitation will be considered in this general category. These projects include routine work, the need for which would be expected to recur. These projects are usually coordinated with Engineering Division for design development including drawings, specifications, and cost estimates. The recurring nature of these projects facilitates the development of a credible database of historical costs upon which project estimates may be based. For these projects, which are generally small in scope and cost, the cost estimate may be developed using MCACES or the standard estimating forms described in Appendix F. The MCACES database is construction oriented and does not contain maintenance cost data. Recurring routine cost data for a local area could be developed and added to MCACES. This would permit ready access to models or assemblies for developing future estimates. The preparation of the cost estimate by Cost Engineering is based on project size, complexity, and familiarity with the particular type of work. The Chief, Cost Engineering, in coordination with the Chief, Operations Division, will determine responsibility for cost development. A fully documented cost estimate shall be prepared for all changes.

18. Cost Estimates for Other Programs

a. The continuing authorities program (CAP). The CAP is a group of legislative authorities under

which the Secretary of the Army is authorized to plan, design, and construct certain types of water resources improvements without specific Congressional authorization.

(1) ER 1105-2-100 contains detailed policy and procedural guidance for the CAP. CAP projects are subject to statutory Federal cost limitations. All Federal expenditures for study, design, and construction of a project are included in the cost limitation. Therefore, judgment is required when limited funds preclude the more detailed studies commonly undertaken for projects which are specifically authorized by the Congress. The Division Commander is delegated certain approval authority under the CAP, including the technical adequacy of planning documents.

(2) Project development for these projects begins with a one or two-step planning process resulting in a Detailed Project Report (DPR). The two-step process follows the guidelines for reconnaissance and feasibility studies while the one-step process combines these studies. In both cases, the DPR provides the basis for making the decision to proceed to plans and specifications. See Appendix C for cost estimate procedures.

b. Dam safety assurance program. The Dam Safety Assurance Program provides for modification of dams and related facilities constructed or operated by the Corps of Engineers which are potential safety hazards, as defined by changes in hydrologic or seismic data. See Appendix C for cost estimate procedures.

c. Dredging projects. Dredging projects are considered in two categories. The first, maintenance dredging, is performed to maintain authorized project dimensions and is managed by Operations Division. The second is new work or improvement dredging which is performed to construct a newly authorized project or increase the dimensions of a previously authorized project and is managed using the Corps' Project Management system.

(1) Maintenance dredging. The policies and procedures for the Corps dredging program are outlined in ER 1130-2-307. Maintenance dredging provides for the removal of shoal material from authorized constructed navigation projects. The maximum practicable benefits involving the discharge of dredged or fill material will be in accordance with 33 CFR 209 and 335-338.

(2) New work dredging. New work dredging projects are processed as regular Civil Works projects requiring specific Feasibility Reports, PMP and authorizations as the project develops. Cost estimates for both maintenance and new work dredging projects shall be prepared by Cost Engineering.

(3) Each MSC and district command that is involved in the preparation of plans and specifications, cost estimates, and contract management for dredging projects should promote the development of expertise related to dredging process within the Planning, Engineering, and Construction-Operations functions. The cost estimates will be prepared by a Cost Engineer preferably experienced in dredging, in coordination wit the dredging program manager. Dredge cost estimates will be developed using the USACE software systems entitled "Corps of Engineers Dredge Estimating Program (CEDEP)." Since many Corps field offices have already developed expertise specific to dredging, technical advice and assistance for project designs and cost estimates are available through these offices upon request. Cost estimate summary reports shall be prepared using MCACES and the current CWBS. The CEDEP printout containing all detail and back-up data will be retained on file in the District Cost Engineer Branch. Specific guidance regarding the preparation of dredge cost estimates is outlined in Appendix G.

(4) Site visits. Dredging projects often present Cost Engineers with unique situations. Observing ongoing operations provides the best opportunity for individuals to gain insight and understanding of the dredging process. Site visits, therefore, are considered extremely important in providing accurate estimates.

(5) Data collection. Cost Engineering Branch will collect and retain data of on-going projects regarding mobilization, daily production, and overall quantity computations historical data for future projects. 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.

(6) Special problems. 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. The regional dredge teams are designed to provide assistance to all districts in the evaluation of bid protests, mistakes in bids, or any 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. A list of the regional geographical areas and office of the chairman is designated in Appendix H.

d. Beach fill and nourishment. To provide adequate protection from coastal storm damage, projects are undertaken to restore beach shorelines. These projects are grouped as either initial construction or periodic nourishment.

(1) Initial construction projects are considered as new Civil Works projects that must be specifically authorized and budgeted for construction.

(2) Periodic nourishment projects are considered continued construction. Cost estimates for both of these groups must be prepared in the same manner as for other construction projects.

(3) Beach nourishment, when performed as an adjunct to a dredging project for the disposal of dredged material, will be considered a feature of the dredging project. The above guidance provided for preparing dredge estimates shall apply.

e. Emergency work. On occasion, emergencies occur, whereby the Cost Engineer may be requested to prepare estimates for natural disasters, e.g., floods. Cost estimates will be prepared based on conditions and circumstances at the site of the emergency.

19. Preparation and Approval of Baseline Cost Estimate

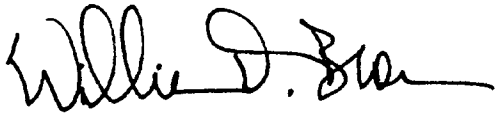
The TOTAL CWE, that is developed to support the recommended scope and schedule in the Feasibility Report is defined as the project BCE. Corporate support is necessary to ensure that only the costs defined in the approved BCE are used in upward reporting. The following procedure establishes the guidelines for development and approval of the BCE:

a. The constant dollar cost estimate covering all project features including 01-Lands and Damages, 30-Planning, Engineering and Design, and 31-Construction Management must be prepared with an identified price level date. Cost engineering is responsible for preparation of the detailed estimate for all construction features and for incorporation of the cost for lands and damages, planning, engineering and design, and construction management provided through the PM. All cost data obtained by the PM for incorporation into the estimate by cost engineering must be in accordance with the established CWBS format and approved by the responsible functional chief, e.g., Chief of Real Estate Division for lands and damages costs, prior to completion of the cost estimate by cost engineering. Approval and signature by the Chief, Cost Engineering Branch, affirms that the construction feature costs are correct and that the backup data for the nonconstruction features (01, 30, and 31) support these feature costs.

b. The PM will ensure that the cost estimate is fully funded, based upon the project schedule developed in the Feasibility Report. The signature by the PM recommending approval of the BCE acknowledges that the inflation factors and current schedule used were accurate in developing the fully funded project cost estimate. Upon review and endorsement by the District Project Review Board (PRB), the BCE is forwarded to the Division for review and approval by the Chief, Cost Engineering, the Chief, Programs and Project Management and by the Division PRB. Upon the release of the Division Engineer's public notice, the BCE becomes fixed in price. A copy of the final approved BCE with comments, if applicable, must be returned to the District Cost Engineering Branch.

c. The approved BCE, within the Engineering Appendix of the Feasibility Report, will be forwarded to HQUSACE. The submission to HQUSACE will include, as a minimum, the MCACES summary sheets for direct costs, indirect costs, and owner costs to the subfeature level, and a total project cost summary following the format in ER 5-7-1(FR) that addresses inflation through project completion. It must contain a narrative that discusses cost relationships and assumptions made, based on the level of design, quantity issues and unknowns, and identified risks or uncertainties used in the development of contingencies. In addition, the submission to the Washington Level Review Center (WLRC) must also include a floppy disk containing the complete estimate and all associated data bases.

FOR THE COMMANDER:



WILLIAM D. BROWN
Colonel, Corps of Engineers
Chief of Staff

8 Appendices
App A - References
App B - Abbreviations and Acronyms
App C - Type of Cost Estimates
App D - Procedures for Preparation of Cost Estimates
App E - Typical Civil Works Project Development
App F - Standard Estimating Forms
App G - Preparation of Dredge Cost Estimates
App H - Regional Dredge Teams

APPENDIX A
REFERENCES

Public Law No. 99-662 (H.R.6)
The Water Resources Development Act of 1986

Title 33 U.S.C. Section 622

Title 33 U.S.C. Section 624

33 CFR Parts 209 and 335-338
Operations and Maintenance Regulations for Activities Involving the Discharge of Dredged or Fill Material in Waters of the United States and Ocean Waters

Davis-Bacon Act

FAR, Subpart 15.8
Price Negotiation

FAR, Subpart 15.9
Profit

FAR, Subpart 36
Construction and Architect-Engineer Contracts

DFAR, Subpart 215.8
Price Negotiation

DFAR, Subpart 215.9
Profit

EFAR, Subpart 1.602
Contracting Officers

EFAR, Subpart 15.9
Profit

EFAR, Subpart 36
Construction and Architect-Engineer Contracts

ER 5-7-1(FR)
Project Management

ER 11-2-240
Civil Works Activities, Construction and Design

ER 1105-2-100
Guidance for Conducting Civil Works Planning Studies

ER 1110-1-1300
Cost Engineering Policy and General Requirements

ER 1110-2-1150
Engineering after Feasibility Studies

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

EC 11-2-XXX
Annual Program and Budget Request for Civil Works Activities, available from CECW-B

APPENDIX B
ABBREVIATIONS AND ACRONYMS

ACO	Administrative Contracting Officer
A-E	Architect-Engineer
AFAR	Army Federal Acquisition Regulation
ASA(CW)	Assistant Secretary of the Army (Civil Works)
BCE	Baseline Cost Estimate
BCO	Biddability, Constructability, and Operability
CAP	Continuing Authorities Program
CECW-B	Headquarters, Civil Works Programs Division
CECW-OM	Headquarters, Civil Works Operations Division
CEDEP	Corps of Engineers Dredge Estimating Program
CFR	Code of Federal Regulations
CWBS	Civil Works Breakdown Structure
CWCCIS	Civil Works Construction Cost Index System
CWE	Current Working Estimate for Civil Works (See TOTAL CWE)
DFAR	Defense Federal Acquisition Regulation
DM	Design Memorandum
DPR	Detailed Project Report
EC	Engineer Circular
E&D	Engineering and Design
EDC	Engineering during Construction
EFAR	Engineer Federal Acquisition Regulation
EM	Engineer Manual
EP	Engineer Pamphlet
ER	Engineer Regulation
FAR	Federal Acquisition Regulation
FCSA	Feasibility Cost Sharing Agreement
FOA	Field Operating Activity
FOUO	For Official Use Only
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.
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IFB	Invitation for Bid (Sealed Bidding)
IPMP	Initial Project Management Plan
LERRD	Land, Easement, Right-of-way, Relocation and Disposal
MCACES	Microcomputer Aided Cost Engineering System
MSC	Major Subordinate Command
NED	National Economic Development
OMB	Office of Management and Budget
O&M	Operation and Maintenance
OMRR&R	Operation, Maintenance, Repair, Rehabilitation and Replacement
PB-2a	Detailed Project Schedule
PB-3	Project Cost Estimate
PCA	Project Cooperation Agreement
PED	Preconstruction Engineering and Design
PES	Project Executive Summary
P&S	Plans and Specifications
PM	Project Manager
PMP	Project Management Plan
PRB	Project Review Board
PRISM	Project Resources Information System for Management
RFP	Request for Proposal (Negotiated Proposal)
SAA	Surety Association of America
SACCR	Schedule and Cost Change Request
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.
USACE	U.S. Army Corps of Engineers
VE	Value Engineering
WLRC	Washington Level Review Center
WRDA	Water Resources Development Act
UPB	Unit Price Book
U.S.C.	United States Code

APPENDIX C
TYPES OF COST ESTIMATES

1. Introduction

a. This appendix provides guidance in establishing the components of the various types of cost estimates prepared for Civil Works projects assigned to the USACE.

b. Virtually every study, project, or activity funded under the Civil Works program requires a 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 the following categories:

(1) Estimates for reconnaissance reports.

(2) Estimates for Feasibility Reports.

(3) Estimates during engineering and design.

(4) Government estimates.

(5) Estimates for contract modifications.

c. 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 CAP, Dam Safety Assurance Program, and OMRR&R. The procedures outlined herein are applicable to the wide variety of projects encompassed in the Civil Works program of USACE.

d. Preparation of all cost estimates is the responsibility of Cost Engineering. The preparation or review of cost estimates will be assigned to an experienced Cost Engineer. Cost Engineering should receive full support from all other elements in the district or MSC in terms of:

(1) Visualizing all features involved in complex projects.

(2) Recognizing from the start, planning, engineering, design, construction, and operating requirements to be met in the evolution of such works.

(3) Applying the total quality management concept in the biddability, constructibility, and operability (BCO) review process from the preliminary design stage through completion of construction of a project.

(4) Determining as accurately as possible the quantities to be used in the cost estimating process.

2. Estimates for the Reconnaissance Phase

a. The preliminary cost estimates prepared by the Cost Engineer, in constant dollars, during the reconnaissance phase are based on the probable type and size of the project and will include the construction features, lands and damages, relocations, environmental compliance and required mitigation, engineering and design, construction management, and contingencies. The assignment of contingencies is very important at the reconnaissance stage of project study. Contingencies are necessary to assure that unforeseen items of work or level of detail found later to be needed will not jeopardize the project recommended in the Reconnaissance Study Report as one worthy of progressing to the feasibility phase.

b. Design detail will be limited at this stage of project development. The cost estimating method used must establish reasonable costs sufficient to support a planning evaluation process for determining whether a study should proceed into the feasibility phase. Alternative plans may need to be considered before an acceptable plan is selected. Good judgement and experience of the estimating team is needed and required for preparing estimates in a method and format suitable for comparing the various alternatives studied.

c. Once it has been determined that a Federal interest is appropriate, a method of development and format must be determined. A cost estimate for the selected plan will be prepared using MCACES

software in the CWBS format to a level of detail necessary to support the preliminary scope.

d. The Reconnaissance Report will contain the cost estimate and will include:

(1) Total Project Cost Summary (ER 5-7-1).

(2) Title Page.

(3) Table of Contents.

(4) Narrative.

(5) Project Owner Cost Summary reported at all levels down to the subfeature level.

e. Cost estimates for the reconnaissance phase may be developed using quotes, calculations, unit prices, or historical data as backup. The Planning, Engineering, and Design Feature and the Construction Management Feature are obtained through the PM and may be a percentage based upon historical cost data. The costs for the Lands and Damages Feature are obtained through the PM from the Real Estate Office. All details used in developing the cost estimate will be kept in a file in Cost Engineering. These details will be made available upon request to reviewing officials.

3. Estimates for the Feasibility Phase

a. Comparative cost estimates of the viable alternatives used in selecting the NED plan must be prepared in the CWBS format to at least the subfeature level. A screening process may be used in the feasibility phase to review all the initial alternatives. Different levels of cost estimating detail may be appropriate at each level of screening. Typically, this screening process will narrow the number of alternatives to a final list, i.e., two to five viable alternatives for a more detailed assessment. Historical bid cost data, experience, and/or unit prices adjusted to expected project conditions are acceptable methods of developing project costs for these alternatives. The cost estimate for each viable alternative will include appropriate comments describing the method of construction, assumptions used in developing the estimate, and the technical/design data available. For the recommended plan (normally the NED plan), sufficient engineering and design are performed to refine the project features and develop a general design memorandum and construction schedule.

b. The cost estimate for method of development and format supporting the NED plan will be prepared using the MCACES software and the established CWBS to at least the subfeature level of detail. In general, the unit costs for the construction features will then be computed by estimating the equipment, labor, material, and production rates suitable for the project being developed. This estimate, developed with a specific price level date, must then be escalated for inflation (fully funded) through project completion. In most cases, this can be accomplished by escalation to the midpoint of construction. This TOTAL CWE which supports the project scope and schedule developed in the Feasibility Report, is defined as the "Baseline Cost Estimate" (BCE) and its value becomes fixed when the public notice is issued by the MSC. When the non-Federal sponsor requests a plan different from the NED plan, cost estimates for both the NED plan and the "locally preferred" plan will be prepared using MCACES as described for inclusion in the Feasibility Report.

c. The Engineering Appendix of the Feasibility Report will contain the MCACES cost estimate developed by the Cost Engineer and will include:

(1) The Total Project Cost Summary (ER 5-7-1).

(2) Title Page.

(3) Table of Contents.

(4) Narrative.

(5) Summary Sheets for Owner, Indirect and Direct Costs reported at all levels down to the Subfeature Level.

(6) A floppy disk containing the complete MCACES project cost estimate and associated databases for the WLRC submission only.

4. Estimates During Engineering and Design

a. Engineering and design is performed during the early phases of project development and during construction. First, there is engineering during the preconstruction engineering and design phase during which all detailed technical studies and design needed to begin construction of the project are completed, e.g., award of the first construction contract. After initial contract award, engineering continues and includes the

completion of all design for the remaining contracts and the design to support ongoing construction required during the construction period.

b. Project cost estimates during PED are primarily revisions to the TOTAL CWE due to refinements or changes in the design and/or progress schedule developed in the feasibility study. As the project is developed and the design is refined, the BCE must be used as a guide in managing the engineering and design process. A cost estimate (TOTAL CWE) must be prepared and included as a part of any required Project Design Memorandum, Feature Design Memorandum, Reevaluation Report, and/or Postauthorization Change Report. The cost estimate documentation required for any of these project submissions requiring HQUSACE or higher approval will be the same as discussed above for estimates for the feasibility phase.

c. After award of the first contract and construction of the project has begun, project cost estimates during construction again primarily become revisions to the TOTAL CWE as the design and/or progress schedule continues to become more refined. Cost estimates (TOTAL CWE) must be prepared and included as a part of each Feature Design Memorandum and/or any necessary Reevaluation Report or Postauthorization Change Report required to support the project during this phase. The cost estimate documentation required for any of these project submissions requiring HQUSACE or higher approval will be the same as discussed above for estimates for the feasibility phase.

d. As project cost estimates for plans and specifications for each contract are finalized, the TOTAL CWE is updated to reflect the changes or refinements in quantities, design parameters, and/or schedule relating to the overall project. When each contract is awarded, the TOTAL CWE will be updated to reflect the actual contract amount.

e. During construction, changes occur which affect estimates supporting construction and these must be incorporated into the contract. All design changes developed in Engineering Division during construction will be supported by a cost estimate prepared by Cost Engineering in MCACES and the appropriate CWBS. All other changes, modifications, and claims that occur during construction will have estimates as described in this appendix.

5. Government Estimates for Contract Award

a. A Government estimate is required for award of each construction contract in excess of $25,000 (FAR/EFAR) based upon a defined set of plans and specifications that represent the cost of performing the work within the time allocated by determining the necessary labor, equipment, and materials. This may be accomplished through adjustments or additions to the appropriate detail levels in the originally prepared BCE. The bid schedule should be structured for the specific contract in coordination with the Cost Engineer. Each bid item on the bid schedule must be identified by the appropriate CWBS that will allow tracking of the total project cost. The Government estimate required for either Sealed Bidding, Invitation for Bid (IFB), or Contracting by Negotiation, Request for Proposal (RFP), will be prepared by the Cost Engineer using the MCACES software. The Cost Engineer will participate in all negotiated contracts including, but not limited to, Small Business and Small Business Section 8(a), Service and Supplies, and/or cost plus contracts.

b. The Government estimate of fair and reasonable cost for a well-equipped contractor to complete a Civil Works construction contract is referred to as the "Government estimate." The procedures outlined in this appendix will result in uniformity and accuracy in the Government estimates and will protect the Government against excessive cost for contract work. To be effective, the Government estimate must be defendable in case of protests by bidders.

c. Government estimates shall be designated "For Official Use Only" until after bid opening and will consist of the following:

(1) Title Page

(2) Signature Page

(3) Bid Schedule

d. Title 33 U.S.C. Section 624 provides that projects for river and harbor improvement shall be performed by private contract if the contract price is less than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or less than 25 percent in excess of a fair and reasonable estimated cost of a well-equipped contractor doing the work. The legistrative history indicates the Govern-ment estimate shall not include profit. Title 33 U.S.C. Section 622 provides that the Secretary of the

Army shall, by contract or otherwise, carry out such work in the manner most economical and advantageous to the Government.

e. Directives. Those responsible for the preparation of estimates should be thoroughly familiar with the requirements of the FAR, DFAR, AFAR, EFAR, and the appropriate ER's.

f. Approvals. Government estimates for contracts exceeding $25,000 shall be approved by the Chief, Engineering Division or the Contracting Officers appointed designee. The Government estimate will be included in the contract documentation and is subject to the final approval of the Contracting Officer (EFAR 1.602).

6. Estimates for Contract Modifications and Other Negotiated Procurement

a. FAR/EFARS require an independently prepared Government estimate for modifications in excess of $25,000. Normally estimates are not required for changes less than $25,000, but are required by the Contracting Officer for unilateral modifications. Further, 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 $16,000 and decrease of $10,000 has an absolute value of $26,000, and a Government estimate would be required.

b. The Cost Engineer should become familiar with the modification and claim processes as presented in EP 415-1-2, "Modification and Claim Guide." This reference contains discussion and regulatory requirements which will enhance the understanding of the estimating process for modifications.

c. For all negotiated procurement, including contract modifications, award requires the Government estimate to equal or exceed the negotiated price; or in the case of reductions, the negotiated credit is equal to or exceeds the Government estimate. A complete narrative justifying the cost changed from the original Government estimate will be included in the revised Government estimate. This requirement does not apply to contract awards by sealed bidding.

d. A request for preparation for estimating is generally received along with the revised contract documents and a description of the change. The Cost Engineer has several important tasks to perform prior to actually preparing the estimate. Some important activities include (See Appendix D, paragraph 2 for specific requirements for preparation of the original Government estimate):

(1) Reviewing the documents received 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 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 impact 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 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.

(5) Attempting, through the negotiator, to coordinate with the contractor to agree on scope of work and format prior to preparation of the Government estimate. This discussion will assist both the Government and contractor at reaching a mutually accepted scope of work to eliminate unnecessary effort for both parties during negotiations.

e. The estimate can be prepared once 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 a detailed estimate supported by accurate cost data for all elements. General guidance for the calculation of direct costs are noted as follows:

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

(2) 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 maintains 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.

(3) 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 utilized. In addition to the direct cost of the work, overhead, profit, and bond costs should be included for credit on the deleted work.

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

(5) 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 utilized 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.

(6) 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 to the Government personnel or other contractors.

(7) In addition to the preparation of an accurate cost estimate, it must be prepared in a timely manner. 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.

f. 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.

(1) 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 General Provision

Clauses; and on Board of Contract Appeals and court decisions.

(2) 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.

(3) Once the extent of impact has been determined, each cost claimed must be classified as either factual or judgmental. The actual 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.

(4) 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.

g. 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 are considered factual, and they include escalation of material prices, escalation of 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 long 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 resubmittal of shop drawings, sample materials, etc., and additional costs resulting from inability to transfer manpower expertise to other work.

(3) Impact costs considered factual but based on judgmental decisions include 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 and/or use; increase from a longer period of using overhead personnel, materials, and utilities; increase from a longer period of providing overhead and project office services.

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

h. Support for negotiations includes the following items:

(1) 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.

(2) The contractor's proposal should be reviewed by the Cost Engineer. 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.

i. Cost breakdown figures in the Government estimate may be revealed only to the extent determined necessary by the negotiator to settle disputed items of work. 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 shall be removed after issuance of a signed modification.

j. Revision of the Government estimate may be necessary as a result of an error, changed conditions, or additional information. The district or MSC should assure that the appropriate responsibility for modifying the Government estimate is delegated to the appropriate authority. Government estimates for modifications may be revised when necessary either by supplementary sheets or by actually changing the contents of the original estimate pages. The method used will be determined by the extent of the revision and the format utilized. All revisions to the estimate must be clearly indicated, dated, justified, and approved by the appropriate authorities. 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.

k. 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's.

l. Approvals. Government estimates for contract actions less than $100,000 that occur during construction shall be approved by the ACO or appointed designee. For other contract actions including those exceeding $100,000, the approval of the estimate shall be the Chief, Engineering Division or the Chief, Construction Division (as appropriate); or the Contracting Officers appointed designee. 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 FAR 36.203(102). The Government estimate will be included in the contract documentation and is subject to the final approval of the Contracting Officer or ACO.

7. Estimates for Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R)

This project phase is managed by the Operations Division and is divided into two categories, major rehabilitation and all other work.

a. Major rehabilitation. The development of major rehabilitation projects is based on an Evaluation Report which is similar to a Feasibility Report in economic justification, evaluation of alternatives, and identification of a recommended plan. Cost estimates developed to evaluate alternatives considered in the report may be based on historical data. The cost estimate for the recommended plan shall be developed using MCACES and the CWBS in the same format as a cost estimate for a Feasibility Report.

b. Other OMRR&R projects. All OMRR&R projects not meeting the criteria for major rehabilitation fall in this category. The recurring nature of these projects facilitates the development of a historical database. This historical data lends itself well to use in MCACES for development of the cost estimates for these projects. The cost estimate for the recommended plan shall be developed using MCACES and the CWBS in the same format as a cost estimate for a Feasibility Report.

8. Estimates to Support Other Programs

a. Continuing Authorities Program (CAP). CAP projects are often limited in scope, and initial planning studies are usually limited in time. Cost estimates should follow the guidance presented earlier for Civil Works projects except as required herein. For projects whose total Federal cost is below $2,000,000, the use of MCACES software is optional for both the Reconnaissance and Feasibility level cost estimates. These estimates must, however, fully support the report recommendations with accurate cost data documented with the appropriate narrative. For projects exceeding $2,000,000 in Federal cost, the use of MCACES is required at the Feasibility or DPR stage for the recommended plan only.

b. Dam Safety Assurance Program. Projects approved under the Dam Safety Assurance Program will required budget justification and other supporting data similar to that required for specifically authorized projects. The initial document for these projects is

called a reconnaissance study (e.g. Reevaluation Report). This report is comparable in scope and purpose to a feasibility report. Normally, a major portion of the design has been completed, and execution of the work will be completed in the same procedure for a typical Civil Works project. The cost estimate prepared for this report becomes the BCE when approved by the MSC.

(1) The cost estimate prepared to support the Reconnaissance study is developed using labor, equipment, materials, and production rates. The cost estimate for the recommended plan shall be developed using MCACES and the CWBS in the same format as a cost estimate for a Feasibility Report.

(2) Once the Reconnaissance study has been approved, Design Memorandum (DM) and Plans and Specifications will be developed in preparation for project advertisement. The cost estimate will be revised and updated as design proceeds and plans and specifications are completed. A Government estimate will be prepared for contract award in accordance with the established guidance for Civil Works projects.

9. Protests to the Reasonableness of the Government Estimate

a. When all bids are more than 25 percent above the Government estimate, there is a possibility that one or more of the bidders will protest the reasonableness of the Government estimate. If this occurs, the Cost Engineer has a major role in documenting the contract file to support the Government estimate and/or evaluate the bid protest.

b. Review of the Government estimate by the Cost Engineer follows notification of a bid protest. The Cost Engineer shall review the estimate to be sure that it does not contain any errors, in calculation or in judgment. This step must be completed as soon as possible to inform the district or MSC which direction should be taken in dealing with the protested bid.

c. Revision of the Government estimate should be done immediately if an error is found. The explanation of the error should accompany the revised estimate which requires the same approval authority as the original Government estimate. If the revisions brings the low bid within 25 percent of the revised Government estimate, the contract can be awarded to the low bidder under the normal procurement processes.

d. Technical analysis and cost analysis of bid protest is the responsibility of the Cost Engineer. If the Cost Engineer determines that there is no valid reason for revision of the original Government estimate, or if revisions are made and the low bid is still more than 25 percent above the Government estimate, the contract may not be awarded. Sometimes a bid protest follows when this situation occurs. A technical and cost analysis will be prepared by the Cost Engineer which becomes a part of documentation supporting a Contracting Officers Decision denying the protest, if appropriate.

(1) The technical analysis will consist of an in-depth, point-by-point response to all items brought up by the protesting bidder, or bidders.

(2) The cost analysis will consist of the Government estimate, including all backup and support data and complete explanations about assumptions made and, if available, historical data from previous similar jobs which support the Government estimate. Proprietary information such as quotes will not be revealed during this process.

e. Meetings may be held with the apparent low bidder to ensure that both the Government and the bidder envision the same scope of work. These meetings will also allow the bidder to discuss with the Government Cost Engineer unusual conditions or circumstances that may affect or complicate the work. If the meeting reveals an error or omission in the Government estimate, the Government estimate may be revised and the contract awarded.

f. Once bids have been opened, the bid schedule will reveal the value of the Government estimate. The Bid Abstract prepared by Contracting Division will be released to the public for a formal solicitation for IFB procurement. The Government estimate will not be made public for all negotiated procurement (RFP). The backup data supporting the Government estimate will be kept on file in Cost Engineering and will not be released. There are valid reasons for not releasing the backup data supporting the Government estimate.

(1) There is a possibility that the project will be readvertised and the Government estimate should not be released disclosing the value to the other possible bidders in future solicitations.

(2) There is a possibility that the project will be converted to negotiated procurement.

g. Support to legal staff by the Cost Engineer may become necessary. A bid protest may take several months to resolve. The protest will be reviewed and evaluated at the district or MSC level, and at HQUSACE. During each of these review processes, questions will arise and the Cost Engineer will be called on to support the estimate. The Cost Engineer is the person most familiar with the Government estimate and, as such, should be prepared to assist the legal staff to resolve the protest. In some cases, the protest cannot be resolved through these channels and the bidder may choose to take the Government to court. The Cost Engineer should be prepared to testify in court in support of the cost estimate.

APPENDIX D
PROCEDURES FOR PREPARATION OF COST ESTIMATES

1. Basis for Preparation of Estimate

a. General. This appendix establishes uniform guidance for estimating labor, equipment, materials and supplies, subcontracted work, overhead, profit, bond, and contingencies.

b. Planning the work. It is important to thoroughly understand the project scope of work and the biddability and constructability aspects of the project being estimated. The Cost Engineer must thoroughly review drawings, specifications, and other references to formulate a construction sequence and duration. A site visit is strongly recommended to relate the physical characteristics of the project to the available design parameters and details. The development of the construction sequence is necessary as soon as possible and should be used to provide a checklist of construction requirements throughout the cost estimating process.

c. Quantities. Cost Engineering is responsible for the accuracy of quantity "take-off's" when prepared by qualified Government personnel or A-E firms. On a case-by-case basis, assistance for making take-off's will be provided by the Technical Design Branch, Engineering Division, in support of Cost Engineering.

(1) Cost engineering personnel are responsible for independently spot-checking and reviewing all quantity estimates.

(2) The quantity take-off is an important part of the estimate and should be based on all available engineering and design data. All quantities should be shown in standard units of measure.

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

(4) During construction, some material is wasted and lost from cutting, fitting, handling, or contamination. The Cost Engineer shall use judgeme to determine the waste and loss allowance to be appli to appropriate items.

d. Sources of unit cost data.

(1) The Unit Price Book (UPB) associated with MCACES provides production rates, unit costs, and crew composition. The UPB supplies the majority of cost data for construction tasks normally found in building and building site work construction.

(2) Each Cost Engineering Branch should develop and maintain a record of past bids, unit costs, and completed project cost reports. Sources of unit cost data may include the UPB, quotes, audits, catalogs, pricing data, previous bid results, historical costs, the cost engineering database, as well as the expertise fro other districts and MSC's. Such data serves as a sour for developing or verifying the reasonableness of futu unit prices.

(3) In Civil Works construction, the work is primarily of a specialized nature. During the reconnaissance phase, historical unit costs may be use or unit costs may be developed for the construction tasks. As the project develops through the feasibility phase and beyond, historical cost data should be used a guide and unit cost development should become the primary goal.

e. Unit pricing.

(1) As a general rule, approximately 80 percent o the direct costs of a project are represented by only 20 percent of the estimated work items. The greatest estimating effort should be concentrated on these criti elements. The unit cost for each of these items shall carefully analyzed and shall be developed as the summation of all direct and indirect costs which will likely be incurred by an experienced and well-equippe contractor. Direct costs are those costs that can be associated with a specific item or unit of construction work in the project. Indirect costs are those costs tha

cannot be associated with a single item or unit of construction work in the project.

(2) The direct cost of the construction tasks comprising the remaining 80 percent of the work elements may be priced from historical sources. The Cost Engineer must use judgement to adjust for project conditions, when cost data is based on previously completed projects to include overhead and price level date adjustments for inflation.

(3) Lump sum bid items may be used for small and easily identified work noted in the drawings and included in the estimate. The cost of the lump sum item should be based on cost data related to the item's total direct and indirect costs.

2. Cost Estimate Components and Supporting Documentation

The following is provided to support the cost estimate submission requirements specified for each phase of project development as outlined in Appendix C, "Type of Cost Estimates."

a. Backup data. All information which was collected or prepared for the cost estimate should be organized by work item and included in the backup data. Such information might include notes on site visits, discussions or telephone conversations with individuals, brochures on special equipment or materials, sketches, and working drawings.

b. Bid schedule. The bid schedule is part of the procurement package and is included with the solicitation for bids. The estimate must be prepared showing the unit prices, quantities, extension of unit prices, lump sum items, and the total costs consistent with the bid schedule.

c. Construction schedule. The Cost Engineer will prepare a construction schedule to support the Government estimate that is consistent with the plans and specifications for completion of the work. It may be in the form of a bar chart or a Network Analysis System, 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.

d. Detail sheets. Detail sheets generated by MCACES provide a complete listing of all labor, equipment, materials and/or crews used to develop all direct costs for each construction task. Although not required as documentation to support a cost estimate submission to HQUSACE, these reports become an important part of the cost estimate in the review and approval process at the district and as necessary for the MSC level submissions.

e. Drawings and sketches. Drawings and sketches which are appropriate may be used to show 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 plan layout.

f. Notes. Notes are any explanations necessary to support the development of cost for individual construction tasks in the cost estimate. This descriptive information that covers areas such as manufacturers quotes, overtime requirements, material availability, and contingencies should be entered as notes to the appropriate MCACES title or detail level of the cost estimate.

g. Project narrative. The narrative defines the parameters upon which the cost estimate has been prepared to support the project scope and schedule and is applied by definition to the project level within MCACES. It describes the project requirements that must be performed in sufficient detail to give a clear understanding of the scope of work including length, width, height, and slope 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, assumptions made for mobilization and demobilization of all equipment, and the reasons for unusually high or low contingencies.

h. Project summary reports. Project summary reports are printouts from MCACES used to summarize costs for each title level established for the specific project cost estimate. There are a variety of summary reports that may be printed from MCACES such as project owner, project indirect, and project direct summaries. The summary reports required for a cost

estimate submission depend on the phase of project development and are outlined in Appendix C.

i. Signature page. The signature page for the Government estimate should contain the names and signatures of those individuals responsible for the preparation, review, submittal, and approval of the cost estimate. If there is sufficient space on the bid sheet for these signatures, a separate signature sheet is not required. If there is not sufficient space on the bidding schedule, a separate signature sheet is necessary. It is important that the sheet containing the approval signatures also contain the estimate of total cost so that there will be no question(s) later as to the estimated amount approved. A statement relating the date of pricing levels on which costs were prepared should also appear on this page.

j. Table of contents. The table of contents is the MCACES table of contents printout.

k. Title page. The title page is the title page printed with the MCACES cost estimate. It should include the name and location of the project, the district or MSC 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.

l. Total project cost summary. The total project cost summary provides a summary of project costs in accordance with ER 5-7-1, Project Management. It relates the MCACES 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. 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) support these feature costs.

3. Labor

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

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

c. Crews. Direct labor cost requirements are broken into tasks of work. Each task is usually performed by a labor crew. 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 labor costs can be determined based on the productivity of the crew and the labor wage rates.

d. Productivity.

(1) Estimating labor productivity is subject to many diverse and unpredictable factors. There is no substitution for the knowledge and experience of the Cost Engineer in estimating labor productivity. The productivity of some crew members such as equipment operators, helpers, or oilers is determined by the productivity of the equipment. The productivity of craftsman such as carpenters, steel workers, and masons may be based on the MCACES crews database, the experience of the Cost Engineer, historical records, or other appropriate reference manuals.

(2) The labor effort needed to perform a particular task varies with many factors, such as the relative experience, capability, and 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, and the existing labor-management agreements and/or trade practices.

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

(4) The Cost Engineer must be aware of labor efficiency and work practices that exist in each project

locality and must consider these practices when preparing the cost estimate.

(5) Other factors affecting production rates include special contract clause requirements, limited working space, and inclement weather conditions, such as temperature and wind.

e. Wage rates. In contrast to productivity, wage rates are generally well-defined. The Davis-Bacon Act requires a contractor performing construction for the Government in the United States to pay not less than the prevailing rates set by the Department of Labor. A schedule of minimum rates is included in the specifications. Where labor is in short supply for certain crafts in the area, 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 to attract labor to the job. The wage rate should be adjusted to include travel time or night differential where these are customary requirements. Future wage increases should be taken into account when there will be an extended construction period.

f. Overtime and shift differential.

(1) Operation shifts. The Cost Engineer should carefully consider the available working time in the progress schedule for each task, sequence of tasks, availability of labor and equipment, labor and equipment production rate to determine the number of shifts to be adopted for the construction of each task. 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 be avoided due to a lower labor efficiency and the requirement to include equipment maintenance.

(2) 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 benefit costs are not. Overtime is expressed as a percentage of direct labor costs and is calculated in the following manner using time and one-half as the basis:

48 hours at straight time = 48.00 hours

8 hours at 1/2 time = 4.00 hours

(52 hrs paid/48 hrs worked = 0.0833) = 8.33%

(3) 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 and the number of hours to be paid for each shift based upon the developed construction schedule.

(4) A tabulation of overtime percentages for most conditions are shown in Table D-1, Overtime and Shift Differential. The percentage also includes an allowance for the direct work loss of multiple shift or shift differential, where applicable.

g. Taxes and insurance.

(1) Rates for all taxes and insurance should be verified prior to computation.

(2) 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.

(3) 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.

(4) 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.

(5) Rates for all taxes and insurance should be verified prior to computation.

(6) The total percentage of the above taxes and insurance is applied to the basic hourly wage rate plus overtime for the various crafts.

Table D-1
Overtime and Shift Differential

Shift	Actual Hours Worked Day	Actual Hours Worked Week	Hours Paid Reg	Hours Paid OT	Percentages for OT and Shift Differential 1.5x Wk/Sat 2x Sun	1.5x Week 2x Sat/Sun	Week 2x 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

(7) Example 1 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.

Example 1

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%

h. Fringe benefits.

(1) Fringe benefits may include health and welfare, pension, vacation, apprentice training, travel, and subsistence; depending on the craft and the location of the work. These 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.

(2) Example 2 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 2

Health and welfare	$0.70/hr
Pension	0.75/hr
Vacation (6% of straight time rate of $10)	0.60/hr
Apprentice training (N/A in this case)	____
Total fringe benefits	$2.05/hr

(3) Travel and Subsistence. Travel and subsistence costs are normally expressed as a daily or weekly cost. When they are to be included in the cost estimate, they should be converted to an hourly cost.

4. Equipment

a. Construction plant and equipment 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.

b. Selection of equipment.

(1) 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 (productivity); 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; mobilization and demobilization costs.

(2) The Cost Engineer preparing the estimate must be familiar with current 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.

c. Estimating methodology. Use the "crew concept" for construction cost estimates requiring detailed estimating of labor, materials, and equipment. For each significant work task, workers and equipment are related to the hourly cost and expected productivity. Where a major piece of equipment serves more than one crew, the total equipment time should be prorated between both crews.

d. Productivity. After determining the type of equipment to be employed, select equipment which has a productivity rate suited to the efficient and economical performance of the work. The size and number of units required will be influenced by equipment productivity, 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 productivity rate. Production may be based on MCACES historical equipment models and assemblies or on the output rating recommended by the manufacturer.

e. Mobilization and demobilization.

(1) Mobilization costs for equipment include the cost of loading at the contractor's yard, transportation cost from the yard to the construction site, 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, base the mobilization and demobilization distance 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.

(2) Mobilization and demobilization costs for plant should be based on the delivered cost of the item, plus erection, repairs, maintenance, taxes, and dismantling costs minus salvage value at the end of the project.

f. Equipment ownership and operating expense schedule, EP 1110-1-8, determines the hourly rates. These rates are also included in the MCACES database and will be used in the preparation of all cost estimates. These pamphlets have been developed for different geographic regions in the United States, and the appropriate pamphlet or MCACES database should be used based upon project location.

g. Small tools. The cost of small power and hand tools and miscellaneous noncapitalized equipment and supplies must be included in the estimate.

(1) This item may 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 shall be considered as part of equipment cost.

(2) The crews database in the UPB includes an allowance for small tools. It is also possible to add small tools as an equipment item.

5. Materials and Supplies

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

(1) Materials. Those items which are incorporated into and become part of the permanent structure.

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

(3) Free on board (FOB) refers to the point to which the seller will deliver goods without charge to the buyer.

(4) Cost estimates will be prepared for all subcontract work using the same methodology and degree of detail outlined for work by the prime contractor.

b. Sources of pricing data.

(1) Cost may be obtained from the UPB, reference manuals, manufacturers catalogs, quotes, or historical data.

(2) Quotes from manufacturers and suppliers. Quotes should be obtained for all specialized or not readily available items of materials and equipment to be furnished and installed by the contractor and for all supplies of significant cost required by the contractor for performance of the work. Quotes from manufacturers and suppliers should be collected and compiled by task. It is preferable to obtain a new quote 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 Government estimate. Quotes should be considered proprietary information and kept confidential to protect the information entrusted to the Cost Engineer.

c. Forward pricing. Sometimes quotes are requested in advance of the expected purchase date. Suppliers are reluctant to guarantee future prices and often will only quote current prices. It may 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 OMB escalation factors. Computations of adjustment should be clear and should be maintained as cost estimate backup support.

d. Freight. The Cost Engineer should check the basis of 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.

(1) 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.

(2) 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.

(3) If the materials or supplies are a large quantity in bulk form 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.

e. 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 included in the direct cost of the equipment. For other items, such as equipment needing secure storage, the cost for the security fencing or a temporary building should be considered as an indirect cost and be included in the job site overhead cost.

f. 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 when 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.

g. 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 a detailed equipment, labor, material, and supplies estimate, and should conclude with a unit cost of material or supply delivered to the stockpile, storage yard, or project feature.

h. Government furnished materials. Government furnished materials 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, and storage from point of delivery. 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.

6. Subcontracted Work

a. Speciality items, such as mechanical and electrical work, are usually performed by subcontract. Subcontracted work may be a significant portion of the total cost of construction.

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 shall be identified in the estimate. The appropriate subcontractor overhead and profit costs should be applied to those items.

c. The cost of subcontracted work is the total cost to the prime contractor for the work performed. This includes the subcontractor's costs for direct labor, materials and supplies, equipment, second tier subcontracts, and charges for overhead and profit. The total subcontract cost is considered a direct cost to the prime contractor.

d. Use of quotes. The Cost Engineer may utilize quotes for the expected subcontracted work in preparing the estimate or to verify the reasonableness of independently estimated subcontract work. Subcontractor quotes will be treated as proprietary information and should only be revealed to those who have a need to know.

7. Contingencies

a. General. 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 MCACES 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 being high when the lack of investigation data or design detail is associated with critical/high cost elements. The reasons for final contingency development and assignment, that describes the potential for cost growth must be included in the cost estimate as a part of the project narrative. When the contingency factors shown 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.

b. The following contingency factors (%) represent a reasonable guide for the construction features of the cost estimate:

	Total Project Construction Cost	
Phase of Project Development	>$10,000,000	<$10,000,000
Reconnaissance/Feasibility	20%	25%
Project/Feature Design Memorandum	15%	20%
Plans and Specifications	10%	10%

c. 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 as described above exceeds these guidelines, the district or MSC management team should consider further investigation and/or design be accomplished in order to reduce the uncertainties.

8. Overhead

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 not be included in overhead costs. The overhead costs are customarily divided into two categories:

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

(2) General Home Office Overhead, commonly referred to as G&A, General and Administrative costs.

b. The Cost Engineer must be sure that 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 evaluated for each project. The Cost Engineer must use considerable care and judgement in estimating 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 of final design requiring a Government estimate. Detailing of overhead costs for subcontract work is recommended when the impact of these costs is significant.

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

(1) Job supervision and office personnel.

(2) Engineering and shop drawings.

(3) Site security.

(4) Temporary facilities, project office.

(5) Temporary utilities.

(6) Preparatory work and laboratory testing.

(7) Transportation vehicles.

(8) Supplies and maintenance facilities.

(9) Temporary protection & OSHA requirements.

(10) Telephone and communications.

(11) Permits and licenses.

(12) Insurance (project coverage).

(13) Schedules & reports.

(14) Quality control.

(15) Cleanup.

(16) Taxes.

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

e. Home office overhead (G&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 are not allowable, such as interest and entertainment. 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. This will assist the Cost Engineer for ongoing negotiations and more accurate overhead rates. Some examples of home office overhead are:

(1) Main office building, furniture.

(2) Management and office staff, estimators.

(3) Utilities.

(4) Communications and travel.

(5) Supplies.

(6) Vehicles.

(7) Business insurance.

(8) Taxes.

f. 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 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.

g. Sources for Pricing. The Cost Engineer must rely on judgement, historical data, and current labor market conditions to establish overhead costs. Some contractors will informally discuss and furnish information for overhead items. Audit reports are available to provide information on overhead costs for previous similar projects. Comparable average salaries in other commercial organizations are frequently available. Overhead salaries should include an allowance for payroll taxes and fringes such as FICA, health benefits, and vacation. Other sources include previously negotiated modifications and review of organizational charts of construction firms for staffing and overhead costs evaluation.

9. Profit

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

b. Weighted guidelines method. Reference is made to FAR and EFAR concerning the use of weighted guidelines method for determining profit. EFAR directs the use of the weighted guideline method when price is to be negotiated. This method (Table D-2 Profit Factor) yields a reasonable profit value and should be used to determine profit for all

Table D-2
Profit Factor

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. _____

Table D-3
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			Weight
$ 0	to	100,000	0.120
100	to	200,000	0.119
200	to	300,000	0.117
300	to	400,000	0.116
400	to	500,000	0.114
500	to	600,000	0.113
600	to	700,000	0.111
700	to	800,000	0.110
800	to	900,000	0.109
900	to	1,000,000	0.107
1,000	to	1,100,000	0.106
1,100	to	1,200,000	0.104
1,200	to	1,300,000	0.103
1,300	to	1,400,000	0.101
1,400	to	1,500,000	0.100
1,500	to	1,600,000	0.099
1,600	to	1,700,000	0.097
1,700	to	1,800,000	0.096
1,800	to	1,900,000	0.094
1,900	to	2,000,000	0.093
2,000	to	2,100,000	0.091
2,100	to	2,200,000	0.090
2,200	to	2,300,000	0.089
2,300	to	2,400,000	0.087
2,500	to	2,600,000	0.086
2,600	to	2,700,000	0.084
$ 2,700	to	2,800,000	0.081
2,800	to	2,900,000	0.800
2,900	to	3,000,000	0.079
3,000	to	3,100,000	0.077
3,100	to	3,200,000	0.076
3,200	to	3,300,000	0.074
3,300	to	3,400,000	0.073
3,400	to	3,500,000	0.071
3,500	to	3,600,000	0.070
3,600	to	3,700,000	0.069
3,700	to	3,800,000	0.067
3,800	to	3,900,000	0.066
3,900	to	4,000,000	0.064
4,000	to	4,100,000	0.063
4,100	to	4,200,000	0.061
4,200	to	4,300,000	0.060
4,300	to	4,400,000	0.059
4,400	to	4,500,000	0.057
4,500	to	4,600,000	0.056
4,600	to	4,700,000	0.054
4,700	to	4,800,000	0.053
4,800	to	4,900,000	0.051
4,900	to	5,000,000	0.050
5,000	to	10,000,000	0.040
Over		10,000,000	0.030

Period of Performance:

	Factor
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

(Continued)

Table D-3 (Continued)

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

Subcontracting:

Subcontracting	Factor
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

contracts where profit is a factor. Profit shall be determined by using the following procedure:

c. Based on the circumstances of each procurement action, each of the factors listed in Table D-2 shall be weighted from 0.03 to 0.12 as discussed in the following text and provided in Table D-3, Guidelines for Weighted Factors, Profit Determination. Statements in sufficient detail to explain the reasons for assigning the specific weights shall be included on the profit computation sheet. The value shall 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: the portion of the work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, whether the negotiation is before or after the period of performance of work.

(2) Relative difficulty of work. If the work is most 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: nature of the work, by whom work is to be done, where, what is the time schedule.

(3) Size of the job. All work not in excess of $100,000 shall be weighted at 0.12. Work estimated between $100,000 and $5,000,000 shall 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) Periods 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 where additional performance time not required.

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

(6) Assistance by Government. Jobs are to be weighted from 0.12 to 0.03 on the basis of average to above average. Things to consider: 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. Profit on subcontractors. 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.

10. Surety Bonds

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

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

b. Purpose of bonds. The purpose of surety bonds varies with the type of bond. Bonds are classified as Class A, Class B, or Class A-1, depending on the type of construction.

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

(2) Payment bonds protect subcontractors, suppliers, and laborers against nonpayment by the prime contractor.

(3) 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 working capital and other assets which might otherwise be tied up by other forms of security such as certified checks, retainage, or deposits.

c. Amount of required surety bonds. The amount allowed should be based on the actual contractor bond cost. Performance and payment bonds are required for all construction 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.

d. Rules governing the application of bond rates (Table D-4).

(1) If the contract is susceptible to two classifications, normally the higher rate is applicable.

(2) 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.

(3) Subcontracts take the same classifications and rates as general contracts.

(4) For nondeviating Surety Association of America (SAA) rates 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.

(5) For nondeviating SAA rates 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.

(6) For deviating rates where the construction time exceeds the bond stipulated time of 12 months, add 1/2 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.

(7) 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.

(8) 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.

(9) The minimum bond premium charge is $25.00.

e. Cost of performance and payment bonds.

(1) Performance and payment bonds are obtained as a single package. The premium is the same as for the performance bond alone. Rates vary with the nature of the contract work, the dollar value, and length of the contract. Most types of Civil Works construction are classified as Class B.

(2) Performance bonds cover the full amount of the contract price (bid amount). The premiums are adjusted at the completion of the work for any subsequent 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.

(3) Example 3 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 to ensure 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. Referring to the Class B rate schedule in Table D-4, Bond Rates, the premium for a

Table D-4
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. Nondeviating 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
Next 2,500,000	6.30	4.92	4.44
Over 7,500,000	5.76	4.44	3.96

performance-payment bond written in the full amount of the contract price and by a nondeviating Surety Association Company, would be calculated as follows:

Example 3 - Bond premium calculation

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
	$2,500,000			28,500
	Eight additional months @ 1%/MONTH			
	(8 mo × 1% × $28,500)			2,280
			Total premium	$30,780

(4) The consent of the surety is required for changes or extras, and premiums for the additional cost are computed at manual rates from the date of the bond.

(5) It should be noted the surety industry has become a state regulated industry. The SSA 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.

(6) Table D-5, Contract Bonds Rate Classifications, shows the various types and classes of bonds as follows:

Table D-5
Contract Bonds Rate Classifications

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

(Continued)

Table D-5 (Continued)

Class B

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

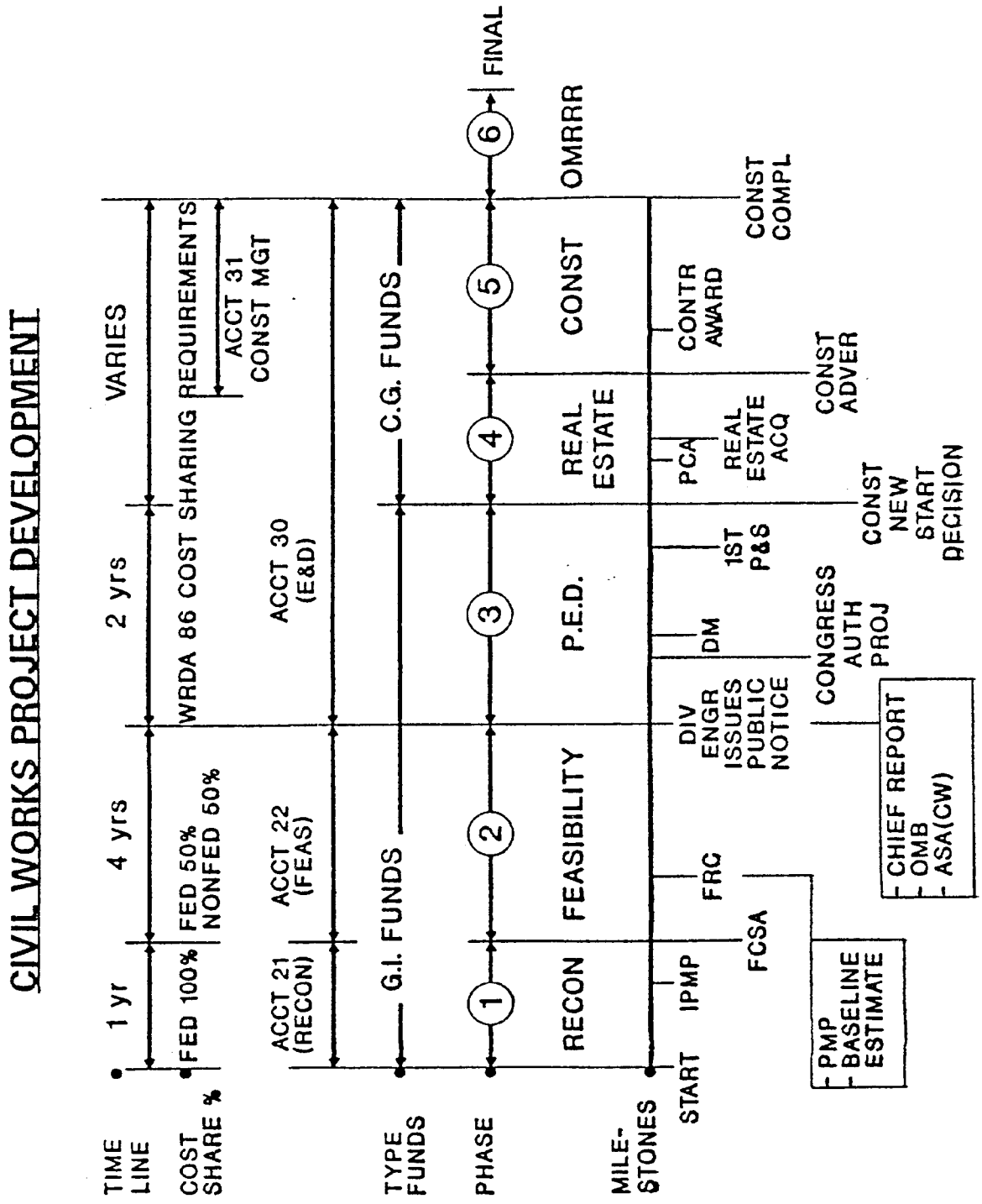
Airport buildings
Aqueducts
Atomic energy plants
Breakwaters
Canals and canal lining
Carpentry
Coal stripping
Commercial buildings
Concrete work
Dams
Dikes
Ditches
Docks and drydocks
Drilling contracts
Educational buildings
Electrical
Embankments
Excavations
Filling stations
Filtering plants
Fountains
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 borings
Tile and terrazzo
Transmission or distribution lines
Tunnels
Underwater cables
Ventilation systems
Water works
Wells
Wharves

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 retubing 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
Photogrammetic 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
Resmelting old metal
Rip rap stone (furnishing only)
Rolling stock
Scaffolding
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

APPENDIX E
TYPICAL CIVIL WORKS PROJECT DEVELOPMENT



APPENDIX F
STANDARD ESTIMATING FORMS

1. General

This appendix provides a discussion of the standard estimating forms and a brief explanation of their use in preparing cost estimates where the use of the MCACES software is specifically exempted by this regulation. These forms have been designated as a guide in the development of a reasonable cost estimate.

2. Reasonable Contract Estimate, ENG Form 1738-R (Figure F-1)

This form 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.

3. Reasonable Contract Estimate Detail Summary Sheet, ENG Form 1739-R (Figure F-2)

This form 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.

4. Reasonable Contract Estimate Worksheet Summary, ENG Form 1740-R (Figure F-3)

This form 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.

5. Reasonable Contract Estimate Worksheets, ENG Forms 1741-R, 1741a-R, 1741b-R, and 1741c-R (Figures F-4, F-5, F-6 and F-7)

These forms 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 then 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.

6. Wage Rate Calculations, DA Form 5420-R (Figure F-8)

This form 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 Appendix D.

REASONABLE CONTRACT ESTIMATE
(ER 1110-2-1302)

SHEET 1 OF 1

PROJECT A PUMPING STATION

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1.	DEWATERING	1	JOB	LS	75,400
2.	STRUCTURE EXCAVATION	4,600	CY	3.15	14,490
3.	STRUCTURE BACKFILL	2,100	CY	4.40	9,240
4.	SUBSTRUCTURE CONCRETE	300	CY	150.00	45,000
28.	ELECTRICAL WORK	1	JOB	LS	13,800
	TOTAL				708,930

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

Figure F-1.

REASONABLE CONTRACT ESTIMATE DETAIL SUMMARY SHEET

SHEET 1 OF 1

PROJECT: A PUMPING STATION

BID ITEM NO.	DESIGNATION	QUANTITY	UNIT	EQUIPMENT	MOBILIZATION AND DEMOBILIZATION	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	DISTRIBUTED COSTS	TOTAL COSTS	UNIT COST	ADJUSTED UNIT COST	ADJUSTED AMOUNT	NO
1.	DEWATERING	1	JOB	—	—	—	—	—	65,000	10,400	75,400	LS	LS	75,400	1
2.	STRUCTURE EXCAVATION	4,600	CY	6,900	966	4,600	—	—	12,466	1,995	14,461	3.144	3.15	14,490	2
3.	STRUCTURE BACKFILL	2,100	CY	4,380	613	2,920	—	—	7,913	1,266	9,179	4.371	4.40	9,240	3
4.	SUBSTRUCTURE CONCRETE	300	CY	3,643	510	10,944	19,876	3,470	38,443	6,151	44,594	148.65	150.00	45,000	4
28.	ELECTRICAL WORK	1	JOB	460	64	6,710	4,540	100	11,874	1,900	13,774	LS	LS	13,800	28
	TOTALS			45,755	6,450	135,643	76,458	12,662	610,400	97,664	708,064			708,930	

ENG FORM 1739-R, MAR 94 EDITION OF FEB 78 IS OBSOLETE (ER 1110-2-1302) (Preparer: CECW-EC)

Figure F-2.

REASONABLE CONTRACT ESTIMATE WORKSHEET SUMMARY SHEET 1 OF 1

PROJECT A PUMPING STATION

SUBJECT 4. SUBSTRUCTURE CONCRETE QUANTITY 300 CY

SUBITEM	EQUIPMENT	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	REF. PG.
a. CONCRETE	1,943	5,694	16,176	20	23,833	
b. FORMWORK	600	2,750	700	2,700	6,750	
c. REINF. STEEL	1,100	2,500	3,000	750	7,350	
TOTALS	3,643	10,944	19,876	3,470	37,933	

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

Figure F-3.

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

SHEET 1 OF 3

PROJECT: A PUMPING STATION

SUBJECT: 4a. SUBSTRUCTURE CONCRETE

QUANTITY: 300 CY

SHIFTS PER DAY: 1

HOURS PER SHIFT: 10

PLAN OF OPERATIONS

THIS PART OF THE ESTIMATE INCLUDES ALL DIRECT COSTS REQUIRED TO PLACE THE CONCRETE FOR THE SUBSTRUCTURE. COSTS FOR FORMWORK AND REINFORCING STEEL ARE ESTIMATED SEPARATELY. ASSUME THAT CONCRETE WILL BE TRANSIT MIX.

1. PLACE CONCRETE - USE 35 TON CRANE, 5 LABORERS, 1 CARPENTER - TO PLACE AT AVERAGE 10 CY/HR.

300 CY ÷ 10 CY/HR = 30 HOURS

2. FINISHING - TOP OF MONOLITHS ONLY -
2 CONCRETE FINISHERS - 10 HOURS

3. CURING - 2 LABORERS
4 HRS/DAY FOR 14 DAYS = 56 HOURS

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

Figure F-4.

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

SHEET 2 OF 3

SUBJECT 4a. SUBSTRUCTURE CONCRETE

QUANTITY 300 CY

EQUIPMENT

UNIT OF EQUIPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
CRANE	35 TON	1	30	43.00	1,290
CONCRETE BUCKET	1.5 CY	2	30	0.50	30
CONCRETE VIBRATOR	2.5 IN	2	30	1.00	60
AIR COMPRESSOR W/ HOSE	250 CFM	1	30	9.25	278
*NOTE: USE WORKING HOURS				SUBTOTAL	1,658
	SMALL TOOLS	5		% OF LABOR	285
				TOTAL EQUIPMENT COST	1,943

LABOR

OPERATION	CRAFT	NO.	HOURS	RATE	AMOUNT
PLACE CONCRETE	CRANE OPERATOR	1	30	18.55	557
	CRANE OILER	1	30	14.33	430
	LABORER	5	30	12.65	1,898
	FOREMAN	1	30	13.30	399
	CARPENTER	1	30	21.20	636
FINISHING	CONCRETE FINISHER	2	10	17.85	357
CURING	LABORER	2	56	12.65	1,417
				TOTAL LABOR COST	5,694

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

Figure F-5.

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

SHEET 3 OF 3

SUBJECT: 4a. Substructure Concrete

QUANTITY: 300 CY

MATERIALS

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
Transit Mix Concrete	CY	300	50.00	15,000
Vinyl Waterstop	LF	80	2.00	160
Joint Filler	1	Job	LS	100
SUBTOTAL				15,260
SALES TAX		6%		916
			TOTAL MATERIALS COST	16,176

SUPPLIES

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
Steel Scaffolding				
(Share of Rental: 1-week)	Frame	20	1.00	20
(1/4 x $4.00/fr/mo)				
			TOTAL SUPPLIES COST	20

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

EQUIPMENT	1,943
LABOR	5,694
MATERIALS	16,176
SUPPLIES	20
TOTAL	23,833

REMARKS: **Prices on these items are based on quotations from manufacturers or suppliers*

DATE: 30 Jul 93

PREPARED BY: T&C

CHECKED BY:

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

Figure F-6.

REASONABLE CONTRACT ESTIMATE WORKSHEET — SHEET 2 OF 2

SUBJECT: 4a. Substructure Concrete — QUANTITY: 300 CY

EQUIPMENT

UNIT OF EQUIPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
Crane	35 ton	1	30	43.00	1,290
Concrete Bucket	1.5 cy	2	30	0.50	30
Concrete Vibrator	2.5 in	2	30	1.00	60
Air Compressor w/ Hose	250 cfm	1	30	9.25	278

(*NOTE: USE WORKING HOURS)

SUBTOTAL	1,658
MOBILIZATION AND DEMOBILIZATION	—
SMALL TOOLS 5% OF LABOR	285
TOTAL EQUIPMENT COST	1,943

LABOR

OPERATION	CRAFT	NO.	HOURS	RATE	AMOUNT
Place Concrete	Crane Operator	1	30	18.55	557
	Crane Oiler	1	30	14.33	430
	Laborer	5	30	12.65	1,898
	Foreman	1	30	13.30	399
	Carpenter	1	30	21.20	636
Finishing	Concrete Finisher	2	10	17.85	357
Curing	Laborer	2	56	12.65	1,417
				TOTAL LABOR COST	5,694

MATERIALS

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
Transit Mix Concrete	CY	300	50.00	15,000
Vinyl Waterstop	LF	80	2.00	160
Joint Filler	1	Job	LS	100
SUBTOTAL				15,260
SALES TAX		6%		916
			TOTAL MATERIALS COST	16,176

SUPPLIES

DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
Steel Scaffolding				
(Share of Rental: 1-week)	Frame	20	1.00	20
(¼ x *4.00/fr/mo)				
			TOTAL SUPPLIES COST	20

TOTAL FOR TRANSFER TO ENG FORM 1739-R or 1740-R	23,833

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

DATE: 30 Jul 93

PREPARED BY: T&C

CHECKED BY:

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

Figure F-7

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

EFFECTIVE PERIOD: Oct 92-Sep 93

PROJECT: A Pumping Station

OPERATIONAL SHIFTS: 1/10 - 5 Days

LOCATION:

ESTIMATOR: TGC

CHECKED BY:

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
Carpenter	14.33	10	1.43	15.76	19	2.99	18.75	2.45	-	21.20
Labor. Foreman	9.20	(	0.92	10.12	(	1.92	12.04	1.26	-	13.30
Laborer	8.70		0.87	9.57		1.82	11.39	1.26	-	12.65
Crane Oper.	12.64		1.26	13.90		2.64	16.54	2.01	-	18.55
Crane Oiler	9.41	(	0.94	10.35	(	1.97	12.32	2.01	-	14.33
Conc. Finisher	12.30	10	1.23	13.53	19	2.57	16.10	1.75	-	17.85

DA FORM 5420-R, Apr 85

Figure F-8.

APPENDIX G
PREPARATION OF DREDGE COST ESTIMATES

1. General

This appendix provides guidance for estimating the dredging portion of a project. Associated work items, such as clearing and grubbing, dike 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 regulation. 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. All dredging estimates will be prepared in accordance with Corps of Engineers Dredge Estimating Programs (CEDEP) and will contain a narrative documenting reasons for decisions and selections made by the Cost Engineer. Figure G-1, at the end of this appendix indicates project dimensions and quantity of material considerations to determine pay items.

2. Definitions

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

b. Allowable overdepth not dredged. "Allowable overdepth not dredged" is the volume of "Allowable overdepth yardage" that is estimated and will not be dredged.

c. Allowable overdepth yardage. "Allowable overdepth yardage" is the volume of material between the required pay prism and the maximum pay prism.

d. CEDEP. CEDEP is the acronym for the three Corps of Engineers Dredge Estimating Programs that operate on microcomputers. The three programs developed are Pipeline CEDEP, Mechanical CEDEP, and Hopper CEDEP.

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

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 yardage. It is determined by multiplying the total monthly cost by the dredging time in months and adding the fixed and indirect costs.

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

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

j. Maximum pay yardage. "Maximum pay yardage" is the sum of the "Required yardage" and the "Allowable overdepth yardage."

k. Net pay yardage. "Net pay yardage" is the "Maximum pay yardage" minus the "Allowable overdepth not dredged."

l. Nonallowable 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 yardage.

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

(2) "Nonpay yardage" 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 yardage.

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

(2) "Required yardage" 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).

3. Development of Dredging Estimate

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:

a. 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, Reports Control Symbol ENGCW-0-13 prescribed by ER 1125-2-304, includes the following daily dredging reports: ENG Form 27, Report of Operations-Hopper Dredges; ENG Form 3735, Report of Operations-Sidecasting Dredges; ENG Form 4267, Report of Operations-Pipeline, Dipper or Bucket Dredges. 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.

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

c. 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 (Appendix H).

d. A combination of the methods described, as previously described, may be used at the discretion and judgment of the Cost Engineer.

e. 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(s) of computer program(s) used in the estimate.

4. Project Overview

The Cost Engineer should review the scope of work for the following items and determine which items are judgmental and which are factual at the time the estimate is prepared.

a. 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.

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

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

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

e. 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.

5. Selection of Equipment

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.

a. Pipeline. The term "pipeline" refers to cutterhead, suction, and dustpan dredges. 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.

b. Hopper. 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 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.

c. Mechanical. 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.

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

6. Production

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. All dredging projects will be estimated using the approved CEDEP software. Whenever possible, the production rate used in CEDEP should be based on historical data. When historical data is not available, the sequence described in paragraph 3, this appendix, shall be used.

a. Pipeline. 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.

b. Hopper. 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 number of cubic yards 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.

c. Mechanical. 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.

d. Specialty. The Cost Engineer will have to investigate in detail the method, equipment, and expected production on a case-by-case basis.

7. Monthly Costs

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

a. 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.

b. 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.

c. Other monthly costs are to be determined by the Cost Engineer. These may include such things as surveys, environmental monitoring, and navigation aids.

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.

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, reinspection, 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 all 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 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 cost includes mobilization and demobilization cost plus dredging cost, previously discussed in paragraphs 9*a* and 9*b*, respectively.

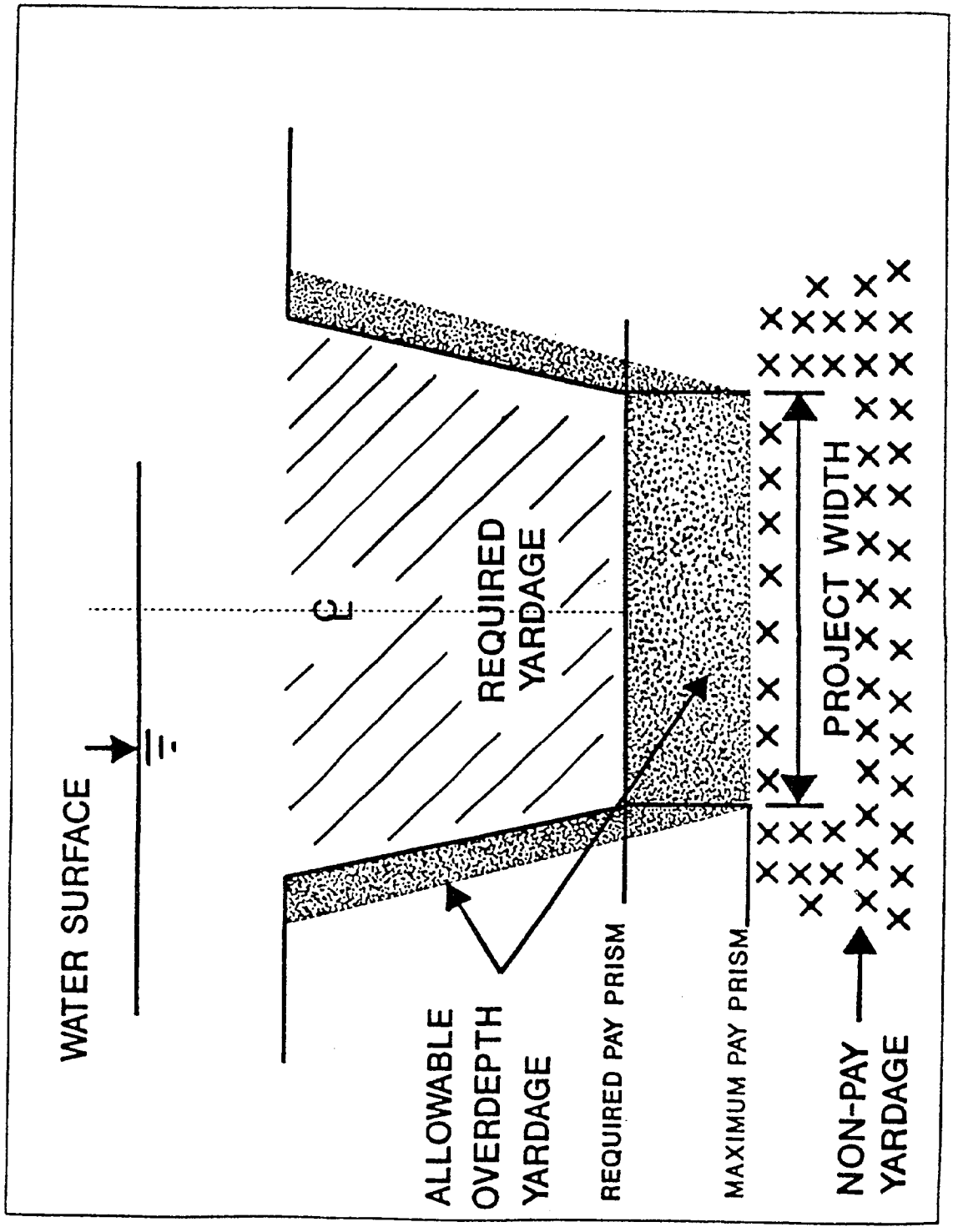

WATER SURFACE
ALLOWABLE OVERDEPTH YARDAGE
REQUIRED YARDAGE
REQUIRED PAY PRISM
MAXIMUM PAY PRISM
NON-PAY YARDAGE
PROJECT WIDTH
MAXIMUM PAY YARDAGE = REQUIRED YARDAGE + ALLOWABLE OVERDEPTH YARDAGE
NET PAY YARDAGE = MAXIMUM PAY YARDAGE - ALLOWABLE OVERDEPTH NOT DREDGED
GROSS YARDAGE = NET PAY YARDAGE + NON-PAY YARDAGE

Figure G-1.

APPENDIX H
REGIONAL DREDGE TEAMS

East Coast:
North Atlantic Division
Chairman, CENAD-CO-OP-N
Tel: (212) 264-7535
Geographic Boundary: Miami, north along Atlantic Coast, including Puerto Rico

West Coast:
Seattle District
Chairman, CENPS-OP-NP
Tel: (206) 764-3400
Geographic Boundary: Pacific Coast, Alaska to Mexico, including Hawaii

Gulf Coast:
New Orleans District
Chairman, CELMN-ED-C
Tel: (504) 862-2726
Geographic Boundary: Miami to Mexico and lower Mississippi River and tributaries (St. Louis to New Orleans)

Great Lakes:
Detroit District
Chairman, CENCE-ED-C
Tel: (313) 226-6793
Geographic Boundary: 5 Lakes, upper Mississippi River and tributaries (St. Louis North)