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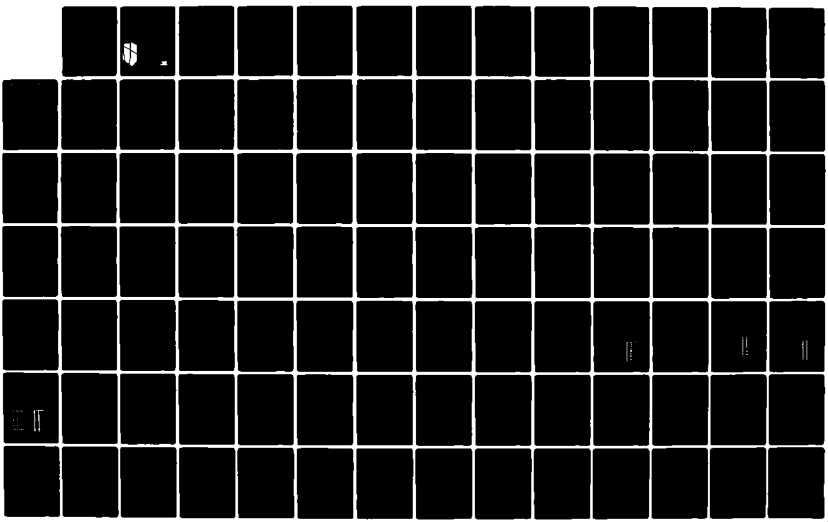

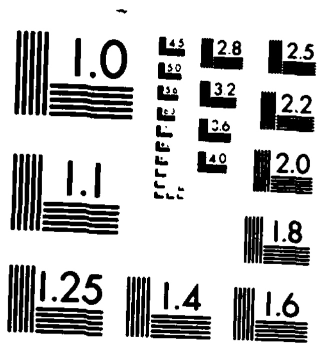

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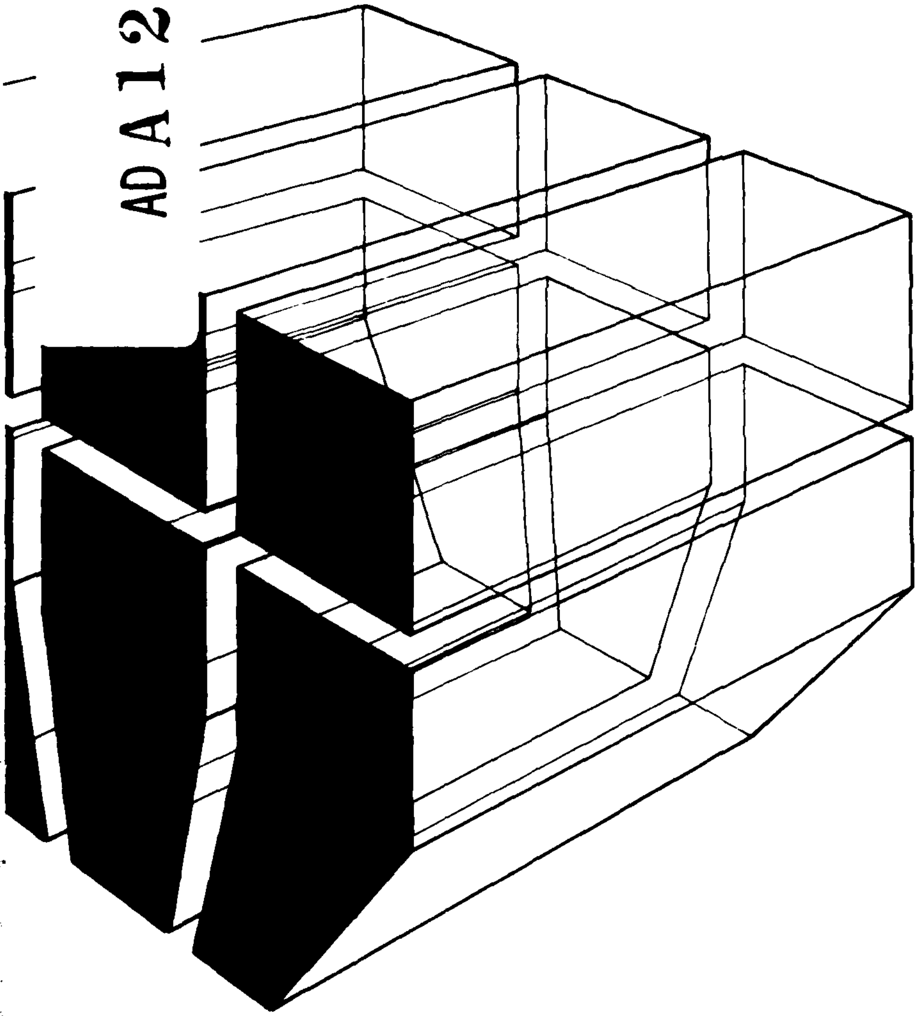
Technical Report P-132
November 1982

A SYSTEMS APPROACH TO MILITARY CONSTRUCTION



by
Thomas R. Napier
L. Michael Golish

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This report provides information on a systems approach to acquiring industrialized building systems for Army facility construction. It also provides technical and procedural guidance on identifying facilities to which a system approach applies, predesign activities using a systems approach, developing documentation for a Request for Technical Proposal, developing performance specifications for facility design and construction, evaluating technical proposals for facilities and awarding construction contracts, and

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construction administration. The information provided in this report may be used by Division and District personnel, the Architect-Engineer, the Facilities Engineer, the Office of the Chief of Engineers, and Major Command personnel.

FOREWORD

This research was conducted for the Directorate of Engineering and Construction, Office of the Chief of Engineers (OCE) under Project 4A762731AT41, "Military Facilities Engineering Technology"; Technical Area A, "Planning and Design"; Work Unit 007, "Technical Manual on Systems Building."

The work was performed by the Facilities Systems Division (FS) of the U.S. Army Construction Engineering Research Laboratory (CERL). The OCE Technical Monitor was Mr. William Johnson, DAEN-ECE-A.

Mr. E. A. Lotz is Chief of CERL-FS. COL Louis J. Circeo is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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A SYSTEMS APPROACH TO
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1 INTRODUCTION

Background

The objective of a systems approach in construction is to expedite the facility delivery process. This is done through process efficiency, and innovation and economy in building technology.

Process efficiency can be achieved through various contracting strategies, including variations of design/build and turnkey strategies. Innovation and economy in building technology can be achieved through industrialization. Production economy can be achieved through volume production, controlled conditions, assembly line techniques, task specialization, and standardization or production techniques. Construction expediency is enhanced by prefabrication, part integration, and field labor reduction.

In a traditional design and construction process, the Architect Engineer (AE) develops a design program based on the client's needs, then designs and details a solution to those requirements. Contractors bid competitively and the contractor placing the lowest bid on the AE's prescribed solution is awarded the contract. In a systems approach, the AE expresses the client's requirements via functional criteria and solicits proposals in response to a Request for Technical Proposal (RFTP). Contractors develop their own solutions to the specified design and construction requirements, and the client and AE select the most favorable proposal for award and construction, be it conventional, industrialized, or any variation thereof.

One common application of a systems approach in "mainstream" construction markets is to use it to solicit the widest variety of satisfactory solutions, including innovative technology. A systems approach can address the acquisition of available technology or second generation building systems and subsystems. (Such products are generally outgrowths of first generation systems and subsystems which have been marketed for general use.) A systems approach can solicit many suitable options and maximize competition among them. The client can then identify the most favorable solution at the most advantageous price. Since such technology is already on the market, this strategy is much less volume-dependent for amortizing research, development, and production costs. This situation is comparable to most common Military Construction-Army construction.

A systems approach is an option in the MCA facility delivery process. It should be applied to those projects which exhibit potential savings through the use of industrialized building systems or the performance concept.

A systems approach to MCA projects allows the acquisition of available building systems and subsystems as an option to conventional construction. Descriptions of these systems and subsystems (and of appropriate building types) are given in Chapter 2. The procurement method is a two-step formal advertising of a single fixed-price contract and is described in Chapter 3.

A general flowchart of the procurement process is given in Figure 1. The major elements of this process are:

1. The District selects projects appropriate for a systems approach or receives directive from the Office of the Chief of Engineers (OCE).

2. The District selects an AE and provides design and technical guidance (if the RFTP is to be developed out-of-house).

3. The AE develops performance specifications and construction documents and assembles an RFTP.

4. The District advertises the RFTP (step one in the two-step procurement process).

5. Proposers develop design and technical solutions in response to the RFTP and submit them to the District.

6. The District evaluates proposals and identifies those eligible for bidding.

7. The District issues an Invitation for Bid (IFB) to eligible proposers (step two in the two-step procurement process).

8. Proposers submit bids on their own proposals.

9. The District awards the construction contract to the low bidder.

10. The contractor completes the construction documents.

11. The contractor executes the work.

12. The District closes out the project.

In a systems approach, the District's AE and the contractor have roles similar to those they would have in a conventional MCA project. The fundamental differences are:

1. The District delegates greater design and engineering responsibilities to the proposer.

2. The District must be able to judge the sufficiency of the proposer-generated aspects of a facility's design.

Purpose

The purpose of this report is to define a systems approach to the acquisition of industrialized building systems for Army facility construction. This report does not mandate either the use of industrialized building systems or a systems approach. Rather, it describes how to decide if such strategies are appropriate, and how to use them to complete the facility delivery process. Furthermore, a systems approach does not mandate the use of industrialized building systems. Rather it allows such systems to compete with

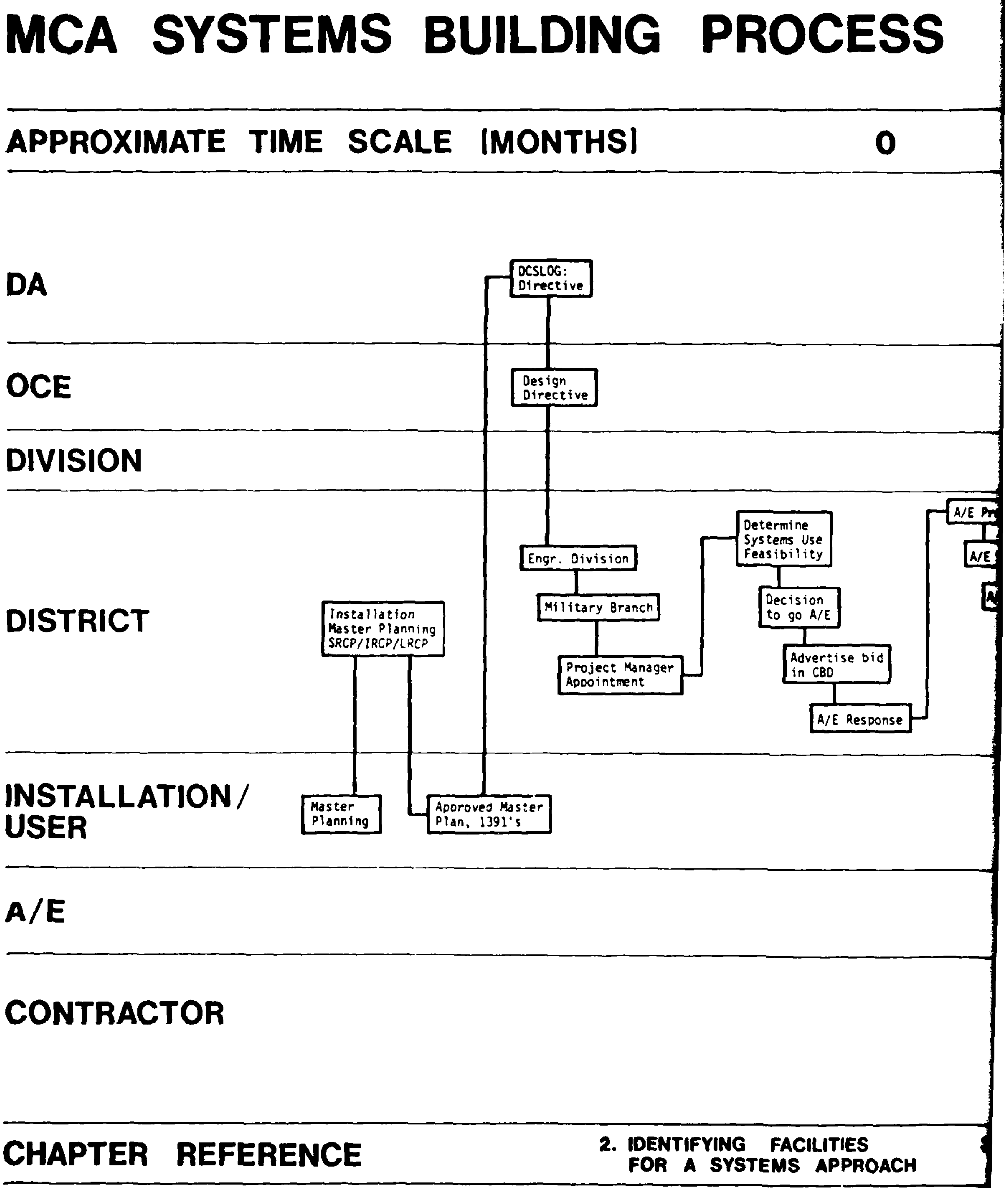

Figure 1. MCA systems building process.

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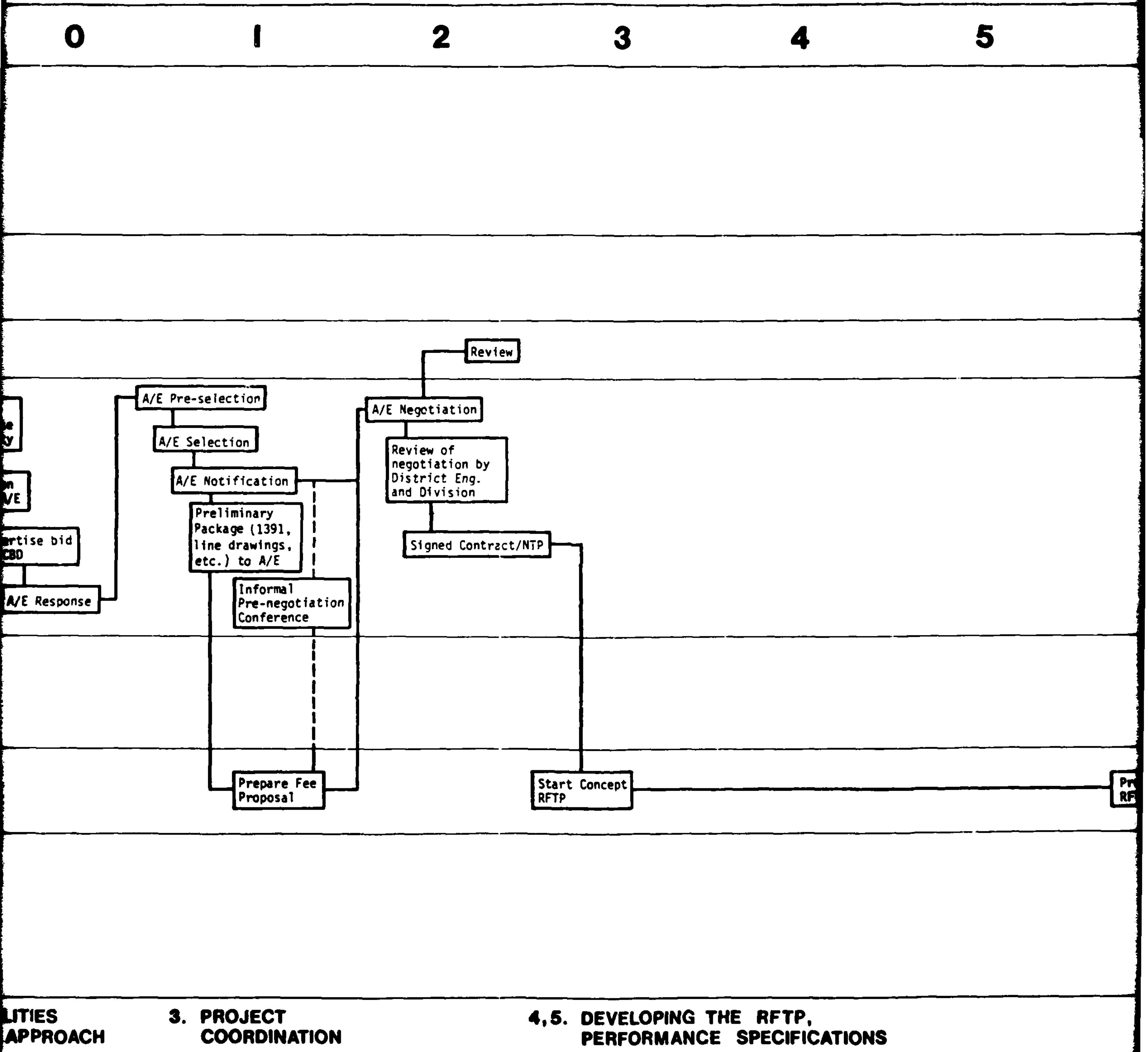
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A/E Negotiation
A/E Selection
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A/E Notification
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artise bid
CBD
Signed Contract/NTP
A/E Response
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Prepare Fee Proposal
Start Concept RFTP
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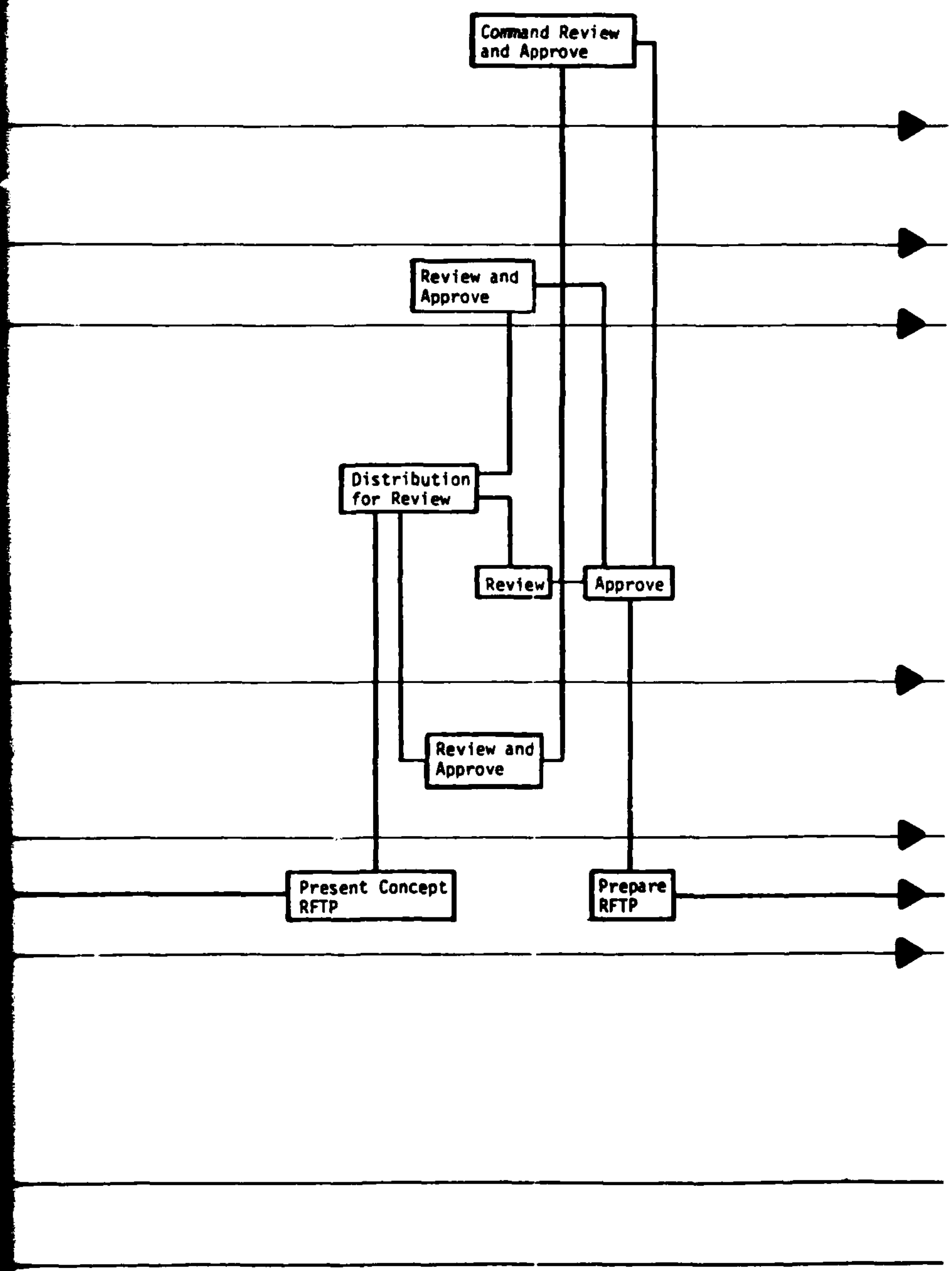

Command Review and Approve
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Distribution for Review
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Approve
Review and Approve
Present Concept RFTP
Prepare RFTP

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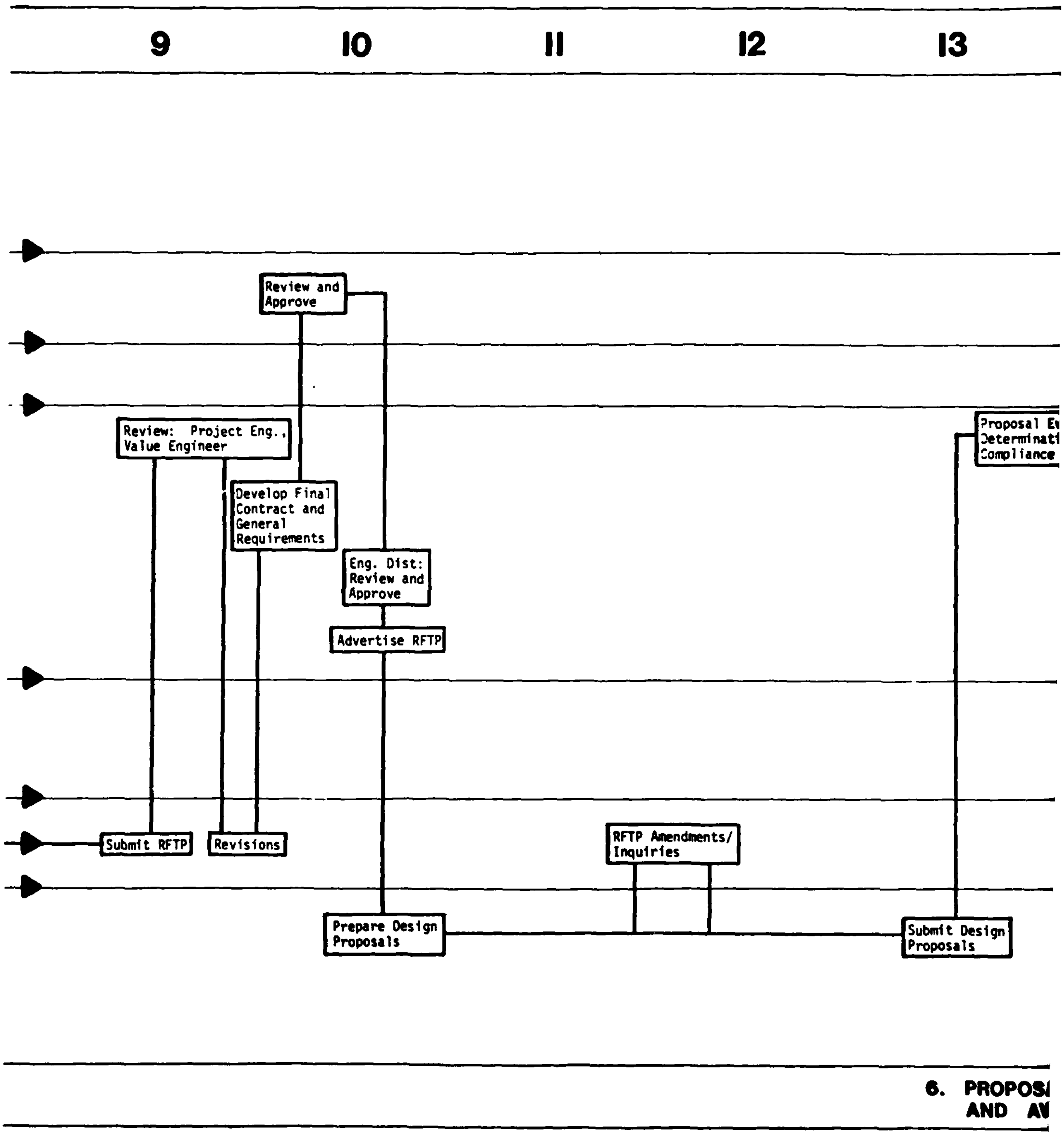

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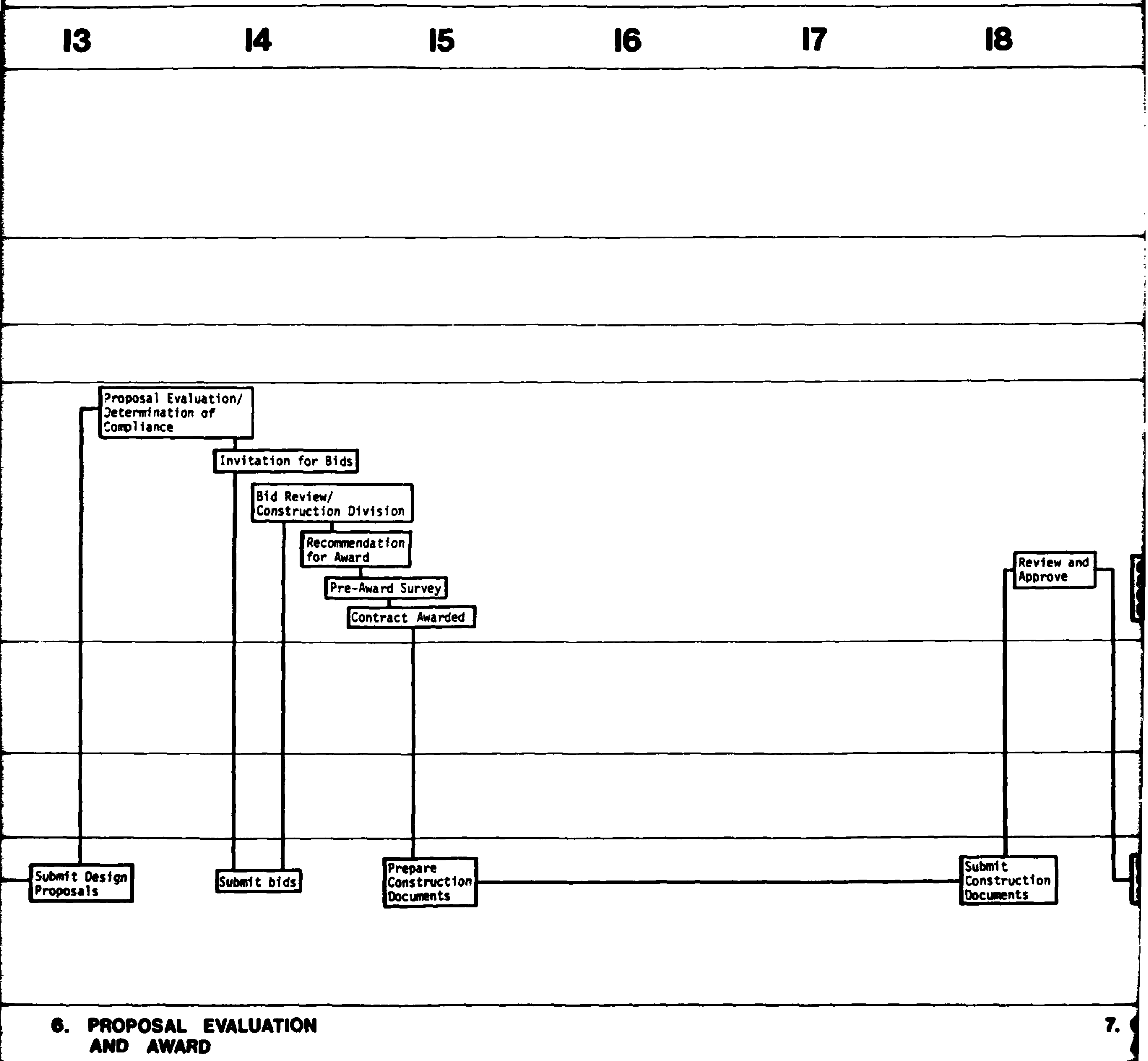

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Bid Review/ Construction Division
Recommendation for Award
Pre-Award Survey
Contract Awarded
Review and Approve
Submit Design Proposals
Submit bids
Prepare Construction Documents
Submit Construction Documents
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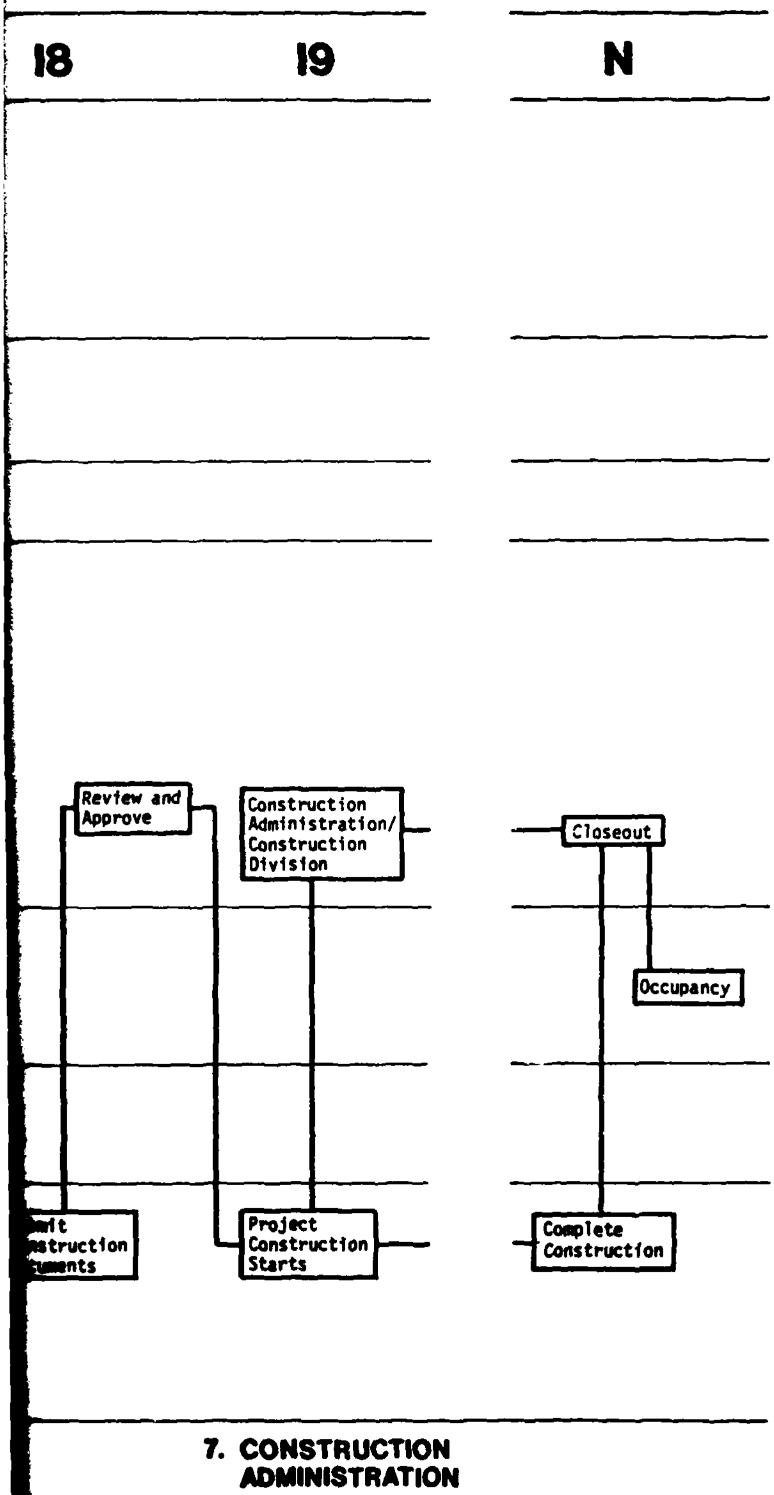
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N
Review and Approve
Construction Administration/ Construction Division
Closeout
Occupancy
Project Construction Starts
Complete Construction
7. CONSTRUCTION ADMINISTRATION

conventional construction, affording the Corps more options for construction economies and efficiencies. The report also gives technical and procedural guidance in the following areas:

1. Selection of MCA facilities appropriate for a systems approach.

2. Predesign activities for MCA projects using a systems approach.

3. Development of documentation for an RFTP.

4. Development of performance specifications for facility design and construction.

5. Evaluation of technical proposals for facilities and award of the construction contract.

6. Construction administration.

Scope

This report applies to all Army projects regardless of funding source, except for Family Housing (AR 210-50).

Approach

Facilities to which a systems approach is applicable were identified and project coordination activities for predesign were described. Procedures for developing the RFTP document were identified, and the development of performance specifications was outlined. The most efficient procedures for proposal evaluation and award were established, and construction administration practices designed to effect the most efficient completion of a project were suggested.

Mode of Technology Transfer

It is recommended that the information in this report be disseminated as an Engineering Manual in the 1180-1 series.

Users of This Information

This report is directed to U.S. Army Corps of Engineers District personnel and to the AE with whom the District may contract for a facility's design. The following material is directed primarily to District personnel:

1. Selection of facilities for a systems approach.

2. Predesign activities.

3. Proposal evaluation and contract award.

4. Construction administration.

Although the following material is directed primarily to the AE, District personnel must also be familiar with it so they can monitor the AE's work and insure that all facility requirements are adequately presented: (1) development of the RFTP, and (2) development of performance specifications.

This report can be used by all participants in the facility delivery process:

1. At the installation level, the Facilities Engineer (FE) can use the information in this report to assess the feasibility of systems building techniques for a planned facility. The FE's assessment will be reflected in the programming documents for the facility and can impact the entire facility acquisition process. The using agency may also use the information given in this report to document design requirements and evaluate proposals.

2. Corps Divisions can use the information in this report to select and aggregate facilities for a systems approach on an inter-District, Division-wide basis.

3. The District can use this report as guidance to administer the design and construction of facilities according to the systems approach described.

4. OCE, Engineering Division (DAEN-ECE), can use the information in this report to select and aggregate facilities for a systems approach on an MCA-wide basis. The Programming Division (DAEN-ZCP) can use this information to program facilities, both geographically and on a fiscal-year basis.

5. The Major Commands (MACOMs) can use the information to establish a systems approach policy by selecting and aggregating facilities MACOM-wide, both geographically and on a fiscal-year basis.

2 IDENTIFYING FACILITIES FOR A SYSTEMS APPROACH

Facility Identification Objectives

This report can help District personnel identify the capabilities and limitations of systems building techniques for MCA facilities programmed for construction in a given fiscal year, or in subsequent fiscal years.

Corps Objectives

The Corps has two primary objectives in considering a systems approach for MCA:

1. To identify facilities that could be procured more economically using systems building techniques.

2. To identify projects that could be combined under one contract to take advantage of the cost savings inherent in an increased scope of work. (Such aggregation can also encourage competitive pricing by attracting more bids on construction contracts.)

Construction Industry Considerations

This report does not require that a particular facility be designed with industrialized building systems -- only that the District's building acquisition process not preclude or restrict the use of such products. In consideration of the construction industry, the *District* should evaluate all technical and procurement alternatives that can provide satisfactory facilities for the user.

Programming Documentation

At this early stage in the project, District personnel may have only a few resources with which to identify facilities suitable for building systems and subsystems. Some user and facility requirements can be identified from the DD Form 1391 and the Program Development Brochure (PDB). Characteristics of the facility type can be identified through previously constructed examples of the facilities with the same or similar building types.

DD Form 1391

The FE and the using agency can indicate on the DD Form 1391 whether a facility can use systems building techniques. This indication is made under item 10, "Description of Proposed Construction." Table 1 lists facility types that are usually suitable for systems building techniques.

Table 1

Facility Types Suitable for Systems Approach

Facility Type (Common Designation)	Basic Category Code	Space Use	Typical Configuration*
Administrative**	610	General office space, semi-private and private executive offices; may include special-purpose spaces such as drafting rooms and computer installations.	One- to five-story reinforced concrete or steel frame construction, flat roof, and modular window areas; extensive interior partitioning with lighting, and air conditioning in all areas.
Operational building	141	Operational activities and equipment include space usage similar to those listed under administrative, training, maintenance, and storage.	See typical configuration for administrative, training, maintenance, and storage, as appropriate.
Training+	171,730+	General academic classrooms for lecture instruction; may include special-purpose classrooms, laboratory classrooms, or seminar rooms.	One- to three- story steel frame or reinforced concrete construction, flat roof; relatively uniform interior or partitioning with lighting, heating, and air conditioning in all areas.
Community	730,740 760	Recreational activity; may include flat track, basketball court, exercise rooms, and shower rooms.	One- or two-story with at least one large clear span area.
Maintenance	211,212 214,215 216,217 218,219	Some or all of the following: wood-working shop (including packing and crating facilities), electric shop, refrigeration and air-conditioning shop, plumbing and heating shop, metal work shop, central tool issue shop stores, shop toilets and locker rooms, administrative offices, drafting space, corridors, and necessary service space.	One-story structure with ceiling height under 14 ft; often on steel frame with masonry or steel panel walls; overhead doors for material vehicle access; industrial quality electrical service.
Production	220,221 222,224 225,226	Production shops for aircraft, missiles, ships, vehicles, and ordnance.	One story, large high bay spaces, often steel frame, panel walls, overhead doors, industrial quality electrical and mechanical services.
Storage (supply)	421,422 441A,C 442A,C	General storage; often provided in 40,000-sq ft increments.	Bay size about 40 by 25 ft; steel or concrete frame building with ceiling height 12 to 19 ft; roof framing often steel joist or truss.
Housing	720	General housing for military personnel.	One to four stories with self-contained units or dormitory-type construction.

*Configurations listed describe conventional construction to illustrate generic characteristics of each facility type. Buildings procured using the systems approach may have other configurations.

**Includes dependent schools.

+Requirements for laboratory and research facilities are often similar to requirements for administrative or training facilities. In such cases, use of a performance specification would be appropriate; however, conventional design should be used to respond to special requirements.

PDB

The PDB contains information which District personnel must consider in the District's approach to the project design. The design data checklist of the PDB, part C, "Architectural and Structural," and part D, "Mechanical and Utility Systems," should be reviewed to determine if there are any unusual architectural, structural, or mechanical requirements which might preclude the use of a systems approach to construction.

Table 2 lists items from the design data checklist of the PDB which contain information relevant to the possible use of systems building techniques. The Project Identification section discusses criteria that should be applied to this information to identify facilities suitable for a systems approach.

Example Facilities

The most definitive information about a planned facility District personnel will have at the programming stage will be documentation for previously constructed or designed facilities of the same or comparable building types. Such documentation will give an example of the configuration characteristics of the new facility. An example would be the District considering site-adapting a design constructed elsewhere at an earlier date.

It is essential that any definitive material be evaluated as an example of configuration and not as a prescribed design. Consideration should be given to such characteristics as layout and configuration of the building plan; arrangement and spatial characteristics; required clear spans and clear areas; required ceiling heights and number of stories; regularity of dimensions and possible dimensional modularity; door, access, and fenestration requirements; equipment requirements and accommodation of equipment; regularity of mechanical system layouts and accommodation of mechanical systems; and aesthetic characteristics such as proportions, feature arrangement, and use of exterior materials. The Project Identification section discusses criteria that should be applied to the items listed above.

Building Systems Information

To determine if a facility is suitable for a systems approach, District personnel must be familiar with available systems building products and their applications.

Description of Systems Building Products

A facility may be constructed using a complete building system, by combining manufactured subsystems into a complete building, or by combining selected manufactured subsystems with conventional construction. The extent of systems use, if any, depends on the availability of the appropriate systems building products at a specific location, as well as the overall advantages to the facility's construction. In a Two-Step procurement, the proposer determines his/her most advantageous use of systems.

Many complete, proprietary building systems are available throughout the United States. These systems use such relatively conventional construction

Table 2

PDB Design Data Checklist Items Relevant to the Use of Systems Building Techniques

PDB Design Data Checklist, Part C, "Architectural and Structural"

Item

1. Material availability
2. Architectural style
4. Walls
   (a) Exterior
   (b) Interior walls and partitions
5. Ceilings
11. Sound attenuation
12. Stairs, elevators, and chutes
15. Unusual foundation requirements
16. Span or height requirements
17. Special bay sizes
19. Roof loads
20. Structural specialties
21. Seismic zone load design criteria
24. Special design projects requirements

Other

PDB Design Data Checklist, Part D, "Mechanical and Utility Systems"

Item

3. Maintenance considerations
5. Plumbing systems
6. Heating systems
7. Ventilation/air-conditioning/refrigeration systems

types as wood, steel, precast concrete frames or panels, and different configurations of geodesic, stress-skin, tensile, and air-supported structures. A variety of manufactured building subsystems and components are available in most areas of the United States. Structural subsystems may consist of steel, precast concrete, composite concrete and steel, or wood components, frames, decks, or panels. Nonstructural exterior wall subsystems may include precast concrete panels, composite steel and cementitious panels, preformed metal panels, metal sandwich panels, glazed sections, metal frame panels, wood frame panels, and various fibrous composition panels. Roofing subsystems include metal roof panels, metal sandwich panels, and membrane roofing. Interior subsystems may include integrated ceilings containing lighting and air-distribution components, access flooring, and movable or demountable partitions (usually prefinished). Plumbing and mechanical subsystems and components include prefabricated plumbing trees, walls, and modules, air-distribution networks, electrical distribution networks, and integrated special networks such as fire protection and energy control.

Complete building systems are usually available through licensed or franchised contractors or (occasionally) through a general contractor. In addition to being responsible for the particular proprietary building system, the contractor is also responsible for all other nonsystem items; i.e., the contractor delivers the building as a complete package.

Manufactured subsystems are generally available through licensed or franchised contractors or through general contractors or subcontractors. These subsystems are sometimes marketed through outlets or distributors. As subsystems are usually manufactured and marketed independently, each subsystem must be coordinated into the complete building design. Manufactured subsystems are often combined for a substantially systems-oriented design, or used individually in an otherwise conventionally constructed facility. Coordination is typically done by the building's designer, a general contractor, or by a construction manager.

It should be noted that the terms "systems" and "subsystems" are often used interchangeably in data, product information, and manufacturers' literature. Most frequently, the term "system" is applied to building elements that are defined in this report as subsystems. The distinction is made in this report for the sake of clarity.

Information Sources

Information regarding systems building products and their availability can be obtained from architectural and construction cataloging services and from manufacturers' data. Such sources of information include, but are not limited to, Sweets Architectural Files (McGraw-Hill Information Systems Company), The Thomas Register (Thomas Publishing Company), Visual Search Microfilm Files (Information Handling Services), Showcase Microfilm Library Systems (Showcase Corporation), IDAC Microfilm Library System (National Design Center, Inc.), SPEC DATA I and II (CSI), MP-7, Sources of Construction Information (CSI), professional journal readers' services, and construction trade associations. Most such cataloging services organize their material under the CSI 16-division format; many systems building products may be found under the following categories:

Complete Building Systems and Structural Subsystems. Division 3 -- Concrete (precast concrete); Division 5 — Metals (structural metal framing, framing systems, space frames, geodesic structures); Division 6 — Wood and Plastics (prefabricated structural wood); Division 13 -- Special Construction (air-supported structures, pre-engineered structures, prefabricated rooms).

Exterior Envelope Subsystems. Division 3 -- Concrete (precast concrete); Division 5 — Metals (lightgauge framing); Division 6 -- Wood and Plastics (prefabricated structural plastics); Division 7 -- Thermal and Moisture Protection (preformed roofing and siding).

Interior Subsystems. Division 13 -- Special Construction (integrated ceilings); Division 10 -- Specialties (access flooring, specialty modules, partitions).

Mechanical Subsystems and Components. Division 15 -- Mechanical (plumbing systems, fire protection, air distribution); Division 16 — Electrical (service and distribution, lighting, special systems).

General

Descriptions of integrated systems and subsystems frequently conflict with materials-oriented categorizations. Therefore, cross referencing categories is essential in identifying all applicable systems building products.

The geographical availability of systems building products can be determined by obtaining manufacturers' directories of franchises, licensees, distributors, or outlets. Trade organization can also provide information on the availability of products, outlets, or contractors. Such information should include the market areas in which these sources operate, i.e., locally, regionally, or nationally from a given location.

Project Identification

To identify facilities suitable for a systems approach, the technical feasibility of a single given facility for systems building techniques must be determined. Those facilities, individually or combined, for which a systems approach should be pursued, can then be selected.

Technical Feasibility

After the facility's programming documentation is examined and the applications and capabilities of building systems and subsystems are assessed, District personnel must determine the technical feasibility of using systems building techniques for a given facility according to the following criteria:

General. A positive response to the following items will contribute to the overall feasibility of using systems building techniques for a facility.

1. Time considerations are such that a reduced construction time is either beneficial or critical.

2. The site is not severe in terrain, unusually restrictive in shape or dimension, or would restrict access by large-scale building components or equipment.

3. The facility's design program or occupancy requires flexibility in interior configuration, or predicted changes in function or occupancy during the life of the facility will require building expansion or rearrangement of its interior configuration.

4. The facility is in a remote location so that maintaining an onsite labor force would be difficult; prefabrication would reduce onsite labor and expedite construction.

Design. Positive responses to the following items will be an initial indication of design compatibility with most building systems and subsystems.

1. The facility's plan configuration can be basically rectangular or rectalinear. The plan, or major space-dividing and structural elements of the plan, is appropriate for a bay or a grid layout. There are no requirements for severe recesses, protrusions, or irregular shapes in the building's perimeter.

2. The plan dimensions can be modular or in increments of 2, 4, 5, 8, or 10 ft.* Required clear spans do not exceed about 80 to 100 ft, except for warehouse- or athletic-type buildings where spans of more than 120 ft can be achieved. Clear areas need not exceed about 50 x 80 ft to about 50 x 100 ft, except for warehouse- or athletic-type buildings.

3. The facility probably will be three stories or less. Various precast or prestressed concrete building systems, however, can assume mid- or high-rise configurations for housing and office or administrative building types.

4. The facility does not require an unusually high ceiling if it is a multistory building. Any high-bay or vertical clearance requirements in single-story buildings should not exceed about 26 to 30 ft. (Clearances of up to about 40 ft, however, can be achieved with a pitched roof with some building systems.)

5. There are no extraordinary design or aesthetic requirements for building proportion, roof outline, or feature arrangement.

6. The desired aesthetic characteristics can be achieved through use of conventional exterior building materials.

Technical. At the programming stage, detailed technical requirements may not yet have been identified for the facility. Positive responses to the general technical criteria below, however, are an initial indication of the technical feasibility of using systems building techniques.

1. There are no extraordinary structural requirements. Live and dead loads, uniform loads, wind loads, and other structural requirements are

* The metric conversion table on p114 provides SI conversion factors for English measurements used in this report.

comparable to local building codes or model building codes used at the given location. There are also no extraordinary concentrated loads, impact loads, dynamic loads, or unusual structural requirements such as blast resistance.

2. There are no extraordinary fire or life safety requirements for the facility. Such requirements are compatible with local building codes or model building codes used at the given location.

3. Exterior environmental conditions are not severely corrosive, abrasive, or otherwise likely to require specialized exterior materials. Also, the interior environment will not require extensive use of specialized finishes.

4. The facility, as a whole, will not be subject to extraordinary high abuse or damage conditions. Any particular item so subject can be constructed as an out-of-systems item with conventional specialty materials.

5. Thermal performance requirements for the facility are comparable to commonly accepted standards.

6. There are no extraordinary acoustic control requirements for the facility, either within or among interior spaces, or external to the building. Any specialized acoustic control spaces can be preengineered or prefabricated, or built as an out-of-systems item.

Use of Criteria. In addition to these criteria, the technical feasibility of systems building techniques must rely on the qualitative experience of Corps personnel with the local construction community. Appendix A gives a checklist which District personnel can use to assess the technical feasibility of systems building techniques for a particular facility. Each of the above listed represents only a component of the condition favorable to the use of systems building techniques. District personnel must consider these criteria in combination, determining an overall indication of favorable conditions. Although no single criterion should be the sole determining factor in technical feasibility, one strongly favorable condition may outweigh other marginally favorable conditions, since any strongly negative condition may outweigh other favorable conditions.

Procurement Considerations

An assessment must be made of the feasibility of using a performance-oriented procurement strategy for a particular facility. Since two-step formal advertising is currently the only performance-oriented procurement method available for MCA facilities, District personnel must evaluate this strategy.

DAR, section 2-501, indicates that the use of two-step formal advertising is permitted in situations where the Government does not have enough detailed specifications to use formal advertising and in procurements requiring technical proposals. Specifically, DAR 2-502 states that the use of two-step formal advertising is proper where inadequate or unduly restrictive specifications would hinder competition, where criteria for evaluating technical proposals exist, where several qualified sources are available, where there is enough time to use the method, and where a fixed-price contract is contemplated.

The first condition of DAR 2-502 concerns the sufficiency of available specifications. The key point here is that available prescriptive specifications are usually "...too restrictive to permit full and free competition without technical evaluation." The need to maximize competition and to take advantage of new construction techniques by using performance specifications will satisfy this condition.

The second condition of DAR 2-502 requires that "...definite criteria exist for evaluating technical proposals...." The RFTP presents these criteria as technical requirements from which proposals are developed and evaluated. These criteria are based on the design and construction guidance provided by the District.

The third condition of DAR 2-502 states that proposals can be expected from more than one qualified source. Information to support that expectation is based on either general knowledge of the industry or an industry survey conducted to determine program interest. The two-step process shall not restrict competition to a certain type of construction; rather it should open competition to all qualified proposers.

The fourth condition of DAR 2-502 requires that there be enough time to carry out a two-step procedure. More time may be needed for proposers to develop their plan and for the Government to evaluate the proposals. This time may, however, be recouped through shortened Government design periods and shorter construction times.

The fifth condition of DAR 2-502 states that because the two-step method is a form of formal advertising, its use is limited to firm-fixed-price contracts and to fixed-price contracts having economic price adjustment clauses.

Two-step formal advertising allows the Corps to take advantage of the latest in building technology, so innovative building systems and subsystems can compete equally with traditional construction methods. It also allows the Corps to maintain quality control by drafting requirements explicit enough to eliminate poor-quality proposals (step one), while using the well-known bidding arrangements of formal advertising in awarding the contract (step two).

A potential disadvantage of two-step formal advertising is that it requires bidders to submit designs; bidders must be able to prepare both initial and final construction documentation in addition to insuring they can supply the appropriate systems or subsystems. This adds to the cost of doing business for both new proposers and established producers with new products. Thus, before using performance-oriented procurement, there must be enough eligible bidders to insure competitive pricing. However, for producers who submit bids based on currently available systems or subsystems, much of the design and development work will already have been done and the cost amortized over the market life of the product.

Facility Selection

After the MCA facilities which can be constructed with systems building techniques are identified, the Corps must select those for which a systems approach should be pursued. The selected facilities should be those which will elicit a favorable response from the local construction industry to a systems-oriented procurement. Facility selection for a systems approach must, therefore, rely on project-specific input. Such factors as locale, timing, logistics, the local construction community, and national construction trends must be evaluated. The selection process is based on a series of qualitative judgments. The information required to make these judgments must be generated locally and applied on a program-specific basis.

Selection Criteria

The selection criteria given below will enable District personnel to identify those conditions which indicate a facility can be constructed economically and efficiently using systems building techniques.

General. Several general considerations indicate certain favorable conditions for the use of systems building techniques. These are:

1. Facilities in locations, such as remote-area sites, where difficulty in maintaining labor onsite would suggest using extensively prefabricated building components.

2. Facilities in areas where there is no labor opposition to the extensive use of manufactured building systems and subsystems.

3. Facilities for which time constraints are such that extensive use of prefabricated components may realize an overall cost savings.

4. Facilities for which the conditions of the site or location create difficulties in building materials delivery, storage, staging, and erection if conventional methods were used.

5. Facilities in areas where local codes permit the use of systems building techniques or innovative building technology, and where such techniques are evident in the local construction community.

Location and Availability of Systems Building Products. The economic advantages of systems building techniques depend largely on local construction conditions and whether systems techniques are competitive with conventional construction techniques. Systems construction can become less economical and efficient if there are procurement difficulties or prohibitive transportation costs. Corps personnel must determine what system building products, including proprietary systems for a complete building as well as manufactured subsystems and components, are available in the area where the proposed facility will be built. They must also decide which facilities are large enough to encourage competitive participation by the systems building industry. Thus, the fundamental elements of this criterion are:

1. For which facilities are systems building products available?

2. For which facilities are systems techniques competitive with conventional construction?

Project Size -- General. The size of the building implies its dollar value, as well as indicating the number of components or units and physical area it requires. The size of a project is an important factor in determining the bidding incentives its contract will offer to the construction community. Project size also helps determine who is likely to participate in a procurement, from how far they are likely to come, and what efforts they are likely to expend. Thus, the fundamental elements of this criterion are:

1. Which facilities are large enough to encourage the competitive participation of the systems building industry?

2. How many smaller facilities must be aggregated to create packages large enough to attract competitive participation?

3. Can large facilities be aggregated to increase the incentive for competitive participation?

Project Size -- Minimum. The following criteria can be used to establish the minimum project size feasible for a systems approach:

The smaller the size of a project, the less effort the proposer is likely to expend preparing proposals. Therefore, for proper evaluation, the nature of smaller-scale project proposals must be such that they require less detail than larger-scale projects.

Complete preengineered building systems usually can be adapted to smaller scale projects (about 10,000 total sq ft or less). Since most detailing and engineering will already have been done and documented for the system, the major proposal effort will be the project design. (This does not imply that preengineered building systems are better suited only to small-scale projects.) Franchise systems builders and design/build contractors will be the most likely participants in projects of this scale.

Because building subsystems must be coordinated and detailed on a project-specific basis, small-scale projects will be less likely to attract these kinds of products. Subsystem franchise installers, design/build contractors, general contractors, or construction management firms may coordinate the required expertise, efforts, and materials and participate in the procurement. A minimium project size of about 10,000 to 30,000 sq ft would likely be needed to attract participation for a project of this type.

Smaller-scale projects will generally not justify any special or nonstandard design, engineering, or detailing. Therefore, projects having less than about 20,000 sq ft should be planned strictly according to standard design and engineering parameters for the building systems or subsystems involved since special or nonstandard requirements will increase costs and discourage participation.

The level of construction activity in the local market will influence the level of local industry's participation in smaller-scale MCA projects. An active local construction market may make smaller projects less attractive, or may only attract participants of marginal sophistication or quality. Conversely, a relatively inactive local construction market may stimulate participation.

Project Size -- Maximum. A single MCA facility rarely would exceed the capabilities of many systems contractors. Building systems franchise contractors commonly participate in projects in excess of 150,000 sq ft for nonresidential type buildings. Housing systems are commonly used in projects of 1000 or more dwelling units, or 400,000 to 500,000 sq ft. However, facilities should be carefully aggregated to prevent any single package from becoming so large that it inhibits participation. Considerations for the maximum size of an aggregated contract include the following:

1. The opportunity to include similar facilities in one aggregated package.

2. The number of sites included in the package.

3. The distance or the presence of geographical barriers between sites.

4. Whether construction is to occur concurrently or consecutively on different sites.

5. The bonding capabilities of the contractors.

6. The contractors' resources and capabilities in administering multiple sites.

7. The established territories of building system franchised contractors.

8. The production capabilities of systems or subsystems manufacturers.

9. The administrative capabilities of District personnel.

Availability of Participants. Perhaps the most critical factor in the selection of facilities for a systems approach is whether enough bidders within the construction community are capable and willing to participate in a systems-oriented procurement to insure that the cost saving potential of systems building techniques is fully realized. A systems-oriented procurement will be let as an RFTP with the award of a single prime construction contract. Therefore, a bidder or participant must be able to administer a prime contract, design and engineer the facility, acquire systems building products and construction materials, do all general contracting and subcontracting of all out-of-house trades, and administer construction. A bidder may employ all required services in-house or may procure the needed services on a project-by-project basis. District personnel must identify participants who possess these capabilities and would be willing to participate in a systems-oriented MCA procurement. Such information may be identified through local sales representatives of systems building products. Such contacts could identify their franchise or licensed contractors, contractors who frequently use their products, architects who frequently design with their products, past clients, and projects where their products have been used at a given location, as well as provide technical data. Corps personnel must also rely on their knowledge of the local construction community to predict its likely participation in a systems-oriented procurement. To verify or supplement this information, the District may also advertise in Commerce Business Daily. This advertisement should be directed to firms having or capable of procuring the services listed above and should request an acknowledgement of interest in a systems-oriented procurement. Such a response will place the firm under no obligation and is intended only as an information tool.

Proposal Effort. Participants in a systems-oriented procurement must develop design proposals in response to an RFTP. With no guarantee of receiving a contract, a proposer will invest time, effort, and money in a proposal's development. This situation represents a risk that the investment may not be recovered. Thus, the investment in developing a proposal cannot be so great as to discourage otherwise capable and willing firms from participating. The time and effort a proposer will likely expend preparing a proposal is commensurate with the size of the project. An investment of about 1 percent of a facility's construction cost will be the maximum a proposer will likely be willing to commit to a proposal's development. This would be the equivalent of about 20 to 25 percent of a conventional AE design fee for the project, at most.

Use of Criteria. Each of the criteria discussed above represents only a component of the condition favorable to a systems approach to facility design and construction. District personnel must consider these criteria in combination, determining an overall indication of favorable conditions. Although no single criterion should be the sole determining factor in project selection, one strongly favorable condition may outweigh other marginally favorable conditions, as any strongly negative condition may outweigh other favorable conditions. In addition to the information presented above, the selection of facilities for a systems-oriented procurement must rest on the qualitative experience of Corps personnel in the construction community.

3 PROJECT COORDINATION

Project Coordination Objectives

Project coordination refers to those activities completed before the design process begins. They include determining design options, selecting the AE, developing preconcept control data, scheduling, and cost estimating. The objectives of project coordination for a systems-oriented project do not differ from those of a conventional MCA project.

Corps Objectives

The Corps principal objective is to make the appropriate early-stage decisions that allow expedient and effective facility design and construction. It is particularly important to a performance-based procurement to determine the degree of control the Corps must exercise to insure design and construction quality while allowing the contractor the appropriate latitude for innovation and economy.

Construction Industry Considerations

In consideration of potential proposers, the Corps should not attempt to exercise design control to the extent that proposers' abilities to innovate are restricted; i.e., constraints which do not genuinely contribute to the quality of the facility should not be imposed. When developing preconcept control data, all reasonable options regarding configuration, materials, and methods should be left open.

Considerations for Systems Building

Project coordination activities for a systems-oriented project should not differ significantly from those of a conventional MCA project. AE selection, preconcept control data development, scheduling, and cost estimating should be done, for the most part, in the usual manner. However, certain decisions are made at this stage of the project regarding procurement and design options that are unique to a systems-oriented project.

Procurement Alternatives

Within the context of the MCA environment, a performance-based procurement can be conducted using either a one-step negotiated contract or a two-step formal advertising method. The use of one-step negotiated contracts is currently restricted to Family Housing construction and, therefore, will not be discussed in detail in this report. If, however, it is felt that the use of this type of contract would be advantageous to the Government, the District may request a waiver from OCE. Two-step formal advertising, often referred to as "two-step" or TSFA, is a hybrid procurement method combining the flexibility of competitive negotiation with the competitive bidding procedure of formal advertising for a fixed price. Since this method is the only performance-oriented procurement method currently allowed in military construction, this report is oriented only toward two-step formal advertising.

A District may initiate a Two-Step Formal Advertising procurement on its own authority. Notification should be provided to the Division Engineer and, in turn, to OCE. This notification should address the following:

1. The feasibility of using building systems or alternative construction techniques.

2. The five required conditions of DAR 2-502 discussed in Chapter 2, pp 24,25.

3. Reporting design completion percentages on the MCA status report. (See discussion of concept development, Chapter 4, p 54.)

4. The possibility of soliciting design and construction proposals (Step 1) prior to appropriation of construction funds. (See discussion of Step 1 advertisement, Chapter 3, p 41.)

As its name implies, the two-step formal advertising method involves two steps. In the first step, the Corps solicits design proposals by means of an RFTP. The RFTP contains contract data, a description of the project conditions, site data, and descriptive and performance specifications for the facility. The Corps advertises the RFTP, and proposers develop detailed descriptions of what they intend to supply to fulfill the Corps' stated needs. Each proposer submits his/her proposal to the Corps for evaluation. The Corps then verifies that the proposal conforms to the RFTP. Proposals that do not conform to the RFTP are disqualified. Proposals that satisfy all specified requirements are eligible to continue to the second step.

Step two is essentially the same as described for a formally advertised procurment in DAR section 2, parts 1, 2, 3, and 4. The Corps issues an IFB to those proposers whose technical proposals were determined to be acceptable in step one. Each IFB must bear the following provision as required by DAR 2-503.2(ii) and set forth in DAR 7-200.37:

> "This invitation for bids is issued pursuant to two-step formal advertising in Part 5 of Section II of the Armed Services Procurement Regulation. Bids will be accepted and considered only from those firms who have submitted acceptable technical proposals pursuant to the first step of such procedures, as initiated by (identify the request for technical proposals). Any bidder who has submitted multiple technical proposals in the first step of this two-step procurement may submit a separate bid covering each technical proposal which has been determined acceptable by the Government."

After the bids are received and all requirements have been met, the contract is awarded to the lowest bidder.

Figure 2 compares conventional formal advertising with two-step formal advertising. In the two-step method, the proposer becomes a major participant in the design of the facility. Consequently, those areas of the process which affect the design responsibilities change somewhat. Those that deal with the contract and price system remain the same.

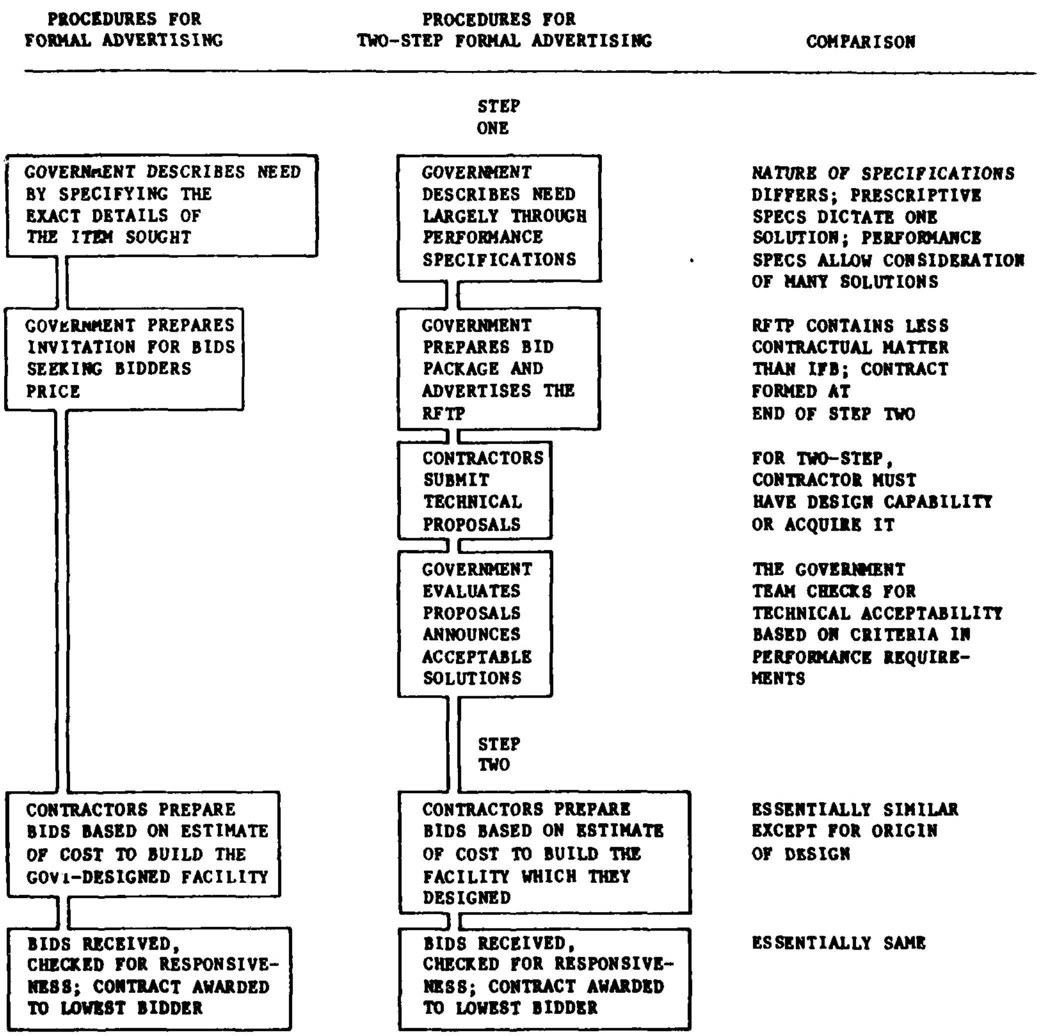


Figure 2. Comparison of conventional formal advertising with two-step formal advertising.

This change in focus from Government design to industry design alters some of the procurement activities. In the two-step method, the initial step is to transmit the information about the procurement to the proposers so they can prepare their detailed proposals. Once this design step is complete, the IFB is sent out with the contractual material. Both documents, when combined with the proposer's design, constitute the complete contractual package.

Although the two-step method makes it possible to consider various solutions to Corps needs, it uses cost as the only variable in choosing among the acceptable proposals. Doing so simplifies evaluation, reduces the chances of favoritism, and reflects Department of Defense preference in awarding contracts. Reliance on lowest cost can, however, become a problem since lowest cost often means lowest quality as well. This problem can be addressed by stating the minimum requirements in sufficient detail to insure that all responsive proposals will satisfy Corps needs. Once the evaluation shows that the desired level of quality is met by the various proposers, step two reverts to a more familiar bidding procedure that results in awarding the contract to the lowest responsive bidder, as in formal advertising.

The use of the two-step method is further detailed in DAR 2-501, ER 1180-1-7, and ETL 1110-2-182.

Design Alternatives

The objective of a performance-based procurement is to allow a proposer the opportunity to implement his/her own methods and innovations to optimize economy and efficiency in a facility's construction. This, however, does not imply that the Corps must relinquish all design control for the facility. The design alternatives available to the Corps relate to the appropriate balance of responsibilities between the Corps and the contractor and the extent to which performance specifying and the use of systems may benefit facility design and construction.

At this stage of a project, District Engineering Division personnel must decide:

1. What elements of the facility (or facilities) might be constructed using manufactured systems.

2. What degree of latitude, or control, the Corps should exercise over facility design and systems configuration.

Thus, determining a design strategy depends on:

1. The availability and potential advantage of building systems and subsystems for the particular facility or facilities.

2. The need for the Corps to dictate definitive configuration, materials, or processes for the facility or a given subsystem of the facility.

The design alternatives available to the Corps range from a descriptive design of the facility and virtually all of its elements, to the delegation of all design and engineering responsibilities to the contractor; from the use of only one selected subsystem, to the use of systems for virtually the entire facility. The design will, in part, be determined by those systems or subsystems the Corps selects for the facility. The level of performance exercised when specifying these elements will establish the parameters for the materials, configuration, and processes used. Chapter 5 of this report describes these levels of performance.

These determinations need not be final at this stage and may be modified and refined even into early design stages. However, some preliminary determination of how extensive the use of systems will be and of contractor latitude is necessary for AE selection and development of preconcept control data.

An indefinite number of design alternatives are available to the Corps, but the one selected must be determined according to the project specific conditions. Figure 3 illustrates this design range and the conditions under which some design alternatives can be used.

The District's Engineering Division personnel can make a preliminary determination of an appropriate design strategy through their own familiarity with the particular project, the information gathered in their project selection activities (Chapter 2), and a review of some of the considerations for developing performance specifications explained in Chapter 5 of this report.

Preconcept Control Data

Preconcept control data are developed for a systems-oriented facility in a manner similar to that used for a conventional MCA project. The important consideration for a systems- and performance-oriented project is to avoid indicating any detail- or material-prescriptive descriptions that may unnecessarily restrict or preclude the use of systems or subsystems at a later stage of the project.

District Engineering Division personnel should first review the DD Form 1391 and PDB to identify any discrepancies between the information contained in the programming documents and preliminary design decisions already taken concerning the extent to which systems or subsystems will be used and the degree of latitude or control to be exercised in the facility's design.

Preconcept control data drawings should be developed in a manner similar to that used for a conventional MCA project. Building plans also should be developed as usual, but within the planning parameters of building systems, where such systems could be used in the facility. Plan dimensions should be indicated only in nominal dimensions, where they may vary depending on the system or subsystem ultimately chosen. Construction type and materials should not be indicated unless the use of a given material is critical to the function of the facility. If sections and elevations are included, they should be developed within the parameters of the appropriate systems, e.g., floor, ceiling, and roof levels. Exterior materials should not be described, unless certain materials are critical to the facility. Potential or acceptable alternatives may be identified where such alternatives are available. The detailed site plan should be developed as usual. If, depending on the system ultimately chosen, the building outline may vary significantly, this can be noted on the site plan.

CORPS CONTROL	MAXIMUM CONTROL				MAXIMUM LATITUDE
DESIGN RESPONSIBILITY	Corps requires strict control over definitive design, materials, *and details*.	Corps requires control over definitive design of the facility, some materials and details. Contractor has control over some materials and *details*.	Corps desires control over basic design configuration. Contractor has control over many design and construction details and materials.	Corps controls design *relationships*. Contractor has control over definitive design, materials, and construction details.	Contractor assumes total control over building and/or site design.
SYSTEMS USE	In-systems work constitutes only a very low percentage of the facility work (less than about 10%).	In-systems work constitutes a low percentage of the facility work (less than about 20%).	In-systems work constitutes *a moderate percentage of* the facility work (more than about 30%).	In-systems work constitutes a large percentage of the facility work (up to about 50%).	In-systems work constitutes the majority of the facility work (more than about 50%).
	Possibly one or two highly standardized, easily integrated subsystems.	Several subsystems or one or two major subsystems *critical to the* buildings configuration.	Many subsystems, several major subsystems, or *a complete* building system.	All or most major subsystems or a complete building system.	All or most subsystems or a complete building system.
CONSTRUCTION DOCUMENTS	Building and site to be designed, detailed, and *specified* in usual descriptive manner.	Building subsystems to be performed specified. The remainder of the building and the site to be designed, detailed, and *specified* in usual descriptive manner.	Systems and subsystems portion of the facility to be performance-specified. The site and nonsystems portions to be designed, detailed, and specified in the usual descriptive manner.	Systems and subsystems portion of the facility to be performance-specified. The site and nonsystems portions to be designed, detailed, and *specified* in the usual descriptive manner.	Building and/or site to be performance-specified.
PROCUREMENT PROCEDURES	Building to be procured using formal advertising procedures. Low bidder must verify responsive-ness of *performance* specified subsystem(s).	Building may be procured using formal advertising procedures or two-step formal advertising. This would depend on the level of performance the District assigns to the sub-system(s). If procured by formal advertising, low bidder must verify responsiveness of per-*formance-specified* subsystem(s).	Building to be procured using two-step formal advertising procedures.	Building to be procured using two-step formal advertising procedures.	Building to be procured using two-step formal advertising procedures.

Figure 3. Design strategies.

Outline specifications should indicate those portions of the facility to be specified in conventional terms and those systems likely to be performance-specified. Chapter 5 of this report describes the content and development of performance specifications. Both descriptive and performance items are integrated into the CSI masterformat; therefore a single-format outline should cover all specification items.

Engineer Form 3086, "Cost Estimates for Budgeting Purposes," should be developed in a manner similar to that used for a conventional MCA project. The only significant difference in estimating a systems-oriented project is in estimating those systems whose materials and configurations are not yet known and may not be identified until proposal evaluation.

Cost estimates for manufactured systems and subsystems are discussed in the Cost Estimating section. Estimates for site, utility, foundation, and finishing work; hook-ups; and any other nonsystems work should be developed as usual and included in the total project estimate.

Where the facility's design and/or construction type cannot be identified yet, or may not be identified until proposal evaluation, the budget estimate should be based on data contained in AR 415-17, per ER 415-345-42.

The preconcept control cost estimate may indicate to District Engineering Division personnel that a revision in the anticipated design strategy may be needed. Any subsystem whose cost appears to be significantly higher than its conventionally constructed counterpart should be investigated. If a higher cost is indeed imminent, the building element may be designed, detailed, and specified in the conventional descriptive manner. But if a conventionally described building element appears to be higher in cost than anticipated, and if available subsystems become cost-effective, manufactured subsystems may be determined appropriate for that building element.

AE Selection Procedure

The AE selection procedure for a systems-built facility is the same as that used for conventional MCA design. AE qualifications and the AE's scope of work, however, will differ to some extent from conventional MCA design, although such considerations will not alter the selection procedure.

General

Qualifications for the selection of an AE will consist of the same criteria as those used for a conventional MCA design, with the additional qualifications of expertise in systems building technology and performance specifying. The AE's scope of work is altered primarily in his/her development of an RFTP, rather than in the development of a definitive design.

Use of SF 254

The SF 254 is used as a reference to an AE's qualifications in a manner similar to that used for conventional MCA design. When the file of SF 254s is surveyed, particular attention should be paid to Experience Profile Code Numbers 069, Modular Systems Design, Prefabricated Structures or Components, 081 Pneumatic Structures, Air-Supported Buildings (if applicable), and 201 through 205, where experience with performance specifying may be indicated.

Advertisement in Commerce Business Daily

An advertisement in the Commerce Business Daily should follow the same format as that used for an advertisement for conventional MCA design services. The following items should be incorporated into an advertisement for an AE for a systems-built facility:

1. The title should indicate "Preparation of a Request for Technical Proposal (RFTP) for ....."

2. The project description should be stated as usual indicating the type of building, square footage, construction cost range, estimated time of design completion, or other general information about the facility.

3. The description of the services included should indicate the preparation of an RFTP for a performance-based procurement, including the preparation of performance specifications, site design (as appropriate), and whatever mechanical design or nonsystems design is required. A description of qualifications required of the AE, in addition to those required for a conventional MCA design, should include experience with performance specifying, experience with systems buildings technology, expertise with the particular building type, and familiarity with the local systems building community. Evaluation factors, if included, should stress experience with systems and performance specifying.

4. Respondents should submit SF 255 and SF 254, if they are not already on file.

Use of SF 255

The submittal and receipt of SF 255 follows the same procedure as that used for a conventional MCA design.

Preselection and Selection

The preselection and selection processes for an AE for a systems-built facility are similar to those used for a conventional MCA design. Expertise in systems building and performance specifying is essential to the successful execution of a systems-built facility. Therefore, these factors may outweigh other selection factors. The selected AE should be notified in a manner similar to that used for conventional AE selection. In addition to the District's typical selection criteria, the following factors must be considered when selecting an AE for a systems-built facility:

1. The number of systems-oriented projects cited in the SF 255.

2. The use of performance specifications in any projects cited in the SF 255.

3. Any systems- or performance-related research or service contracts.

4. Any construction management experience which would be beneficial to the completion of a systems-built facility.

5. Any local systems or performance-oriented work.

Predesign Meeting

After notifying the selected AE, the District should forward the facility's design criteria in a manner similar to that used for conventional MCA design. In addition to the design and technical criteria and site data for the facility, the District should include guidance on the Corps systems building and performance specifying procedures and applicable regulatory guidance on two-step procurement. Also included should be a statement of the anticipated scope of work for the AE.

A predesign meeting should be arranged at the location of the facility, in a manner similar to that used for conventional MCA design; the personnel involved will also be the same. Discussions of facility design characteristics and technical criteria should be conducted as usual.

The two-step procurement method should be discussed as it applies to systems-built facilities, and the procedures and responsibilities of each participant should be identified. The performance-based nature of the procurement should be reiterated to explain the AE's development of performance criteria, the Corps request for technical proposals, the submittal and evaluation of proposals, and the bidding and contract award.

The predesign meeting may include discussions of the systems-orientation of the project, including the extent to which systems or subsystems may be used, the availability of systems products and contractors, or the extent of performance specifying likely to be used for the facility. Thus the determination described in the Design Alternatives section may be either reaffirmed or modified, as appropriate.

4. The AE's scope of work must be discussed and agreed upon during the predesign meeting. This agreement is essential for two reasons: to insure that all required tasks and activities are identified and assigned, and to serve as an accurate basis upon which the AE will develop his/her proposal.

AE's Scope of Work

The AE's scope of work for a systems-built facility consists fundamentally of the preparation of the RFTP, paralleling the preparation of the architectural construction documents in a conventional MCA design. This includes the following tasks (the contents of the RFTP, the performance specifications, and the evaluation documents are detailed in Chapters 4, 5, and 6 of this report):

1. The preparation of RFTP site drawings from Corps-provided site data.

2. The development of other site data and preparation of documentation, as required.

3. The development of the site design, as appropriate.

4. Site civil engineering, as appropriate.

5. The preparation of RFTP site design drawings.

6. The development of the design program, as appropriate.

7. The development of the architectural design, as appropriate.

8. The development of the appropriate nonsystems architectural details.

9. The preparation of the appropriate RFTP architectural drawings.

10. The preparation of RFTP performance specifications for systems work.

11. Mechanical design of heating, ventilating, and air conditioning (HVAC), plumbing, and electrical systems, as appropriate.

12. The preparation of the appropriate RFTP mechanical engineering documentation.

13. The preparation of RFTP descriptive specifications for site work, foundation work, and the appropriate nonsystems work.

14. The preparation of evaluation documents, if requested by the District.

15. Participation in the proposal evaluation, if requested by the District.

The District will also require the AE's services during the administration of the RFTP and the facility's construction. The following tasks can be included in the AE's scope of work.

1. Response to inquiries concerning the RFTP during the development of proposals.

2. Participation in a preproposal meeting.

3. Development and preparation of RFTP amendments.

4. Participation in construction administration activities similar to those used for conventional MCA design.

In the event that a systems approach is determined as being no longer feasible during the course of the AE's contract, this contingency may be discussed during the predesign meeting. An alternative scope of work may be developed for conventional 100 percent design completion.

The scope of work statement should also include the AE's obligations for the schematic, concept, prefinal, and/or final presentations required during the development of the RFTP. These reports are to include design and RFTP presentations, cost estimates, and scheduling as detailed in Chapter 4.

Negotiation and Award

Fee negotiation and the award of the AE contract should be conducted in a manner similar to that used for conventional MCA AE contracting procedures.

Scheduling

District engineering division personnel can, for the most part, construct a project schedule for a systems-oriented project in a manner similar to that used for a conventional MCA project. There are, however, certain areas that will vary in activity and necessary time allotment. Such areas are discussed below.

Product Information

A conventional MCA project usually does not require an extensive building product search by the District. However, time must be allotted for product investigation and feasibility determination (as described in Chapter 2) when considering a systems approach for a facility.

Product information should be gathered as soon as possible; i.e., before the project authorization is received. Barring any extraordinary conditions or project requirements, 2 weeks should be ample time for District engineering division personnel to perform the appropriate investigations and feasibility determination. Less complex facilities will require less investigation time. Facilities of a common building type, such as administrative, housing, or warehousing, will also require less investigation time. As the District develops resources, contacts, and expertise, required data-gathering time should be reduced further, and this decision may be made without a great deal of extraordinary effort or time.

Advertisement for AE services is the only other activity which depends on the selection of facilities for a systems approach. All other activities can be scheduled as usual.

Bidders List

If the District wishes, it can develop a bidder's list (before advertising the RFTP) as part of the building product information search.

Design and Documentation

RFTP preparation will generally require significantly less time than descriptive design, specification, and preparation of a conventional bid package. This time savings depends largely on the extent of systems use and the degree of performance specifying anticipated.

Development of a design up to the concept stage should require about the same time for either a systems-oriented or a conventional MCA facility. Development of construction documents for nonsystems work should also require the same time as that needed for conventional construction documentation. For the systems portions of the facility, however, the development of performance specifications may require only 40 to 60 percent of the time normally allotted for descriptive design, detailing, and specifying, unless an inordinate amount of research is required.

The amount of time allotted for the development of construction documents depends on the degree of performance specifying anticipated. If many major subsystems have been determined appropriate for performance specifying, the construction documentation time may be substantially less, possibly 50 percent less overall.

The RFTP will frequently be ready to advertise prior to the appropriation of construction funding for the project, sometimes 2 or 3 months. Were this to happen in a conventional design, the District would normally wait for funding appropriation to advertise the bid package. However, since Step One and Step Two will take substantially longer than a conventional bid evaluation and award, waiting to advertise would be to the District's disadvantage.

The District should take the opportunity to advertise Step One upon completion of the RFTP, even if in advance of construction fund appropriation. This is not inconsistent with DAR 7-104.91(A), since it does not obligate the Government to spend funds not yet appropriated. Rather, this action only requests design proposals, eventually to be bid, contingent upon receipt of funds for construction. This contingency must be made clear in the RFTP. Also, as an act of good faith to the construction community, the District must be reasonably certain that the project will, indeed, be funded for construction. A request for advertisement of Step One prior to appropriation of construction funds should be made, through the Division, to DAEN-ECC. The Invitation for Bids in Step Two, like a conventional IFB, must wait until after appropriation of construction funds.

Proposal Development

Proposers will require more time to develop proposals than they would to develop conventional bids. Again, this time depends on the amount of performance-oriented material contained in the RFTP, as well as the nature of the systems for which proposals are to be generated.

Usually, the Corps should require proposal submittals to be developed only up to about 20 to 25 percent design completion, as explained in Chapter 4 of this report. A portion of the proposal development time, therefore, will be spent in developing designs for the performance-specified systems to the required state of completion. When proposal development time is scheduled, the following should be considered:

The percentage of in-systems work for the project will have a significant impact on proposal development time. If a relatively low percentage of the facility work is in-systems, proposal development time should be relatively short. A greater percentage of in-systems work will mean more proposal development time. not appear onsite at the first stages of construction (as

If the District provides definitive building configurations in the RFTP, the proposer's efforts will consist of engineering a system or subsystems for that configuration. Proposal development time should be relatively short compared with conventional design development time. If the District only provides a design program, additional time must be allotted for the proposer to first generate a design.

Where most major facility subsystems will be in-systems work (such as superstructure, exterior walls, roofing/deck, etc.), a pre-engineered building systems contractor will generally require less proposal development time than would a proposer who must coordinate subsystems from various manufacturers.

If the in-systems portions of the facilities consist of only highly standardized subsystems commonly used within the building community (such as most interior subsystems), design development for the proposal may be relatively short. If, however, the in-systems portions of the facilities will require some design and detailing effort (as virtually all manufactured systems and subsystems will to some degree), then proposal development will take somewhat longer.

Proposal development time will also depend on the amount of nonstandard design, engineering, and fabrication the RFTP imposes on in-systems work. If the RFTP strictly adheres to system and subsystem design and engineering parameters, a relatively short proposal development will be required. If RFTP requirements deviate from or conflict with system and subsystem standard parameters, proposal development will require more time.

Enough time must be allotted for any performance testing the Corps requires specifically for a particular project. In most cases, however, submittal of the results of previously conducted tests should be sufficient.

If a system or subsystem proposal is to involve multiple facilities or multiple sites, enough time must be allotted for the application and required documentation for each facility.

The actual bid development time (and accompanying bid submittal documentation time) should not differ from that allowed for a conventional MCA project.

A proposal's design development should generally require substantially less time than comparable design competition in conventional MCA design. Three months should be adequate for most common MCA building types of ordinary scope (i.e., under $10 million). Larger or more complex facilities may take somewhat longer. The District's Engineering Division personnel's familiarity with the construction community should help determine the time necessary for proposal development.

Proposal Evaluation

Proposal evaluation will require significantly more time than a simple bid opening. The time required depends on the complexity of the facility, the extent of in-systems and proposer-designed work, the number of proposals submitted, and the degree of review the Corps intends to use to evaluate the proposals.

Proposal evaluation should approximate the review undertaken at the concept stage of a conventional MCA design. Chapter 4 describes the material which will comprise a proposal. The critical distinction is that proposal evaluation is not a review of design solutions, but a mechanism for the selection of a contractor, and, accordingly, must be conducted with care. The level of investigation for a proposal must be more deliberate than the review of a concept design. Evaluation, however, will be on a responsive/nonresponsive basis, eliminating the need for feedback and review commentary.

Submittals

Once a proposal has been selected and a contractor is under contract, the remaining submittals may be scheduled in a manner similar to that used for a conventional MCA project. The contractor must complete final design development and construction documentation to the 100 percent completion stage. Completion of working drawings and specifications should be done in a similar manner to conventional MCA final design development, but should require significantly less time. This is due to (1) a substantial portion of the design already being completed in the RFTP and the proposal, (2) the likelihood of extensive pre-engineering, (3) the composition of working drawings in a two-step procurement (see p 99), (4) expedient production of construction documents by the "designer" as contractor, and (5) omitting the usual final design review period. A reasonable submittal time for working drawings and specifications is 6 to 12 weeks for most common MCA building types of ordinary scope. Once again, more complex or larger facilities may require a longer time. The District's review and final approval of the construction documents should require the same time as that allowed for a conventional MCA project. If any further certifications are required from the contractor regarding the systems chosen, their submittal and review should also be scheduled in the usual manner, as should the submittals of any required shop drawings, samples, or mock-ups.

Fabrication

Some systems work may require somewhat longer lead or tool-up time than many comparable conventional items delivered to the site. However, as long as the contractor is under contract, he/she may begin ordering and purchasing, tooling up, and performing certain fabrication tasks before the final construction documents are completed. Most tasks, however, cannot begin before the construction documents receive final approval.

Most major systems or subsystems should be available for delivery to start within about 6 weeks of approval of the construction documents. This would include most modular and preengineered building systems as well as most types of structural, exterior wall, roof, deck, and interior subsystems. Any extraordinary custom design and fabricating requirements, however, will require longer fabrication time. Any other long-lead items that would occur in conventional construction, such as boilers or special mechanical equipment, should be scheduled as usual.

Fabrication time should be scheduled immediately after final approval of the construction documents. Although manufactured systems and subsystems will conventional materials may), they should be available for installation after the prerequisite site and foundation work is completed.

Construction

In most cases, construction time for a systems-oriented facility will be significantly less than that allowed for a comparable conventionally constructed facility. The time reduction depends on the extent to which systems and subsystems are used.

Where only a few subsystems are used in a facility, only modest overall time savings can be expected, although those subsystems may in themselves be quite expedient. Where several major subsystems are used in a facility, overall time savings will be greater. Pre-engineered building systems may often require less construction time than comparable buildings composed of subsystems from various manufacturers, especially with common building types such as housing or industrial buildings. Certain in-systems items may require as much as 50 percent less installation time than their conventionally constructed counterparts. Modular building systems frequently require only a fraction of the onsite, conventional construction time.

Site, utility, and foundation work should be scheduled as usual. These tasks may be performed during systems fabrication, so the systems can be installed after fabrication is completed. If time is critical, the District also has the opportunity to approve site, utility, and foundation drawings before the remainder of the construction documents are completed, if the appropriate interfaces are detailed. This is possible because the contractor is already under contract before completion of the design. Further "fast-tracking" can be accomplished, as required, which can reduce overall submittal and construction time by as much as 50 percent. Time should be allotted for all other nonsystem and finishing work, as usual.

After the AE is selected, the preliminary project schedule may be amended according to the District's and AE's agreement on in-systems scope and schedule feasibility.

Cost Estimating

In most cases, preliminary cost estimates for a systems-oriented facility can be developed in essentially the same manner as that used for a conventional MCA project. There are, however, some areas of difference. These areas depend on the extent to which systems or subsystems will be used and the degree of control the Corps intends to exercise over facility design and configuration.

Manufactured systems and subsystems will comprise a portion of the total building cost. The remainder of the cost will be attributable to conventional techniques. Furthermore, manufactured systems and subsystems rarely differ radically from their conventionally built counterparts; their distinction stems mostly from their design and production techniques, rather than their in-place characteristics.

Cost data for manufactured building systems are not readily available as such, although many subsystems do appear in conventional estimating sources under their material-oriented headings. Other sources helpful for cost estimating in a "systems" context are available, among them Dodge Construction Systems Cost and Means' Building Systems Cost Guide. Although not developed specifically for manufactured systems, these sources do offer data for larger-scale assemblies of materials and components, often comparable in configuration to the manufactured systems and subsystems. Data include budget-stage subsystem costs as well as the average percent of the total building cost a system is likely to represent in each of several building types. Frequently, however, very little is documented on certain manufactured products such as modular building systems and pre-engineered structures and building systems. In these cases, the estimator must rely on recent project experience with these systems for cost data. Systems manufacturers or manufacturers' representatives are usually able to provide cost information.

An estimate for a particular system or subsystem can be developed according to the latitude or limits on its materials or configuration determined appropriate for the particular project. Where the use of a specific material will be required for a particular subsystem, the estimator may use available data for that material-specific subsystem. Where the materials, configuration, or processes of a system or subsystem will be left to the option of the contractor, the estimator should generate an estimate typical of any likely alternative for that system or subsystem. Where it is likely the facility may be completely constructed using a pre-engineered or modular building system, and cost data on these complete systems are not readily available, an estimate can be generated based on the composite of the closest approximations to each subsystem comprising the total building system. If that building system may be any of several generic materials or types, the estimate should be typical of any likely alternative.

Where the definitive design of the facility is to be developed by the contractor, any preconcept estimates should be based on data contained in AR 415-17, per ER 415-345-42. When the AE develops a concept design typical of the designs likely to be developed by proposers, a current working estimate (CWE) can be based on that concept design according to the guidance provided in this section.

The AE can be asked to perform CWEs at various stages of the development of the RFTP. This should be included in the AE's scope of work, as appropriate.

4 DEVELOPING THE RFTP

The RFTP

The RFTP document is used by the Corps to solicit technical proposals for facility design and construction.

Context of the RFTP

In the conventional MCA design process, the District, or an AE contracted with the District, will generate construction drawings and specifications for a single specific building design. The Corps will then advertise for bids, and all bidders will compete for the construction of that one design. In a systems approach, the RFTP occupies a position similar to that of the bidding documents in the conventional MCA process. The District, or its AE, generates a design program and technical criteria, rather than a single, definitive design. This RFTP communicates the Corps building requirements to the construction industry; proposers use the RFTP to develop and bid their own design and technical solutions. Thus, a bidder's competition exists among a variety of design solutions as well as bid price.

Corps Objectives

The RFTP should provide enough guidance and detail to insure that the responding proposals will fulfill the user's needs. The RFTP, however, should avoid unnecessary restrictions to encourage broader industry participation and, thus, greater competition.

Construction Industry Considerations

In consideration of potential proposers, the RFTP should not inhibit or exclude any type of design or technical solution for a facility that can perform to the satisfaction of the user.

RFTP Format

The RFTP will be in a format similar to that used for a conventional construction document bid package; that is, the CSI 16-division format. This format provides for consistent documentation, reduces search time for proposers, and reduces the potential of errors, omissions, and conflicts.

Written Material

Written material should be in standard 8-1/2 x 11 inch format. Contract documents should be included in the appropriate Division 0 and Division 1 headings. The technical criteria should be included within the appropriate technical divisions. Any design program or supplementary tabular or written material should also be included and referenced in the drawings index (section 00850).

Graphic Material

Site drawings, architectural and detail drawings, mechanical drawings, schedules, or any drawings that may eventually be used in a proposal should be presented as full-size reproducible drawings. These drawings, however, may be included in half-size format (from which full-size reproducibles may be obtained by a proposer on request). Schematic or guide drawings usually should be in 8-1/2 x 11 inch format, unless larger size or exceptional detail is required. These drawings should be referenced in the drawings index.

RFTP Content

The RFTP has essentially two elements which comprise the construction documentation for the project: contract and technical requirements.

Contract Requirements

The construction contract for a facility using a performance-based procurement should not differ from a conventional contract to any great extent. The contracting officer should, however, review certain items with regard to their applications to systems building or an RFTP. These may include, but are not limited to, the following:

General

General information regarding performance procurement and the use of building systems should be included in section 00001.

Preproposal Information

In an RFTP, the terms "proposer" and "proposal" are used in the same way as the terms "bidder" and "bid" are used in a conventional MCA construction contract. This reference should be included in section 00010.

Special Instructions to Proposers

The following items may be reviewed for their application to an RFTP, and should be included in section 00100.

1. A description of the offeror's responsibility for interpreting the data in the RFTP.

2. An explanation of the evaluation process, evaluation factors, and basis for contract award.

3. An explanation of life-cycle costing and the life-cycle cost analysis method, if appropriate.

4. Statutory limitation on cost.

5. "Buy American" provisions.

6. Value engineering provisions.

7. Proposal errors and caution to offerors.

8. Proposal time.

9. Proposal confidentiality.

10. A description of the contractor's responsibility for the construction documents.

11. Construction on multiple sites.

12. A warning of nonconformance to all aspects of technical requirements.

Information Available to Bidders

The descriptions of existing project conditions and physical site data in an RFTP should not differ greatly from those offered in a conventional MCA bid package. These data, however, must be complete in every detail, as proposers are less likely to maintain as direct a contact with the District as is the District's AE in a conventional MCA project. This material should be included or referenced in section 00200.

Proposal Form

The appropriate proposal form, an explanation of the price presentation for the two-step procurement, and the appropriate price schedules should be included in section 00300.

General Contract Conditions

General provision material should be included in section 00700.

Supplementary Conditions

Special provision material should be included in section 00800. The following items may be reviewed for their applications to systems building or a performance-based procurement.

1. Factory labor wage rates.

2. Davis-Bacon Act.

3. Value engineering incentives.

4. Schedule and schedule reports.

5. Completion of work.

Drawings Index

An index of site drawings, architectural and detail drawings, mechanical drawings, schedules, as well as any design program, diagrams, schematic drawings, or supplementary written material should be included in section 00850.

Addenda and Modifications

Addenda and modifications to any RFTP material throughout the course of proposal development should be issued for inclusion in section 00900.

Submittals

A description of the material to be submitted with a proposal should be included in section 01300. A proposal must contain enough technical detail for the District to determine the proposal's technical adequacy and for the proposer to develop an accurate bid price. It must not, however, require such extensive preparation that its expense will discourage participation in the project. Development of a proposal up to about 20 to 25 percent design (comparable to the concept stage in conventional MCA design) should be appropriate for evaluation purposes. A specific project, however, may require more or less detail for evaluation; in such cases, District Engineering Division personnel and the AE should determine the appropriate level of detail for the submittals. Proposals should be submitted in the standard drawing format, per ER 1110-345-710. Engineering calculations and other printed material should be submitted in bound 8-1/2 x 11 inch format. Appendix B gives examples of submittals required for a proposal.

Quality Control

Quality control provisions for both in-plant and onsite work should be included in section 01400.

Other Contract Items

The remaining sections of Division 0 -- Contract Requirements, and Division 1 — General Requirements, should be used, as appropriate, for all other contract items normally used in a conventional MCA construction contract.

Design and Technical Requirements

Design and technical requirements presented in the RFTP should consist of the appropriate design program, design drawings, construction drawings, and technical specifications composed of performance and descriptive items. These requirements must be expressed in a comprehensive manner to insure that the facility's design and engineering will satisfy all the user's functional requirements.

Facility Design

Design requirements will consist of site and building design documentation. If a definitive site design is to be developed by the AE, that design documentation will be contained in the RFTP. This material will be similar to conventional site design documentation, with the possible exception of the proposed building outline. If the building plan is also to be developed by the AE, the outline should be indicated on the site plan as usual. If the building's design is to be developed by the proposer, a blank area in which the building is to be located should be indicated as the building's "footprint." Any sitework within the footprint will be the responsibility of the proposer.

If the definitive site design is to be the responsibility of the proposer, the RFTP should contain site design criteria and/or guidance drawings. This material may be similar to that provided to the AE by the District. (Any nongraphic site design program or guidance can be included as an appendix to the drawings and should be referenced in the drawings index.) Criteria should be included for, but not limited to, the following items:

1. Building placement.
2. Building orientation; solar and wind considerations.
3. Site circulation, access, service, and parking.
4. Contours and retaining walls.
5. Landscaping and landscape materials.
6. Site fixtures and accessories.
7. Drainage and run-off.
8. Pavement design.
9. Water supply layout.
10. Sanitary sewer layout.
11. Gas supply layout.
12. Electrical supply layout.

If the building design is to be developed by the AE, the documentation presented in the RFTP will be similar to conventional plans, elevations, and sections, but will differ in degree of detail. Nominal, rather than definitive, dimensions should be indicated on the drawings. Materials should not be indicated for those items which are to be performance-specified. Detailed configurations also should not be offered for performance-specified items. A degree of flexibility is essential in RFTP drawings to allow a building systems proposer to use his/her own definitive details and dimensions.

If the facility is to be designed by the proposer, the RFTP should contain a design program from which the proposer can develop definitive design and construction documents. The RFTP may consist of material contained in the AE package, such as the PDB, special design instructions, and/or design guidance drawings or any OCE or District guide specifications appropriate for inclusion in the RFTP. The design program should be referenced in the contract documents as an appendix to the drawings and should be indexed in the drawings index. Design program requirements should include, but are not limited to, the following items:

A general statement describing such items as the function of the facility and the latitude the proposer may exercise when developing his/her design solution.

A statement of objectives describing such factors as the facility's response to site conditions, psychological factors, architectural considerations, aesthetics, economic factors, energy considerations, maintenance and operating cost factors, and any other special objectives such as visual, acoustic, privacy, or security considerations.

A description of functional groups including a tabulation of all required spaces and areas (both primary functional spaces and ancillary spaces), volumetric and dimensional considerations for space configurations, proximity and adjacency requirements for functional space arrangements, and access circulation requirements.

Definitions for all the facility's critical dimensions, including requirements for stairs, landings, ramps, emergency egress, and hallways, as well as references to appropriate standards such as the American National Standards Institute (ANSI), the National Fire Protection Association (NFPA), or the Department of Defense (DOD). Such dimensional requirements as story and ceiling heights, building height or number of stories, minimum door and window sizes, minimum space dimensions, and clearance dimensions should also be defined.

Descriptions of the equipment or furnishings required in a functional space may be included in the design program if such descriptions are not otherwise appropriate in the specification equipment schedules, or if such equipment significantly impacts on the design of the facility.

Schematic line drawings, bubble diagrams, flow charts, or other graphic means of expressing design program requirements may be included in the RFTP to supplement written design guidance. Such material should not imply a definitive design solution, and its suggestive or schematic intent should be stated on the drawings. If, however, a definitive arrangement is essential to the functional requirements of the facility, the appropriate drawings should be included in the design program and their definitive nature should be indicated.

It is critical that the design requirements contained in the RFTP be presented clearly so design solutions submitted as proposals will satisfy the requirements of the user and the Corps. Once this is done, it will be easier to make sure the design conforms to the program requirements; conformance is checked during design development and verified during the District's evaluation of the proposal.

Construction Drawings

The RFTP may contain definitive detailed construction drawings similar to those used for a conventional bid package. The content of these drawings will depend on the selected building systems or subsystems and the scope of performance determined appropriate for the facility. Essentially, the RFTP will contain detailed construction drawings for any nonsystems work for which the AE will prepare definitive designs. Where performance-specified systems or subsystems are indicated, the proposer will complete the project's construction drawings by detailing his/her own solution to the performance-specified items.

Construction Specifications

Construction specifications will be contained in the RFTP in a manner similar to that used for a conventional bid package. Descriptive specifications will be included in the appropriate CSI division, broadscope, and narrowscope readings. Performance specifications for in-systems work will also be included in the specifications document. Chapter 5 of this report describes how to develop performance specifications.

RFTP Development

An RFTP is developed in essentially the same way as design and construction documents are developed for a conventional MCA facility.

Predesign Activities

The District's activities during the development of an RFTP (i.e., before design development) should not differ significantly from the activities of a conventional MCA project.

AE Package

Technical and design guidance for a facility should be gathered from the DOD Construction Criteria Manual and the appropriate Army Technical Manuals, Army Regulations, Engineer Regulations, Engineer Circulars, and Engineer Technical Letters. OCE guide specifications, OCE engineering instructions, District guide specifications, special District criteria, and the updated PDB and DD Form 1391 can also be used. The District also may include guidance on developing performance specifications, appropriate examples of performance specifications, and any regulatory data pertinent to the two-step procurement method. The AE package should contain the actual documents, not just references. Technical guidance documents should be organized as closely as possible to the format of the performance specifications. District Engineering

Division personnel should review the material in the AE package and remove redundancies and resolve inconsistencies and contradictions.

Predesign Conference

After the AE is selected, a predesign conference with the AE should be conducted in a manner similar to that used for a conventional MCA project. The review of the design and technical aspects of the project should proceed as usual.

Design Authorization

The District should receive design authorization from OCE in the usual manner. The authorization, however, may include a directive for using performance-based procurement or systems building, and may indicate the aggregation of several facilities.

Other Data

If not yet available, soil and topographical data and any other pertinent site data should be obtained for inclusion in the RFTP. Design criteria and the AE package should be updated in a manner similar to that used for a conventional MCA project.

Schematic Design

When a schematic design is appropriate, its development for a systems-oriented facility should not differ significantly from a conventional MCA project. The AE should assimilate the given design guidance, and develop a schematic design to about 10 percent design completion. The design should include schematic drawings of the site layout, building layouts, and volumetric considerations.

The AE should make a preliminary identification of in-system and out-of-system items, as well as items to be specified in descriptive or performance terms. The AE should also identify and delineate to the District any systems building parameters to which a facility's design must adhere. The AE should develop an outline performance specification and an outline of the RFTP contents.

District Engineering Division personnel should review the schematic design in a manner similar to that used for conventional schematic design review. The objective of this review is to verify that the AE's interpretation of the District's design guidance is consistent with the District's and the user's intentions and expectations. The District's review of the schematic design should examine the design solution in the context of the design parameters identified by the AE, and evaluate how those parameters may affect the facility's final design. The specification outline should be reviewed at this stage primarily for content; that is, to determine whether critical items have been omitted or nonessential items have been included.

In reviewing the schematic design, it is important that the District not impose descriptive feedback on performance-oriented items. Commentary generated in a descriptive manner should be related to the functional requirements of the facility when transmitted to the AE.

Concept Design

The AE should develop a concept design and concept RFTP according to AR 415-20. This concept development is similar to the concept design development for conventional MCA design and should be reported as such. Its differences are of a performance rather than descriptive nature. The concept presentation should address three aspects of the project: the facility design to be executed using building systems or subsystems, the contract and technical requirements to be contained in the RFTP, and the administration of the project.

Because of the nature of a performance-oriented procurement, relatively little actual definitive design can be accomplished prior to authorization of construction. For the purposes of reporting design completion percentages on the MCA status report, OCE has instructed in previous Two-Step procurements that 35 percent complete design consists of completion of preliminary site and utility design, floor layouts, preliminary cost estimate, and outline specifications.

Design -- AE Developed

If the AE is to develop a definitive design for the site and/or facility, the concept design should be submitted at 35 percent of the completed design, similar to conventional MCA design. Concept submittals may include, but are not limited to, the following items.

The area and project site plans, site utility plans, and site civil plans should be developed in a manner similar to that used for conventional MCA concept design. A record of site visits and meetings can also be submitted.

Floor plans should be developed as in conventional MCA design, but within the appropriate system and subsystem design parameters. The AE should identify those planning or dimensional parameters to which the design must adhere, and any unique features of the design attributable to the use of systems techniques. Nominal interior and exterior dimensions should be indicated, as well as the locations and sizes of doors, windows, and other openings. Vertical circulation and other plan features should be located and dimensioned. Equipment and furnishing layouts should also be indicated, as appropriate.

Building elevations and sections should detail only those features which must be prescribed. Vertical dimensions should indicate floor elevations, ceiling and roof heights, window and door head heights, window sill heights, and the location of specialty items such as rails or grills. Materials and exterior treatments should not be indicated on building elevations unless they are functional requirements of the facility. Rather, acceptable alternatives that can be accommodated with available building systems or subsystems should be indicated.

Pictorial and/or volumetric drawings of the facility may be included in the concept presentation if such representations help communicate the AE's intent for the facility's design.

Construction type or structural layouts normally should not be indicated in the concept design unless such features are functional requirements of the facility. If, however, the execution of a definitive design will vary significantly among available building systems of different construction types, these variations should be indicated in the concept presentation.

If the AE is to develop definitive designs for a facility's mechanical, electrical, and/or plumbing subsystems, they should be developed for the concept submittal. Submittals should indicate the types of subsystems selected and the appropriate justification or analysis, schematic layouts, equipment, and rough sizing in a manner similar to that used for conventional MCA concept design. In this case, the AE may continue development of these subsystem designs for inclusion in the final RFTP.

The concept stage of design development should be adequate for inclusion in the final RFTP. Therefore, further design development usually need not exceed the appropriate revisions or corrections to the concept design.

Design -- Proposer Developed

If the facility and/or site are to be designed by the proposer, the AE should develop a concept design to 35 percent design completion. In this case, the concept design suggests to the using agency and the District the design potentials of available building systems and subsystems. It should not imply a definitive design or a design that is to be executed by the proposer. The concept design should be an example of an acceptable building solution and of the type of proposal that is likely to be developed in response to the RFTP. The concept design submittals may include, but are not limited to, the following material:

A site and design analysis which includes an explanation of such considerations as site access, circulation, and service; building placement, orientation, and configuration; and relationships external to the site which could impact the design.

Area and project site plans, a site utility plan, and site civil plans are developed to the concept stage in a manner similar to that used for conventional MCA design. These plans will be examples of an acceptable site design that can be developed from the site design program to be contained in the RFTP.

Floor plans are developed in a manner similar to that used for conventional MCA concept design. Concept floor plans should display an acceptable design solution that can be developed from the design program to be contained in the RFTP as well as the type of plan solution likely to be proposed using available building systems and subsystems. The AE should identify any unique plan features that may be attributable to the use of systems building techniques. The AE should also identify any significant variation in plan configuration that may be possible with different types of building systems and subsystems. Nominal interior and exterior dimensions should be indicated on the plans as well as the locations and sizes of doors, windows, and other openings; vertical circulation; and other plan features. Any dimensional considerations attributable to systems building should also be identified. Equipment and furnishing layouts should be indicated, as appropriate.

Building elevations and sections should display aesthetic and volumetric characteristics of an acceptable design solution and of the type of proposal likely to be developed in response to the RFTP. Vertical dimensions should indicate floor elevations, ceiling and roof heights, window and door head heights, window sill heights, and the location of any specialty items such as rails or grills. Exterior treatments and materials should be indicated only to show acceptable alternatives that can be accommodated with available building systems and subsystems.

Concept

The concept RFTP should outline the contents of the final RFTP to 35 percent completion. In addition to the design documentation described above, the AE should submit an outline of the contract, specifications, and appropriate evaluation documents to be contained in the RFTP.

Contract documentation for an RFTP should not differ radically from conventional construction. The AE, in conjunction with the District contracting officer (if necessary), should identify which required clauses are unique to performance-based procurement. The AE should outline these clauses and their content for the concept submittal.

Facility technical requirements should be developed to 35 percent completion for the concept stage. The AE should first identify those elements of the facility which are to be specified in performance terms, and those which are to be specified in conventional descriptive terms. The AE should then develop an outline of the content of the specifications, as described in Chapter 5. An outline of performance specifications should display the appropriate subsystems, the performance attributes assigned to each subsystem, and a statement for each attribute describing the types of definitive criteria to be developed for that attribute. The standard Corps guidance from which these criteria were derived may also be indicated. The AE should also reference the applicable OCE guide specifications and should indicate any requirements for modifications or waivers to these standard specifications.

The concept submittal of evaluation documents is primarily for the benefit of the District personnel, since these documents will not be contained in the final RFTP. The AE should outline the evaluation documents as described in Chapter 6. This outline should display the relationships among a specification criterion, its evaluation statement, and the method by which conformance to the criterion is to be verified.

Project Administration

As part of the concept submittal, the AE should provide the District with information regarding the anticipated progress of the project. The AE should develop a cost estimate in a manner similar to that used for conventional MCA concept design. Any anticipated cost overrun should be identified at this stage in order to initiate any appropriate reprogramming of funds. If the AE is to provide a life-cycle cost analysis, it should be developed according to OCE life-cycle costing instructions and included in the concept submittal.

The AE should provide District Engineering Division personnel with an anticipated schedule for the progress of the project. Bar charts should be developed for the award of the contract and for the construction of the facility. The schedule for the contract's award may include, but need not be limited to, the following activities (as appropriate for the specific project):

1. Assembly of facility design program requirements.

2. Assembly of site and project data.

3. Industry survey and data collection.

4. Preliminary design development.

5. Performance data research.

6. All concept development and submittal activities.

7. Concept review.

8. Prebid conferences (as appropriate).

9. All activities to finalize RFTP documents.

10. RFTP review and approval.

11. RFTP advertisement.

12. Proposal and proposal receipt.

13. Proposal evaluation.

14. Approval of award recommendation.

15. Contract award.

The schedule for the facility's construction may include, but need not be limited to, the following activities (as appropriate for the specific project):

1. Contract award.

2. Development of construction documents.

3. Submittal, review, revision, and approval of construction documents.

4. Development of shop drawings (if appropriate).

5. Materials order and delivery, both in-plant and onsite.

6. Fabrication tool-up.

7. All major off-site fabrication activities.

8. Site preparation.

9. Foundation layout and excavation.

10. Foundation installation.

11. Utilities excavation.

12. Utilities installation and rough-in.

13. Component transportation.

14. All major building erection activities.

15. Mechanical subsystem installation.

16. Utilities hook-up.

17. Site paving.

18. Finish grading.

19. Building finishing.

20. Installation of site fixtures and accessories.

21. Clean-up.

22. Close-out.

The District may require additional material specific to a particular project in the concept presentation. The AE also may need to present other material at the concept stage. Such items should be clearly delineated in the AE's scope of work before the design is begun.

Concept Review

The District's review of the concept RFTP should be conducted in a manner similar to that used for conventional MCA concept review. The review panel should include representatives from the using agency, the District Engineering Division's technical sections, and, as appropriate, the Division and/or OCE.

If the concept design is to be definitive, design review should be conducted as usual. Design review should include an examination of the systems building parameters that the AE has defined for the facility, the design's adherence to those parameters, and the impact those parameters will have on a satisfactory design solution. The design review should also assess whether the available building systems and subsystems can accommodate the definitive design.

If the concept design is a suggestive design, design review should emphasize the design program to be contained in the final RFTP, and the likely translation of the program into a definitive design by a proposer. The reviewers should, in this case, maintain the performance context of the concept presentation, that is, its "suggestive" or "typical" nature. Any deficiencies in the design should be traced to the design program and its communication of the functional requirements of the facility.

The contract outline review should assess whether appropriate conditions in the contract documents which are unique to systems building or to a performance-based procurement are represented.

Performance specifications should be reviewed at the concept stage to make sure they are complete. The outline specification should be reviewed to make sure all necessary items from the AE package are included. The outline of performance attributes should be reviewed to insure that all appropriate building elements in the display of the building systems or subsystems and all appropriate functional characteristics for each subsystem are included. (The content of the performance specifications is described in Chapter 5.) The descriptive specifications should be reviewed in a manner similar to that used for conventional MCA concept review.

If the evaluation outline is included in the concept presentation, it should be reviewed to insure that specification criteria correspond to evaluation statements. This review should also consider the methods by which criteria will be evaluated and the abilities of the evaluators to execute those methods.

The review of the AE's cost estimate should be conducted in a manner similar to that used for conventional MCA concept review. Construction economy that may be realized through the use of systems building techniques should be considered when reviewing these costs.

The review of the design and construction scheduling should be conducted in a manner similar to that used for conventional MCA concept review. Scheduling considerations are described in Chapter 2.

Final RFTP Development

The RFTP will be developed to its completion in a manner similar to that used for a final design in a conventional MCA project. The only difference is in the RFTP's performance orientation versus a conventional bid packages descriptive orientation. After the concept review commentary is received, the AE will complete all design and technical requirements for the final RFTP.

After the AE has identified specific contracting considerations for systems building in the concept presentation, he/she should have no further responsibilities in developing contract documents. Finalizing the contract documents will be the responsibility of the District contracting office, collaborating with the AE (if necessary).

The AE should develop final project and site description documents in a manner similar to that used for a conventional MCA bid package. The appropriate site and utility drawings, soil and topographic data, and descriptions of other pertinent conditions should be developed to 100 percent completion.

If the AE has developed a definitive site design, site drawings should be developed to 100 percent completion, in a manner similar to that used for a conventional MCA bid package. If a facility's design is to be displayed definitively, the AE should add the appropriate revisions to the concept design and include that design in the final RFTP. If definitive mechanical, electrical, or plumbing design is also to be done by the AE, this work should be presented in the RFTP in as complete a state as practical. Final design, sizing, and detailing might not be possible until various critical or interfacing elements are completed by the proposer. Such items may include the design of the building envelope, lighting layout, or distribution network support. The AE can indicate layouts, materials, and locations of fixtures and equipment, so the proposer will be responsible for the completion of those subsystem designs.

If the proposer is to be responsible for a facility's design, the AE should develop the design program to a completed state, so the proposer can develop a definitive design. The AE may also develop schematic diagrams or other graphics to augment written descriptions of the design requirements, or may include the appropriate revised concept design drawings. The concept design drawings may be included in the final RFTP, but only as design guidance drawings. These drawings are to provide proposers with an example of acceptable plan relationships and design characteristics. Any such drawings presented in the final RFTP should be accompanied by a notice stating that the proposer is not obliged to use them and that departure from the concept design will incur no penalties as long as all elements of the design program are satisfied.

The AE should develop detailed construction drawings for descriptive nonsystem elements of the facility to 100 percent completion. Performance-specified, nondefinitive items should also be represented in the construction drawings.

Where a narrow scope of performance has been established, much of the construction documentation can be completed by the AE as usual. The occurrence of a performance-specified item may be represented by an abstract drawing, an outline without detail, or any such nondefinitive representation. The AE must, however, definitively indicate the elements with which performance-specified subsystems must interface (see Figure 4). This information will be critical to the contractor. Nondefinitive drawings must not have too much detail. Doing so may imply a prescription or detail that is not necessarily present, and may mislead a proposer. The proposer will return a set of construction documents indicating his/her subsystems, in place, in the definitive drawings provided in the RFTP.

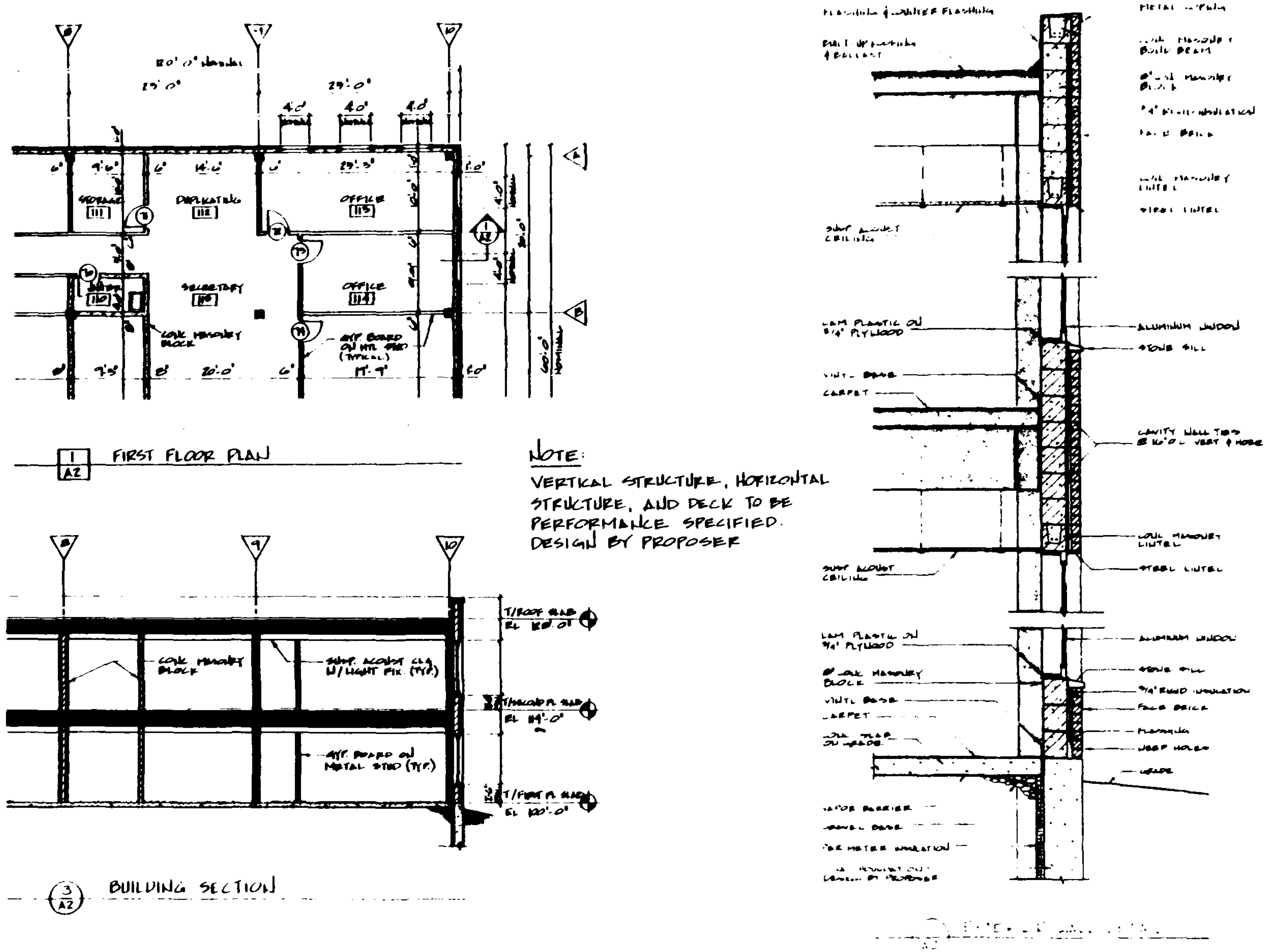


Figure 4. Examples of drawings where one subsystem is being performance-specified.

When the level of performance is broadened somewhat, several major subsystems may be performance-specified. In this case, sections and details must allow for a greater degree of contractor completion. Foundation and layout drawings also must accommodate the appropriate subsystems allowed in the performance specifications. Materials should be indicated definitively only where they are prescribed in the specifications. Where materials or configurations are contractor options, they should only be drawn as generic, nondefinitive representations. Definitive details may be drawn as usual for descriptively specified items. Details of definitively described items also should be drawn, indicating their interface with performance items. The performance-specified items, however, should be shown only in generic or nondefinitive form (see Figure 5). The proposer will return a complete set of construction drawings, indicating his/her subsystems and their interfaces with the conventionally designed elements provided in the RFTP.

A broad level of performance will allow the proposer to develop a proposal for most building subsystems, or perhaps the entire building. If the AE develops a definitive building plan, the proposer will develop all definitive construction drawings (see Figure 6). If the proposer is to develop the complete building design, the AE will provide only definitive site plans as construction documents. The proposer will then develop all construction documentation for the building.

At the broadest scope of performance, construction drawings provided to a proposer will consist only of existing site drawings. Site design and building design guidance should be communicated primarily through a design program. The proposer will develop all construction drawings for the entire project. Figure 7 is an example of a schematic design guidance drawing.

The AE should develop facility specifications to 100 percent completion. Performance items should be complete in content and criteria and final in wording and composition. The AE should present descriptive items as edited from OCE guide specifications, in a manner similar to that used for conventional MCA final design. These edited specifications should be completed to the 100 percent stage; that is, so they are ready for final typing and reproduction.

The AE should prepare a final CWE for submittal with the final RFTP. This estimate should be developed in a manner similar to that used for a conventional MCA final design estimate.

Final RFTP Review

Final review of the RFTP documents occupies a status similar to that of the final design review in conventional MCA construction. The final RFTP review insures that all contract document items are suitable for advertising. Rather than reviewing a definitive final design, the District will review the design and/or technical requirements from which a proposer will complete the definitive design.

The final RFTP review panel should include representatives from the using agency, the District, and, as appropriate, the Division and/or OCE. District

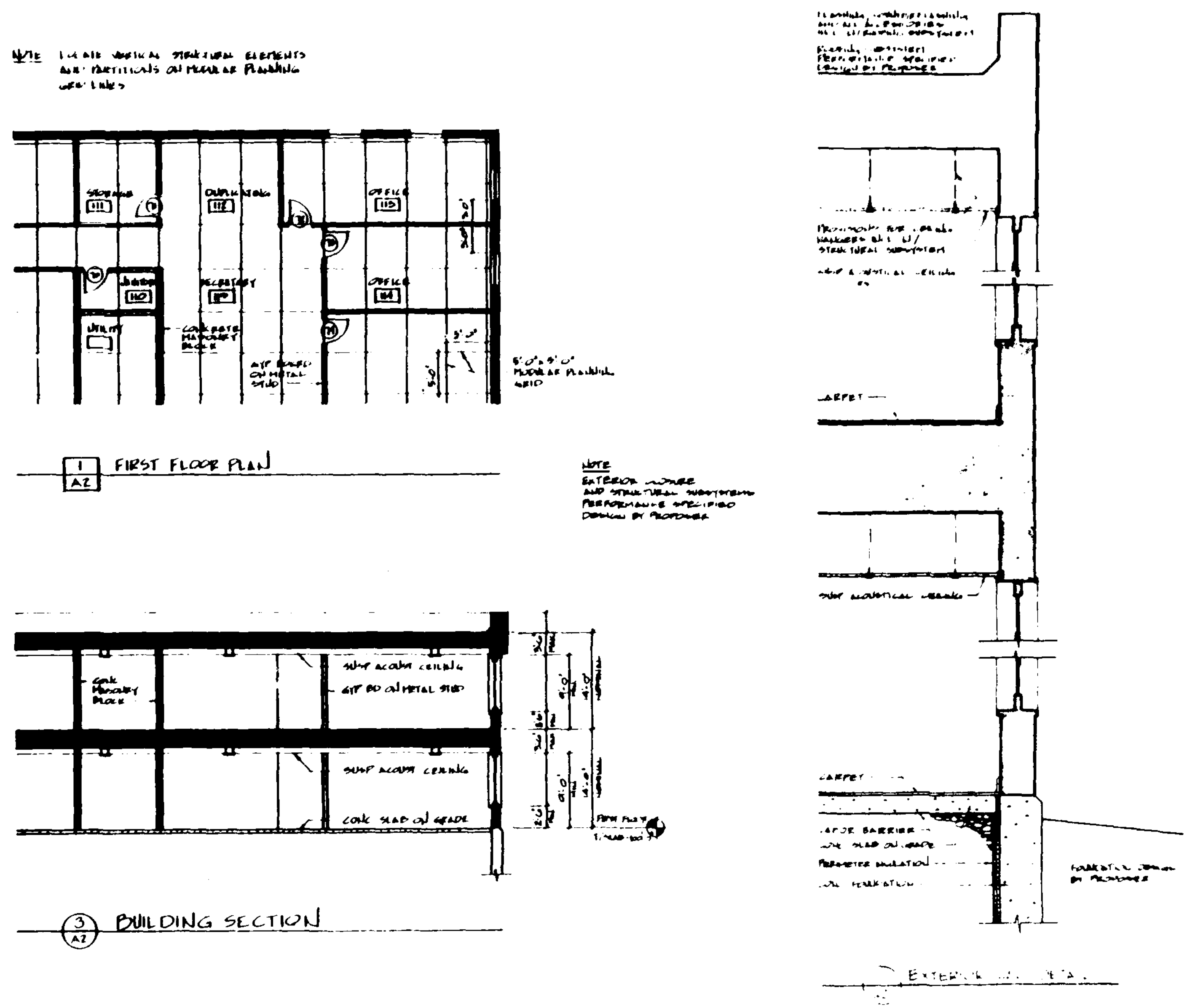


Figure 5. Examples of drawings where several subsystems are being performance-specified.

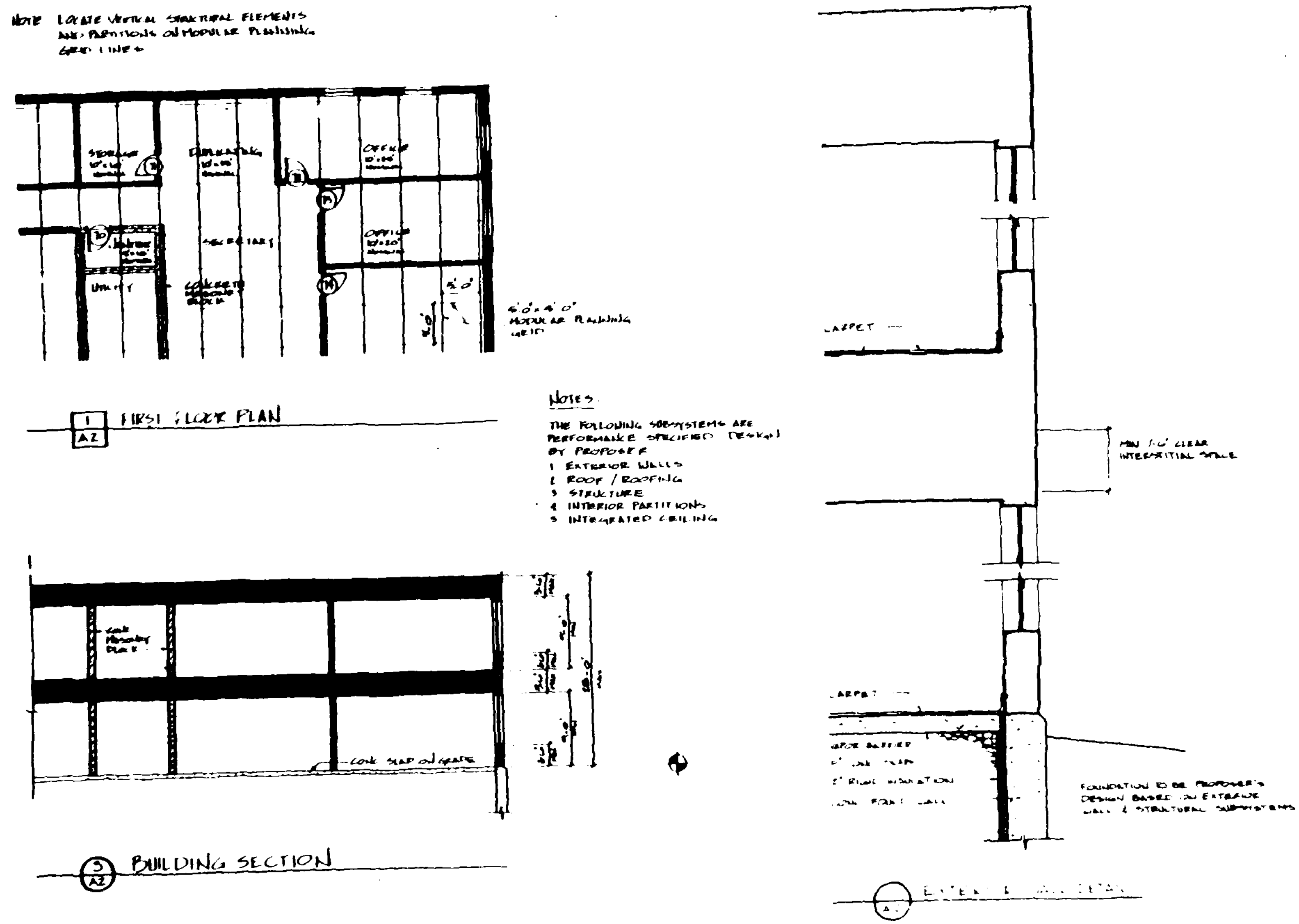
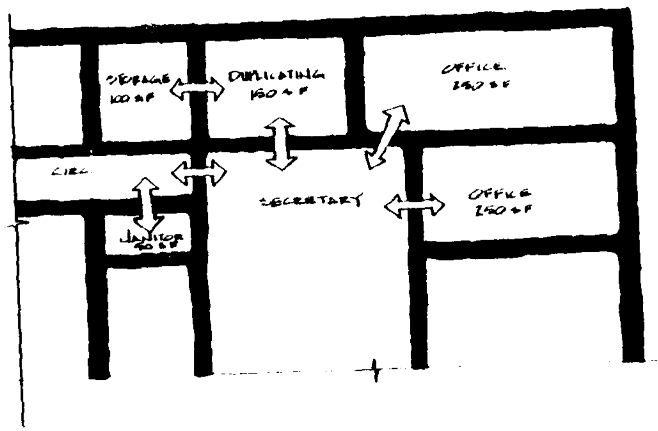
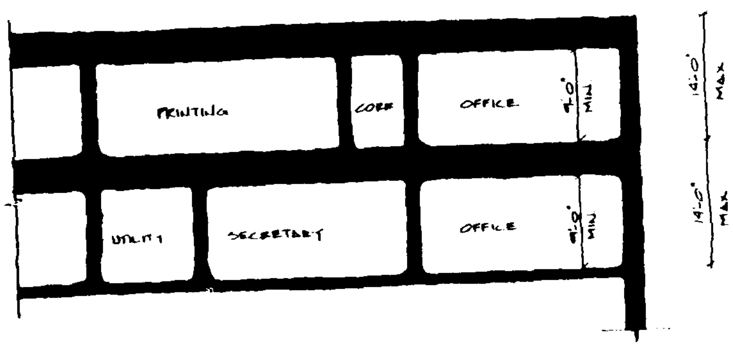


Figure 6. Examples of drawings where nearly all of a building is being performance-specified.



1/A2 RELATIONSHIP AND ADJACENCY DIAGRAM



2/A2 BUILDING SECTION

NOTES:

DESIGN STRUCTURE, EXTERIOR ENVELOP, AND IN-SYSTEMS PARTITIONS ON 4'-0" x 4'-0" OR 5'-0" x 5'-0" MODULAR GRID.

THE FOLLOWING SUBSYSTEMS ARE PERFORMANCE SPECIFIED. DESIGN BY PROPOSER.

1. EXTERIOR WALLS
2. ROOF / ROOFING
3. STRUCTURE
4. PARTITIONS
5. INTEGRATED CEILING

Figure 7. Examples of schematic design guidance drawings.

Engineering Division personnel should include representatives from the following branches or sections:

1. Sanitation.

2. Paving and grading.

3. Architectural.

4. Structural.

5. Mechanical.

6. Electrical.

7. Specifications.

The District's review of the final RFTP should be conducted in a manner similar to that used for the concept review. Definitive site design drawings and construction drawings should be reviewed to make sure they are correct and that the appropriate revisions can be implemented. Definitive mechanical, electrical, and/or plumbing design material should be reviewed in a manner similar to that used for conventional MCA final review. The design program and accompanying graphic material should be reviewed to make sure they are complete and correct. Performance specification items should be reviewed to insure that they are complete, that the specified criteria are correct, and that the referenced test methods are reasonable. Descriptive specifications should be reviewed in a manner similar to that used for conventional MCA final design review.

Constructability Review

A constructability review should be conducted on a definitive site design and other nonsystem items in a manner similar to that used for a conventional MCA constructability review, as prescribed by ER 1110-345-803. A constructability review of the building's design, engineering, and detailing, however, cannot always be done within the same context as conventional construction. This is because much of the building's design, materials, and detailing may not yet be known. A constructability review before the release of the bid documents, therefore, will assume a somewhat different context. Design aspects of the RFTP's technical requirements may be reviewed by the District Engineering Division before the bid documents are released. However, review of construction documents by the District Construction Division will be deferred until after the contract is awarded and the construction documents are completed.

RFTP Completion

The completion of the final RFTP package should occur in a manner similar to that used for the completion of a bid package in conventional MCA design.

The AE should implement any necessary revisions in the project description and site data, design drawings or guidance criteria, and prescriptive specifications or specifications. After approval, these documents should be presented ready for reproduction and inclusion in the final RFTP.

The District's Contracting Office should conduct a contract data review in a manner similar to that used for conventional MCA contract development. The applicability of general provisions should be reviewed as should any data specific to the particular project. The Contracting Office should assemble the appropriate general provisions and develop the necessary special provisions and instructions to be incorporated into the appropriate Division 0 and Division 1 formats.

During the preparation of the final RFTP, the District's Construction Division and the using agency should provide the Engineering Division with the necessary support data, in a manner simiiar to that used for a conventional MCA project. These data include the estimate of liquidated damages, phasing requirements, and construction time requirements.

The District Engineering Division will then assemble all components of the project and site description, contract documents, and facility design and technical requirements. These documents should, at this stage, be ready for distribution. Advertisement should be conducted as for a conventional MCA bid package.

5 DEVELOPING PERFORMANCE SPECIFICATIONS

Performance Specification Objectives

A comprehensive statement of performance specifications is essential to insure that a facility's design and engineering will satisfy all functional requirements. Performance specifications must:

1. Define and describe the building element to which the specification applies.

2. State applicable requirements, criteria, and performance levels.

3. Describe how performance is to be tested.

References

The CSI Manual of Practice (1980) gives an orientation to and general data for performance specifying. MP1-11, "Performance Specifications," includes general guidance for the use of performance specifications. MP2-6, "Organization and Format for Performance Specifying," provides detailed guidance for the development, formatting, and use of performance specifications. This report does not duplicate all relevant information in the Manual of Practice; District personnel and the project AE should consult the latest edition of the CSI manual when developing performance specifications for a systems-oriented building procurement.

Development of Performance Specifications

User needs are specified by listing essential properties of the system or subsystem in terms of quantitative values or limits and specific tests or evaluation procedures. Thus, performance specifications establish the ends to be achieved rather than the means of achieving those ends. The contractor may choose whatever materials, fabrication methods, and installation techniques he/she wishes, as long as it is insured that the results will satisfy user requirements.

Levels of Performance Specifying

The AE may specify a system or subsystem according to different levels of performance. Table 3 compares various degrees of performance and descriptive specification.

The level of performance to be used in a particular facility depends on the latitude the Corps and the AE are willing to allow the contractor or supplier, and on the capabilities of potential participants in the project. For most MCA systems-oriented facilities, specification in the range from level C to level F (occasionally level G), as shown in Table 3, is appropriate.

Table 3

Levels of Performance/Descriptive Specification

Level	Mixture of Performance/ Prescriptive Content	Sample Criteria	Contractor's Technical Input	Source of Components
A	Building specified according to human requirements only requiring translation into suitable design.	Office tasks without lighting harshness, attractive ceilings that absorb undesirable noise without denying sharpness of voice communication...	None until AE translates general statement to at least Level C content.	Assembled largely from project-designed components.
B	Building specified to be developed solely according to general statements of performance.	Live loads necessary for structural integrity and the safety of the occupants...capable of receiving partitions along a module grid...	None until AE translates general statement to at least Level C content.	Assembled largely from project-designed components.
C	Most major components specified as systems to be designed solely according to performance requirements.	PSF live load...capable of supporting partitions at any module line...	Contractor must have highly developed design capability.	Assembled from available components modified for project or from project-designed components.
D	Several major assemblies specified with interface required.	Key slots along building module lines to receive top rail or partitions.	Contractor must have design capability and ability to design or adapt components.	Assembled largely from available products modified for project.
E	Major assembly specified as a self-contained component.	Integrated ceiling...capable of supporting dead load + 6 psf live load...	Contractor must develop many details of assembly and interface.	Assembled largely from available products.
F	Prescriptive with overall performance criteria.	Hangers of size, spacing and attachment sufficient to support a uniform ceiling load of 7.5 psf.	Contractor proposes type, size, spacing, and attachment of hangers.	Off-the-shelf products.
G	Prescriptive with some performance criteria.	Wire hangers of size and attachment sufficient to support 60 lb each spaced 4 ft o.c. both ways.	Contractor proposes size.	Off-the-shelf products.
H	Total building described in prescriptive terms.	10-gage galvanized annealed steel-wire hangers, spaced 4 ft o.c. both ways.	No design input.	Off-the-shelf products.

The AE can retain greater control over a facility's configuration by specifying to a lower level of performance. To do this, the AE identifies a particular type of subsystem or component, for example, a steel structural frame, an integrated lighting/ceiling subsystem, or an aluminum curtain wall. Performance criteria can be tailored to that particular subsystem, with many performance characteristics intrinsic to that type of component. Thus, the proposer has an opportunity to derive a configuration, but within the constraints of the subsystem's description.

The AE can allow greater latitude in configuration, materials, and process by specifying a higher level of performance. By describing subsystems or components in broader terms (e.g., "exterior walls"), and criteria in broader terms (e.g., "thermal transmission" or "weather resistance"), the proposer may respond with any of a variety of solutions. For example, curtain wall, precast panels, or concrete masonry may all be acceptable solutions to "exterior walls."

Specification Format

Performance specifications shall conform to the CSI masterformat. Although CSI developed this format primarily for descriptive, material-oriented specification, the format can accommodate performance specifying. In this way, both performance and descriptive items are integrated into the same specification document. This reduces the chances of redundancy, omission, and conflict within the specification.

CSI 16-Division Format

Performance specifying within the 16-division format depends on the level of performance appropriate for a particular item. When performance specifying at the product or component level, the work usually can be specified within an appropriate broadscope section. But for certain components, narrowscope sections frequently will be appropriate.

When performance specifying at the integrated assembly or subsystem level (within the constraints of a prescribed material), the work usually can be specified within a material-dependent division. Broadscope sections also will be appropriate for performance-specifying certain material-prescribed subsystems.

When specifying on a higher level of performance (for example, where a constraint to one material is either not required or not appropriate), the work cannot always be specified within a material-specific division. Similarly, performance-specifying a component or a subsystem incorporating several primary materials is inappropriate within a material-dependent division. In these cases, the work must be specified within Division 13 -- Special Construction. A structural subsystem can be specified within section 13120, Preengineered Structures. Section 13020, Integrated Assemblies, is the appropriate broadscope section for performance-specifying other subsystems that are inappropriate for other material-dependent sections.

Broadscope section 13020, Integrated Assemblies, may include narrowscope sections 21 through 29, allowing up to nine subsystems to be specified within that heading. In the other divisions, broadscope headings may be used as all-inclusive (if appropriate), or may be further divided into narrowscope headings. Narrowscope section numbers and headings which are otherwise unassigned can be used for performance-specifying items inappropriate for previously designated sections. The AE may also create sections before the 100 numbers in any division.

Nonsystems work and work specified in conventional descriptive terms shall be specified within the appropriate division, broadscope, and narrowscope sections.

Table 4 shows the possible locations within the CSI 16-division format of subsystems described in this report. The format of Table 4 is an example of how the CSI 16-division format can be used to specify the appropriate level of performance and how it can be used to organize subsystems appropriate for a specific project.

CSI Three-Part Format

Each performance specification section is specified in three parts in a manner similar to that used for conventional descriptive specifying in a CSI three-part format. Descriptive specification sections are headed Part 1 — General; Part 2 -- Products; and Part 3 — Execution. Performance specification sections will be headed Part 1 — General; Part 2 — Subsystems; and Part 3 -- Execution. Each part will contain the items listed in Table 5 (as appropriate) for a particular project.

Specifying by Attribute

An attribute is a characteristic of performance to be described and defined by requirements and criteria. The performance concept requires that results rather than materials or methods be specified. The required results must be explained in clear, definitive terms, usually by describing them in terms of performance attributes.

Performance specifications are developed by applying attributes to elements of the building. Not all attributes will apply to all building subsystems, and an attribute will not necessarily apply to the same subsystem in all projects. The AE must match the appropriate attributes with the appropriate subsystems or components for each particular project.

After an attribute is associated with a particular subsystem, the desired performance of that subsystem must be defined and described as part of the performance specification. This is done by using the three essential components of a performance attribute: requirements, criteria, and tests.

A requirement is a statement of the desired end result, usually in qualitative terms. More than one requirement may be defined for an attribute.

Table 4

Performance Specifying in CSI 16-Division Format

Subsystem	*Component/Product*	*Material-Prescribed Subsystem*	*Unconstrained Component/Subsystem*
SUPER- STRUCTURE	DIVISION 3 -- CONCRETE 03400 Precast Concrete* 03500 Cementitious Deck*'**	DIVISION 3 -- CONCRETE 03400 Precast Concrete*	DIVISION 13 -- SPECIAL CONSTRUCTION 13020 Integrated Asemblies+ 13120 Preengineered Structure+
	DIVISION 5 -- METAL 05100 Structural Metal Framing* 05200 Metal Joists*,** 05300 Metal Decking* 05400 Cold Formed Metal Framing	DIVISION 5 -- METALS 05100 Structural Metal Framing 05300 Metal Decking**	
	DIVISION 6 -- WOOD AND PLASTIC 06100 Rough Carpentry* 06130 Heavy Timber Construction* 06150 Wood-Metal Systems 06170 Prefabricated Structural Wood 06500 Structural Plastic*	DIVISION 6 -- WOOD AND PLASTIC 06170 Prefabricated Structural Wood	
EXTERIOR WALLS	DIVISION 3 -- CONCRETE 03400 Precast Concrete*	DIVISION 3 -- CONCRETE 03400 Precast Concrete*	DIVISION 13 -- SPECIAL CONSTRUCTION 13020 Integrated Assemblies
	DIVISION 4 -- MASONRY 04235 Preassembled Masonry Panels	DIVISION 4 -- MASONRY 04235 Preassembled Masonry Panels	
	DIVISION 7 -- THERMAL AND *MOISTURE PROTECTION* 07400 Preformed Roofing and Siding*	DIVISION 7 -- THERMAL AND MOISTURE *PROTECTION* 07400 Preformed Roofing and Siding*	
	DIVISION 8 -- DOORS AND WINDOWS 08100 Metal Doors and Frames* 08200 Wood and Plastic Doors* 08400 Entrances and Storefronts 08500 Metal Windows* 08600 Wood and Plastic Windows* 08650 Special Windows* 08900 Glazed Curtain Walls*	DIVISION 8 -- DOORS AND WINDOWS 08900 Glazed Curtain Walls	
	DIVISION 9 -- FLOORING 09100 Metal Support Systems*	DIVISION 9 -- FINISHES 09100 Metal Support Systems**	
FLOORING	DIVISION 9 -- FLOORING 09300 Tile 09400 Terrazzo 09550 Wood Flooring 09650 Resilient Flooring 09680 Carpeting	DIVISION 9 -- FINISHES 09650 Resilient Flooring 09680 Carpeting	DIVISION 9 -- FLOORING 0900 Flooring PARTITIONS
PARTITIONS	DIVISION 3 -- CONCRETE 03400 Precast Concrete*	DIVISION 3 -- CONCRETE 03400 Precast Concrete*	DIVISION 10 -- SPECIALTIES 10150 Compartments and Cubicles* 10250 Service Wall Systems 10600 Partitions

Table 4 (Cont'd)

Subsystem	Component/Product	Material-Prescribed Subsystem	Unconstrained Component/Subsystem
PARTITIONS (CONT'D)	DIVISION 4 -- MASONRY 05235 Preassembled Masonry Panels	DIVISION 4 -- MASONRY 04235 Preassembled Masonry Panels	
	DIVISION 5 -- METALS 05400 Cold-Formed Metal Framing	DIVISION 5 -- METALS 05400 Cold-Formed Metal Framing	DIVISION 13 -- SPECIAL CONSTRUCTION 13020 Integrated Assemblies
	DIVISION 6 -- WOOD AND PLASTIC 06100 Rough Carpentry*	DIVISION 6 -- WOOD AND PLASTIC 06100 Rough Carpentry	
	DIVISION 9 -- FINISHES 09100 Metal Support Systems* 09250 Gypsum Wallboard* 09500 Acoustical Treatment*'**	DIVISION 9 -- FINISHES 09100 Metal Support Systems 09260 Gypsum Wallboard Systems	
	DIVISION 10 -- SPECIALTIES 10150 Compartments and Cubicles 10250 Service Wall Systems 10600 Partitions	DIVISION 10 -- SPECIALTIES 10150 Compartments and Cubicles 10250 Service Wall Systems 10600 Partitions*	
CEILING LIGHTING	DIVISION 9 -- FINISHES 09120 Ceiling Suspension Systems** 09150 Acoustical Ceilings 13070 Integrated Ceilings 16500 Lighting*	DIVISON 13 -- SPECIAL CONSTRUCTION 13070 Integrated Ceilings	DIVISION 13 -- SPECIAL CONSTRUCTION 13070 Integrated Ceilings
HVAC	DIVISION 15 -- MECHANICAL 15600 Power or Heat Generation* 15650 Refrigeration* 15800 Air Distribution*	DIVISION 15 -- MECHANICAL 15600 Power or Heat Generation 15650 Refrigeration 15800 Air Distribution	DIVISION 15 — MECHANICAL
PLUMBING	DIVISION 15 -- MECHANICAL 15400 Plumbing Systems* 15450 Plumbing Fixtures and Trim* 15500 Fire Protection*	DIVISION 15 -- MECHANICAL 15400 Plumbing Systems 15500 Fire Protection	DIVISION 15 -- MECHANICAL
ELECTRICAL	DIVISION 16 -- ELECTRICAL 16400 Service and Distribution* 16500 Lighting 16600 Special Systems* 16700 Communications*	DIVISION 16 — ELECTRICAL 16400 Service and Distribution 16500 Lighting 16600 Special Systems 16700 Communications	DIVISION 16 — ELECTRICAL

Notes:
- * Including any appropriate narrowscope sections.
- ** If such material constraint is appropriate or desired.
- \+ Dependent upon the scope of the component or subsystem.
- ++ Special-use partitions should be specified within the appropriate Division 13 broadscope section.
- • Including any appropriate broadscope sections.

General: The above display reflects the 1978 edition of CSI MASTERFORMAT; verify section numbers and titles with the current edition.

Table 5

Items Included in CSI Three-Part Format

00000 (MASTERFORMAT TITLE)

PART 1 -- GENERAL

Description
- Related work
- Work installed but furnished by others
- Work furnished but not installed
- System description
- Definitions

Quality Assurance
- Applicator's/erector's qualification
- System prequalification
- Testing agency
- Submittals

PART 2 -- SUBSYSTEM

Subsystem performance (the total subsystem, as an integrated unit)
- Attribute
- Specification statements (containing requirements, criteria, and tests)
- (Repeat for each appropriate attribute)

Component performance (repeat, as necessary, any distinct component inappropriate for specification under "Subsystem Performance")

- Attribute
- Specification statements (containing requirements, criteria, and tests)
- (Repeat for each appropriate attribute)

PART 3 -- EXECUTION

- Inspection
- Field quality control
- Adjustments and cleaning
- Schedules

A criterion is a definitive statement of a performance level for a particular requirement, stated in quantitative or qualitative terms. A criterion must be either measurable or observable. If a criterion cannot be quantified, its statement of required performance must be explicit enough to guarantee the required result. Several criteria may be needed to completely and accurately define a requirement.

A test is the method by which performance is verified; that is, how a building element's actual or predicted performance level is measured. Each criterion has at least one test associated with it; such tests may be recognized industry methods, calculation or engineering analyses, observations, or professional judgment. Test evaluation may require conducting the specific test or simply submitting certified results of previous testing, as appropriate.

The attributes listed in Table 6 define the requirements of the subsystem to be specified. They are grouped into four categories: safety and protection requirements, functional requirements, sensible requirements, and practical requirements.

Relevant Attributes

The AE must identify which attributes must be specified if a subsystem is to function according to the user's needs. This attribute choice depends on the judgment and expertise of the AE. However, certain groups of attributes are usually associated with particular subsystems. Figure 8 shows some relationships among attribute groupings and subsystems that were established in previous systems-oriented construction projects. This figure is an example of how attributes relevant to a particular subsystem and facility can be identified. However, the performance specification should not be considered complete until the entire attribute list has been checked. Note that the list in Table 6 may not include all attributes appropriate to a particular building subsystem. Additional attributes can be included, as appropriate for a specific project.

Attribute Requirements

For each attribute, the performance specification must include a requirement, criterion, and test statement.

An attribute requirement is a qualitative statement describing, in a broad sense, the function a subsystem is to perform with regard to the attribute being specified. It is the first statement of a subsystem's required performance level. Each requirement is further described by criteria which set definitive performance levels.

Any particular attribute may require several requirements to adequately describe the intended function of the subsystem. Similarly, each requirement may need several criterion statements to adequately define the intended performance level. All necessary criteria should be attached to a requirement before the next requirement is stated. See Appendices C and D for examples.

Table 6

Attribute List

SAFETY AND PROTECTION ATTRIBUTES

11 Fire Safety

(01) Fire Code Compliance
(02) Fire Areas
(03) Fire Barriers
(04) Egress Means
(05) Protective Devices
(06) Fire Resistance/Combustibility
(07) Fire Load/Fuel Contribution
(08) Surface Spread of Flame
(09) Flame Propagation
(10) Smoke Generation
(11) Smoke Propagation
(12) Accidential Ignition

12 Life Safety (other than fire)

(01) Physical Safety
(02) Electrical Safety
(03) Toxicity
(04) Chemical Safety
(05) Protection Against Biological Life
(06) Erection Safety

13 Property Protection

(01) Theft Security
(02) Security Against Vandalism
(03) Resistance to Misuse

14 Handicapped Considerations

(01) Handicapped Access
(02) Physically-Impaired Usage
(03) Vision-Impaired Usage
(04) Hearing-Impaired Usage

FUNCTIONAL ATTRIBUTES

21 Code Compliance

22 Strength

(01) Static Loading
(02) Live Loading
(03) Horizontal Loading
(04) Deflection
(05) Thermal Loading
(06) Structural Serviceability
(07) Seismic Loading
(08) Impact Loading
(09) Penetration Resistance
(10) Temporary Loads

23 Durability

(01) Impact Resistance
(02) Moisture Resistance
(03) Thermal Resistance
(04) Corrosion Resistance
(05) Chemical Resistance
(06) Weather Resistance
(07) Ultraviolet Resistance
(08) Surface Stability
(09) Stain Resistance
(10) Absorbency
(11) Cleanability
(12) Color Resistance
(13) Friability/Frangibility
(14) Abrasion Resistance
(15) Scratch Resistance
(16) Dimensional Stability
(17) Cohesiveness/Adhesiveness
(18) System Life

24 Transmission Characteristics

(01) Heat
(02) Light
(03) Air Infiltration
(04) Vapor Penetration
(05) Water Leakage
(06) Condensation

Note: Sound transmission is included in Attribute 32(02).

25 Waste Products and Discharge

(01) Solid Waste
(02) Liquid Waste
(03) Gaseous Waste
(04) Odor
(05) Particulate Discharge
(06) Thermal Discharge
(07) Radiation

Note: Energy radiated in the the form of sound or vibration is considered under Attribute 32(01).

26 Operational Characteristics

(01) Method of Operation
(02) Results of Operation
(03) Cycle Time/Speed of Operation

Table 6 (Cont'd)

SENSIBLE ATTRIBUTES

31 Aesthetic Properties
- (01) Arrangement
- (02) Composition
- (03) Texture
- (04) Color/Gloss
- (05) Uniformity/Variety
- (06) Compatibility

32 Acoustic Properties
- (01) Noise Generation
- (02) Noise Transmission
- (03) Reverberation

33 Illumination
- (01) Level
- (02) Color
- (03) Shadow/Glare
- (04) Reflection

34 Ventilation
- (01) Air Quality
- (02) Velocity
- (03) Distribution
- (04) Pressurization
- (05) Temperature
- (06) Moisture

35 Measurable Characteristics
- (01) Levelness
- (02) Plumbness
- (03) Dimension/Tolerance
- (04) Volume
- (05) Flatness
- (06) Shape
- (07) Weight/Density

36 Material Properties
- (01) Hardness
- (02) Ductility/Brittleness
- (03) Malleability
- (04) Resilience
- (05) Elasticity/Plasticity
- (06) Toughness
- (07) Viscosity
- (08) Creep
- (09) Friction
- (10) Thermal Expansion

Note: Reflectance is considered under Attribute 33(04)

PRACTICAL ATTRIBUTES

41 Cost
- (01) Initial Cost
- (02) Cost of Operation
- (03) Maintenance Cost
- (04) Salvage Value
- (05) Replacement Cost
- (06) Relocation Cost

42 Interface Characteristics
- (01) Fit
- (02) Attachment
- (03) Tolerance
- (04) Modularity
- (05) Rotatability
- (06) Relocatability
- (07) Erection Sequence

43 Service
- (01) Repairability
- (02) Interchangeability
- (03) Accessibility
- (04) Replaceability
- (05) Inconvenience
- (06) Extendibility
- (07) Adaptability
- (08) Replacement Sequence
- (09) Service Frequency

44 Source
- (01) Multiple Source
- (02) Guaranteed Source
- (03) Stability of Producer

45 Personnel Needs
- (01) Maintenance Personnel
- (02) Training
- (03) Labor Organization Requirements

NOTE: The numbers appearing with attributes in this table are only for reference in this report. They need not be so numbered in a performance specification.

PERFORMANCE ATTRIBUTES		SUBSYSTEM-ATTRIBUTE MATRIX	SYSTEMS							
			STRUCTURE	EXTERIOR	CEILING/LIGHTING	FLOORING	PARTITION	HEATING/COOLING	PLUMBING	ELECTRICAL
PERFORMANCE ATTRIBUTES	SAFETY	FIRE	●	●	●	●	●	●	●	●
		LIFE	●	+	+	+	+	●	+	●
		PROPERTY	+	⊕	⊕	⊕	●	⊕	⊕	⊕
		HANDICAP	+	+	+	+	+	+	+	+
	FUNCTIONAL	CODE	●	⊕	⊕	⊕	⊕	●	●	●
		STRENGTH	●	●	⊕	+	●	⊕	+	+
		DURABILITY	⊕	●	●	●	●	⊕	⊕	⊕
		TRANSMISSION	⊕	●	+	+	+	●	+	+
		WASTE MANAGEMENT	+	+	+	+	+	●	●	+
		OPERATIONAL	+	+	⊕	+	⊕	●	●	●
	SENSIBLE	ESTHETIC	+	●	●	●	●	+	+	+
		ACOUSTIC	+	+	●	+	●	●	⊕	+
		ILLUMINATION	+	+	●	+	⊕	+	+	⊕
		VENTILATION	+	⊕	+	+	+	●	+	+
		MEASURABLE	●	●	⊕	⊕	●	+	+	+
		MATERIAL	●	●	⊕	⊕	⊕	⊕	⊕	⊕
	PRACTICAL	COST	⊕	⊕	⊕	⊕	⊕	●	⊕	⊕
		INTERFACE	●	●	●	●	●	●	●	●
		SERVICE	+	⊕	●	⊕	⊕	●	⊕	●
		SOURCE	+	+	⊕	⊕	⊕	●	+	●
		PERSONNEL	+	+	⊕	+	⊕	●	+	●

LEGEND

● ATTRIBUTE OF KEY IMPORTANCE AND SPECIFICATION SHOULD BE DEVELOPED.

⊕ ATTRIBUTE OF SECONDARY IMPORTANCE AND SPECIFICATION SHOULD BE DEVELOPED.

+ ATTRIBUTE SHOULD BE CONSIDERED AS PART OF A TOTAL CHECK LIST.

Figure 8. Subsystem-attribute matrix.

Criteria Sources

After the AE has applied the appropriate attributes and defined the appropriate requirements for a subsystem, he/she must establish definitive criteria for each requirement. The AE's criteria sources will be in the AE package as described in Chapter 4. Department of Defense publications that may be used as sources from which criteria can be developed are listed in Table 7. Although these documents are usually of a descriptive nature, they can help identify appropriate performance levels. Nonmilitary sources of criteria are listed in Table 8. The AE's function in preparing a performance specification is mostly to review requirements and criteria documentation supplied in the AE package and to translate applicable criteria into a format appropriate to the performance specification.

In some cases, standard military criteria are expressed in performance terms, and they can be translated to performance criteria statements with little modification, e.g., fire safety and structural criteria. In other areas, however, the AE must develop performance criteria for which only descriptive military criteria exist. In these cases, the AE must determine the performance equivalency of the descriptive criteria and express the appropriate performance levels in the specification. For example, durability or acoustic transmission criteria must be developed by the AE where military criteria give only wall construction and finish r quirements.

Guidance for developing definitive criteria for selected performance attributes is given in Appendix F. Example requirement statements and criteria statements for selected attributes discussed in this chapter are given in Appendix C.

Test and Evaluation

The third element in part II of a performance specification is a statement of how District Engineering Division personnel will evaluate the proposal to insure it conforms to the criteria stated in the specification. This may be done during the proposal evaluation process, during construction, or during the final, post-construction acceptance procedure. In the context of the performance specification, the test and evaluation procedure includes:

1. Review of drawings.

2. Review of design calculations or computer simulation results.

3. Independent testing laboratory certification that a subsystem or component satisfies a specific American Society of Testing and Materials (ASTM) or other standard industry test.

4. Supplier c rtification that components satisfy criteria in an appropriate, legally binding format.

5. Contractor tests of prototypes or first-delivered items usually conducted in the presence of the District's representative either in the factory or onsite.

Table 7

Army Criteria Sources

Department of Defense Manuals	
DOD 4270.1-M	Construction Criteria Manual
Engineering Regulations (Corps of Engineers)	
ER 1110-6	Fire Protection and Safety
ER 1110-102	Design for the Physically Handicapped
ER 1110-1-260	Fire Protection Policy
ER 1110-345-700	Design Analysis
ER 1110-345-720	Specifications
Technical Manuals	
TM 5-618-12	Paints and Protective Coatings
TM 5-785	Engineering Weather Data
TM 5-800-1	Construction Criteria for Army Facilities
TM 5-800-2	General Criteria: Preparation of Cost Estimates
TM 5-805-3	Roof Decking
TM 5-805-4	Noise Control for Mechanical Equipment
TM 5-805-6	Caulking and Sealing
TM 5-805-7	Welding
TM 5-805-8	Builders Hardware
TM 5-805-9	Power Plant Acoustics
TM 5-805-10	Acoustical Treatment
TM 5-805-11	Movable Partitions
TM 5-805-12	X-Ray Shielding
TM 5-805-13	Raised Floor System
TM 5-805-14	Roofing Design
TM 5-807-7	Color for Building
TM 5-809-2	Concrete Structural Design for Building
TM 5-809-3	Masonry Structural Design for Building
TM 5-809-4	Structural Steel, Structural Aluminum, Steel Joints and Cold-Formed Steel for Buildings
TM 5-809-5	Wood Structural Design for Buildings
TM 5-809-8	Metal Roofing and Siding
TM 5-809-10	Seismic Design for Building
TM 5-809-11	Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes

Table 7 (Cont'd)

TM 5-810-1	Mechanical Design: Heating, Ventilating and Air Conditioning
TM 5-810-5	Plumbing
TM 5-811-1	Electrical Design: Electrical Power Supply and Distribution
TM 5-811-2	Electrical Design: Interior Electrical System
TM 5-811-3	Electrical Design: Lighting and Static Electricity Protection
TM 5-811-4	Engineering and Design: Corrosion Control
TM 5-812-1	Fire Protection: Fire Prevention
TM 5-813-5	Water Supply: Water-Distribution System
TM 5-814-1	Sanitary Engineering: Sanitary and Industrial Wastes
TM 5-814-8	Evaluation Criteria, Guide for Pollution Prevention Control and Abatement Program
TM 5-830-3	Dust Control
TM 5-840-2	Storage Facilities: Storage Depots

Engineering Manuals

EM 385-1-1	General Safety Requirements Manual
EM 1110-1-103	Design for the Physically Handicapped
EM 1110-1-2101	Working Stresses for Structural Design

Standard Designs

Refer to Standard Designs prepared for the appropriate facility types.

Engineering Technical Letters

ETL 1110-1-87	OSHA Standards
ETL 1110-3-141	Environmental Consideration in Construction Contracts
ETL 1110-3-183	Revised Seismic Design Manual
ETL 1110-3-190	DOD Construction Criteria Manual
ETL 1110-3-309	Interim Energy Budgets for New Facilities
ETL 1110-3-317	Engineering and Design, Snow Loads

Technical Bulletin

TB MED 251 Noise and Conservation of Hearing

Department of Labor/OSHA (by Reference)

16 CFR 1201 Safety Standards for Architectural Glazing Materials

Table 8

Non-Government Criteria Sources

American Conference of Governmental Hygienists

	Threshold Limit Values for Toxic Dusts, Fumes and Mists (1973)

American National Standards Institute (ANSI)

A58.1-72	Building Code Requirement for Minimum Design Loads in Buildings and Other Structures
A117.1-80	Specification for Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped
C1	National Electrical Code
C2	National Electrical Safety Code

American Society of Mechanical Engineers (ASME)

A40.8	National Standard Plumbing Code

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

	Guide and Data Book
	Handbook of Fundamentals
90.75	Energy Conservation in New Building Design

Building Officials Conference of America

	Basic Building Code

Illumination Engineers Society (IES)

	Lighting Handbook

International Conference of Building Officials (ICBO)

(UBC)	Uniform Building Code

National Fire Protection Association (NFPA)

13	Requirements for Sprinkler System
70	National Electrical Code (Same as ANSI C1)
78	Lightning Protection Code
80A	Protection of Buildings from Exterior Fire Exposure
90A	Air Conditioning and Ventilating System
90B	Warm Air Heating and Air Conditioning
101	*Life Safety Code (Same as ANSI A9.1)*
220	Noncombustible Materials
231	General Storage
256	*Fire Resistance Ratings*
258	Test Materials for Measuring Smoke

Structural Engineers Association of California (SEAOC)

(SEAOC Code)	Recommended Lateral Force Requirements and Commentation

6. Onsite inspection by the District's Construction Division representative.

A statement of the test method must be included with each criterion statement in the performance specification. Appendix C indicates the type of evaluation procedure applicable to each attribute.

Appendix E lists ASTM and other test documentation frequently used in performance specifications. For convenience, the tests in Appendix E are listed by attribute. A test may be appropriate for more than one attribute. Several tests may apply to a single attribute. The AE must identify the test most representative of a specific project's conditions. Specifications should refer to the most recent edition of each test procedure. The AE should verify the date of the latest revision with the organization that issues the test procedure.

Form of Specification

Part II of the performance specifications may be written in either explicit or implicit form. In the explicit form, requirements, criteria, and tests are specifically identified in the specification statement. In the implicit form, the specification content usually includes a statement of requirements, criteria, and test without specific identification. (Table 9 gives examples of similar specification statements in both explicit and implicit form.) There is no clear advantage or disadvantage to either form. In most cases, the implicit form is less wordy and repetitious. The explicit format often is longer and may be redundant, but the AE may find cases where a specification in the explicit form describes the required performance more accurately than the implicit form.

Table 9

Comparison of Explicit and Implicit Specification Format

The following two excerpts from performance specifications have essentially the same content, although different test methods are required. Both excerpts are concerned with the Durability Attribute for a Floor/Ceiling System.

EXPLICIT FORMAT:

Requirement
Provision should be made for a level, cleanable and aesthetically suitable finished floor wearing surface for living, dining, sleeping, and activity areas, and for corridors.

Criterion A
The floor covering shoul be dimensionally stable to the fluctuations in temperature and moisture which occur in normal service. The linear dimension change should be less than 0.024 inches per foot for Test 1 or should compare favorably with recognized floor coverings when evaluated under procedures of Test 2.

Test 1
Evaluate floor coverings using the linear dimensional stability method of 6211 of Federal Test Method Standard No. 501a.

Test 2
Evaluate floor coverings under simulated service conditions such as those specified in ASTM D 2394-68 or those required by the exposure conditions.

Criterion B
The floor covering should remain attached to substrate, the amount of sag not to exceed 1/2-inch.

Test
Adhesion test -- the bond strength of the adhesive should be tested as in Paragraph 4.4.4 of Federal Specification M-MM-A115a.

EXPLICIT FORMAT (Continued):

Criterion C
The floor covering should have a satisfactory acceptable service life of 10 years in light traffic areas and 5 years in moderate or heavy traffic areas, when recognized maintenance methods and schedules are used.

Test
Satisfaction of previously delineated criteria, analysis of performance data, and added simulations as necessary.

IMPLICIT FORMAT

Provide level, cleanable, durable, and aesthetically suitable floor wearing surfaces for bathrooms, kitchens, and laundry areas that will resist grease, water, water vapor, detergents, and normal household chemicals.

a. Linear dimension change shall not exceed 0.024 inches per foot, as determined by Method 6211 of Federal Test Method Standard No. 501a.

b. Performance shall be rated for 10 years under light traffic and for 5 years under heavy traffic when tested in accordance with Federal Specification SS-T-312a (gradual color mellowing is acceptable).

c. The bond strength of the adhesive shall not exceed a 1/2-inch sag when tested as in Paragraph 4.4.4 of Federal Specification M-MM-A-115a.

Evaluation Objectives

During proposal evaluation, proposals responsive to all RFTP requirements are identified. Because the responsive proposal with the lowest bid will be recommended for contract award, this evaluation must insure that all proposals eligible for bidding will completely satisfy the user's requirements.

Evaluation Context

Proposal evaluation does not differ radically from conventional MCA design review. Drawings, design analyses, and material specifications are reviewed to insure compliance with Corps requirements. This review should be conducted by the same professionals responsible for reviewing conventional MCA designs.

Verifying a proposal's compliance to Corps requirements is a critical step in a performance-oriented procurement. It is in the best interest of the user, the Corps, and the eventual contractor to establish a proposal's responsiveness before the construction contract is awarded. This is especially critical for any proposal using innovative or nonstandard building technology.

If a proposal's compliance with Corps requirements is not established before the contract is awarded, the Corps can only attempt to compel the contractor to comply with performance specifications during the course of the contract. This can lead to misinterpretations, conflicts, and changes. Most important, timeliness and construction quality may be compromised.

A systematic evaluation of proposals justifies the propriety of the contract's award and minimizes the risk of an award challenge; e.g., by eliminating the possibility that a losing proposer will claim the successful proposer cannot meet Corps requirements.

The Comptroller General has consistently upheld the Government's authority to base proposal evaluations on any reasonable factor. However, each requirement must be clearly stated in the RFTP; the evaluation and determination of acceptability must be entirely objective, based on the proposal's conformance to the RFTP criteria. Each proposal is evaluated against the specified criteria and <u>not</u> against other proposals. Thus, a proposal cannot be judged "more acceptable" or "less acceptable" than another. Rather, a proposal is either "acceptable" or "not acceptable" in its compliance with the provisions of the RFTP.

Competent evaluation depends largely on whether the RFTP criteria are accurate and complete. Competent evaluation also depends on whether a comprehensive procedure to determine a proposal's compliance with Corps requirements can be developed.

Corps Objective

The Corps' objective in evaluating proposals is to deliver facilities that meet all the user's specified requirements at the least cost to the Army. To do this, facility requirements in the RFTP must be accurate and comprehensive and data submitted by the proposer must be complete and detailed. The proposal's documentation can then be reviewed to verify compliance with each RFTP criterion.

Construction Industry Considerations

The Corps should inform proposers of the basis on which their proposals will be judged, so they are aware of the evaluation criteria from their first involvement in the project. A proposer may also monitor his/her proposal with regard to its evaluation throughout the proposal's development.

Evaluation Criteria Content

A proposal is evaluated against the requirements and criteria specified in the RFTP. However, it is not always easy to make a direct association between a specified performance criterion and its actual performance (as indicated by proposal documentation). Evaluation criteria should be developed so Corps personnel can readily identify a proposal's compliance with the requirements specified in the RFTP. These criteria must have the same content as the specification criteria. Evaluation criteria do not stipulate required performance, but serve only as a guide to comparing the proposed solution to the specified requirements.

Evaluation may consist of a simple "yes" or "no" response to a provision or display of a specified item or characteristic. Or it may consist of an indication of a value or degree of measure which rates the sufficiency of an item or characteristic displayed in the proposal.

Three major proposal components will be examined during the evaluation: the proposer's responsibility in financial and business matters, the proposal's technical responsiveness to the facility's requirements, and the cost of the facility. The evaluation must insure that the accepted proposal completely satisfies the specified requirements in each of these three areas.

Proposer Responsibility

Criteria for the evaluation of a proposer's financial and business responsibility will, at this stage, consist only of a "yes" or "no" response to each submittal required of the proposer in the RFTP's contract requirements. This evaluation is similar to the inspection of bid submittals in conventional MCA bid evaluation. A statement of "provided" or "not provided" should be developed for, but not limited to, the following submittals required by the RFTP.

1. Professional certification of involved personnel.

2. Bid guarantee, as appropriate.

3. Representation and certification.

4. Disclosure statement.

5. Proposal form.

6. Identification of subcontractors and consultants.

7. Small business contracting program, as applicable.

8. Minority business contracting program, as applicable.

Following the final selection of a proposal, a preaward survey will be conducted for the winning proposer, in a manner similar to that used for conventional MCA construction contracting. Thus, a proposer's capabilities in executing the contract will be adequately investigated.

Technical Responsiveness -- Site Design

If the site design is to be executed by the proposer, evaluation criteria should be included for the following items, as they are presented in the site design criteria specified in the RFTP.

1. Building placement. Includes use of the site, relation to features external to the site, approaches, views, and aesthetics.

2. Building orientation. Includes solar exposure, wind exposure, topographical relation, views and vistas, and aesthetics.

3. Site circulation. Includes vehicular and pedestrian flow, conflicts, safety, circulation identity and image, traffic capacity, parking capacity, parking arrangement, building access, and building service.

4. Site grading. Includes use of topography, aesthetics, and drainage.

5. Landscape. Includes use of existing materials, microclimate effects, aesthetics, material hardiness, maintenance, and erosion control.

6. Site fixtures. Includes placement, function, aesthetics, and scale.

7. Other. Includes miscellaneous site design features, as specified.

Site civil items will be evaluated only to make sure they conform to prescriptive site specifications. Evaluation criteria should be included for the following items, as appropriate for the site specifications of the RFTP.

1. Pavement design. Includes materials and structural design.

2. Storm drainage. Includes drainage courses, capacity, and disposition.

3. Water supply. Includes layout, materials, capacity, and fixtures.

4. Electrical supply. Includes layout, materials, equipment, and capacity.

5. Gas supply. Includes layout, materials, and capacity.

6. Sanitary sewer. Includes layout, materials, grade, capacity, and equipment.

7. Other. Includes miscellaneous site civil items, as specified.

Technical Responsiveness -- Architectural Design

If a building's design is to be executed by the proposer, evaluation criteria should duplicate each item of the RFTP design program. Because these items are rated as either "conforming" or "nonconforming," it is critical that every user-required characteristic be completely and accurately documented, that conformance to design criteria will insure satisfactory design, and that only those proposals that completely satisfy the specified criteria are accepted. Criteria should be included for the following items, as presented in the design program of RFTP.

1. External orientation. Includes relation to surrounding buildings, spaces, and activities.

2. Functional spaces and areas. Includes functional groups and square footages.

3. Furnishings and equipment. Includes layout and clearance dimensions.

4. Adjacencies and proximities. Includes distance, access, and visual and audio relations.

5. Circulation. Includes distance, flow, conflict, origin, and destination.

6. Access. Includes emergency ingress and egress, distance, and personnel population.

7. Critical dimensions. Includes stairs, landings, ramps, hallways, window and door dimensions, story height, number of stories, and building and ceiling heights.

8. Interior volumes and spaces. Includes function and use.

9. Exterior volumes. Includes arrangement, composition, massing, shape, scale, context, and aesthetics.

10. Exterior treatment. Includes materials, compatibility, texture, color, design image, and aesthetics.

11. Interior finishes. Includes texture, color, function, maintenance, and aesthetics.

12. Other. Includes miscellaneous architectural design features, as specified.

Technical Responsiveness -- Building Construction

An evaluation criterion should be developed for each performance criterion specified in the RFTP. Chapter 5 of this report gives the attributes (and their respective criteria) used in performance specifications and the test methods used to measure an attribute's conformance to the criteria. Evaluation of each descriptive item of the specification should indicate "conformance" or "nonconformance" to the specification, as in conventional MCA design review.

Costs

As the use of one-step procurement is currently restricted to Turnkey Family Housing, cost evaluation criteria for a performance-based MCA procurement can consist only of a proposer's bid. Technically responsive proposals are evaluated on the basis of low cost alone.

A facility's cost has several components. ETL-1110-3-296 requires that both life-cycle costs and initial construction price be considered in the development of MCA facilities. As a minimum, life-cycle costs consist of the following items: (1) initial investment, (2) operating costs, (3) maintenance costs, (4) custodial costs, (5) repair costs, and (6) replacement costs.

Other life-cycle costs may include, but should not be limited to, the following items (as appropriate for a particular facility): (1) the cost of money, (2) operational training costs, (3) documentation costs, (4) design and redesign costs, (5) remodeling and space modification costs, (6) downtime, (7) functional use costs, and (8) beneficial income such as salvage or the sale of byproducts.

Evaluation Criteria Development

As each contract paragraph, design requirement, and specified section is written, a corresponding evaluation criterion should be composed. This concurrent development serves two purposes: it insures that all contractual design and technical criteria will be examined during evaluation, and that each specified criterion can be verified when the proposal is evaluated.

Evaluation criteria may be developed either by the AE or by District Engineering Division personnel, but the District's Engineering Division may find it more convenient to include the development of evaluation criteria in the AE's scope of work.

Criteria Development -- Proposer Responsibility

Evaluation criteria for proposer responsibility should be developed in a manner similar to that used for conventional MCA contracting. The criteria should be designed so the evaluation team can respond "yes" or "no" to statements about the proposer's fulfillment of specified conditions, or provision of specified data. The District Contracting Officer can help the AE or District Engineering Division personnel identify the appropriate conditions or submittals required of the proposer.

Criteria Development -- Technical Responsiveness

Technical evaluation criteria will consist of statements which correspond to each design and technical criterion specified in the RFTP. Each statement should have three basic elements:

1. A description of the criteria specified in the RFTP.

2. The proposal's response to the specified criterion.

3. A statement of whether the proposal has satisfied the specified criterion.

The evaluator also must consider the following information (either explicitly or by reference) in evaluation criteria statements:

1. The attribute under evaluation.

2. The characteristic, value, or measure specified in the RFTP.

3. The submittals or documentation required by the RFTP.

4. Whether the proposer has provided the required submittals.

5. Whether the attribute in question can clearly be identified in the proposal.

6. The characteristic, value, or measure provided in the proposal.

7. Wnether the proposal's quantification or units of measure are consistent with the specified criterion.

8. Whether the proposer's method of verification is technically valid.

9. Whether the proposal does or does not satisfy the specified criterion.

The criteria format given above applies to descriptive specification items and performance criteria. Conformance to descriptive items can, therefore, be verified in a manner similar to that used for conventional MCA design review (see Appendix G for an example).

Cost Criteria

As with conventional formal advertising, contract award is based simply on the lowest responsive bid. In a two-step procurement, however, the bid cost may include both initial and life-cycle cost considerations.

Initial Cost

A proposer's bid may be broken down into several elements, as appropriate, for a specific project's contract and bid requirements. This breakdown may include in-plant costs, site work costs, or transportation costs, in addition to total construction costs. The cost evaluation criterion for initial cost will consist only of lowest initial cost.

Life-Cycle Costs

ETL 1110-3-296[1] requires that both initial construction costs and life-cycle costs be considered during development of an MCA facility design. Unlike conventional design, however, the Corps does not exercise control over all details of the design in a performance-based procurement. Thus, the first opportunity for the Corps to assess life-cycle economy is at the proposal evaluation stage.

Life-cycle cost considerations can be reflected in a performance-oriented building procurement in either of two ways: through performance criteria, or through analysis of proposals' life-cycle economies. By establishing performance criteria to reflect life-cycle considerations, a responsive proposal will meet the minimum life-cycle economies acceptable to the District. By directly analyzing proposals' life-cycle performances, the District can optimize life-cycle and construction economies.

1. Performance criteria: considerations for life-cycle economy can be incorporated directly into performance criteria. An example would be specifying a maximum energy budget for the facility, such as "...maximum 60,000 Btu/sq ft gross floor area/year for heating and cooling...". A proposal meeting this requirement would, therefore, meet the minimum life-cycle economies acceptable to the ps. Conformance would be evaluated in the same way as other performance criteria.

The primary advantages of this method lie in its simplicity and objectivity. A proposal either does or does not meet the minimum criteria. Evaluation is straightforward, since energy-use analysis is a fairly well understood exercise. Contract award is still based on low responsive bid.

The greatest disadvantage to this method, however, is that there is no incentive to improve on the minimum life-cycle performance. Life-cycle economies are sacrificed for low initial construction cost. A proposer cannot improve energy efficiency at the expense of a higher construction cost, since contract award is based on low construction cost alone.

[1] Economic Studies, ETL 1110-3-296 (Office of the Chief of Engineers, 1978).

In order to be used effectively, the following steps must be taken:

a. The criteria presented must be measurable and reasonable and relate to the function being measured.

b. The method of analysis must be identified in the RFTP. The proposer must be informed as to exactly how his/her proposal is to be analyzed. If an automated simulation is to be used (such as CERL-BLAST), that must be stated. If a manual procedure is to be used, that procedure must be delineated. Such explanation is necessary not only for the proposer's benefit, but also for the District's protection by establishing the validity and credibility of the analysis prior to bid opening.

c. Responsibility for executing the analysis must be defined -- whether the proposer is to conduct the analysis at his/her own expense, or whether the District is to conduct the analysis.

d. All data and information necessary to conduct the analysis must be identified in Required Submittals. The District can request the proposer to tabulate data or present information in a format directly applicable to the analysis method.

e. The analysis must be conducted in a valid and competent manner to avoid inaccurate results misrepresentative of a proposal's actual life-cycle performance.

2. Analysis of life-cycle cost: Life-cycle costs can be included directly in the award mechanism as a component of bid price; the total bid price consists of construction cost plus life-cycle cost. Life-cycle cost for energy use would be identified by establishing an appropriate period of time, calculating energy use for the prescribed time, and assigning appropriate unit costs for the fuels used in the proposals.

The primary advantage of this method is that it provides an incentive to the proposer to improve upon minimum life-cycle efficiencies without necessarily risking competitiveness in the procurement. It provides the opportunity to optimize initial and life-cycle cost trade-offs rather than meet minimums alone, thus providing better overall value to the Army. This method maintains objectivity by relying on calculated values and costs. Energy use analysis should be straightforward. Contract award is still based on low cost.

The greatest disadvantage of this method is that it is a new tech[illegible] without extensive precedent or experience. Thus, it may imply [illegible] to the District. Proposers may also find it harder to judge their [illegible]tiveness in a procurement. Introducing another variable int[illegible] development also introduces an additional element of uncertai[illegible]

In order for this method to be used effectively, [illegible] should be taken:

a. The District's legal counsel should be [illegible] concurrence should be obtained [illegible] that level.

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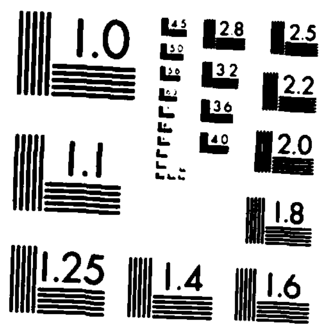

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

b. The District can specify absolute minimum life-cycle performance, below which a proposal can be judged non-responsive (for example "...but in no case shall exceed 65,000 Btu/sq ft gross floor area/year for heating and cooling..."). Such a specification prevents life-cycle economies from being sacrificed for unreasonably low initial cost.

c. The method of analysis must be identified in the RFTP. The proposer must be informed about exactly how his/her proposal is to be analyzed. This information must also include fuel unit prices and the time frame to which the analysis applies. If an automated simulation is to be used (such as CERL-BLAST), that must be stated. If a manual procedure is to be used, that procedure must be delineated. Such explanation is necessary not only for the proposer's benefit, but for the District's protection by establishing the validity and credibility of the analysis prior to bid opening.

d. The time for which the analysis is to apply must be established. The time need not represent the entire life of the facility, but should be long enough to clearly differentiate life-cycle economies and initial construction cost. Furthermore, selecting a shorter time span will achieve more realistic results, since current fuel unit prices will be more representative over a shorter period of time.

e. Fuel unit prices must be assigned. It is essential that the price difference between fuel types is accurately represented, since different proposals are likely to use different fuels. Inaccuracies could misrepresent relative life-cycle energy economies, and thus distort the bid price.

f. Responsibility for executing the analysis must be defined -- whether the proposer is to conduct the analysis at his/her own expense, or whether the District is to conduct the analysis.

g. All data and information necessary to conduct the analysis must be identified in Required Submittals. The District can request the proposer to tabulate data or present information in a format directly applicable to the analysis method.

h. The analysis must be conducted in a valid and competent manner to avoid inaccurate results misrepresentative of a proposal's actual life-cycle performance.

Evaluation Procedure

Proposal evaluations should be conducted in a manner similar to that used for the design reviews conducted for a conventional MCA project. The performance-based evaluation differs only in the number of designs to be reviewed and their degree of completion.

The level of detail to which proposals are subjected during evaluation will depend on a number of factors, including how complex the facility is, how familiar the reviewers are with the systems or subsystems proposed, and the District's time and manpower resources. The District, however, must establish that a proposal complies with all requirements spe^ified in the RFTP to insure that the user's requirements are satisfied; to expedite construction administration by avoiding conflicts, changes, and delays; to substantiate the basis for contract award; and to minimize the risk of award challenge.

Receipt of Proposals

In a two-step building procurement, the District will receive technical proposals without a bid price attached. Therefore, the proposals do not have to be sealed. However, the content of each proposal must remain confidential at least until the award of the contract. Since submitted proposals will be both bound printed material and drawings, care should be exercised not to separate proposal material. Receipt of a proposal's submittals should be recorded as soon as they are delivered to the District Engineering Division. If a portion of a proposal appears not to have been delivered, the proposer should be notified.

If the District's policy is to conceal the proposer's identity, title blocks and other identifications should be obscured by personnel not involved in the evaluation. All proposals should be keyed for identification after the evaluation.

Evaluation Personnel

The evaluation team may differ with each specific project. Generally, the evaluation team should have enough personnel to guarantee that all requirement, design, and technical aspects of the facility will be examined in a comprehensive, accurate, and timely manner. But, there should not be so many evaluators (or evaluators from such diverse positions) as to generate unwarranted debate, conflict, or delay in completing the proposal evaluation or in reaching a decision on the responsiveness of the proposal.

At a minimum, the evaluation team should have representatives from the using agency and technical and contracting personnel from the District. The AE who developed the requirements of the RFTP, and is thus able to judge conformance to those requirements, should also be invited to participate in the evaluation. It may also be appropriate to include representatives from OCE, the Major Command (MACOM), and the Division on the evaluation team, especially if policy guidance will be needed on a specific project.

The District's technical personnel should include representatives from each discipline in which the proposals will be involved. These may include: (1) the sanitation or site utility section (as appropriate), (2) the paving and grading section (as appropriate), (3) the architectural section, (4) the structural section, (5) the mechanical section, (6) the electrical section, (7) the specifications section, and (8) the constructability review section.

The District contracting personnel seated on the evaluation team should have the authority to disqualify a proposal which fails to meet the specified contractual requirements. The representatives from the using agency must be thoroughly familiar with the functional requirements of the proposed facility. They must also be able to recognize whether the requirements are satisfied by examining the design and technical drawings of the proposal. Personnel from the installation's FE and/or master planning offices may be able to help in this review.

Evaluation team selection should begin during RFTP development. Considerations should include the administrative responsibilities and authority of each member, as well as technical competence. In addition to an overall knowledge of design and construction, members should be familiar with systems building products, factory fabrication, procurement, and delivery. Final commitments from all evaluation team members should be made as soon as possible after the advertisement of the RFTP, so the members can follow the progress of the proposal development. The District's project manager for the facility may be responsible for arranging the evaluation team selection.

Evaluation Steps

Step one of the evaluation process verifies or denies a proposal's technical responsiveness to the project's requirements. Those proposals judged as "not responsive" are dropped from further consideration. Step two of the evaluation process is an IFB to those proposers judged responsive. Proposers bid their own proposals, and the responsive proposal with the lowest bid is recommended for contract award.

Preevaluation Meeting

The District may arrange a brief meeting of evaluation team members before evaluating the proposals. The objectives of this meeting are:

1. To familiarize members with the specific characteristics of the project and its requirements.

2. To familiarize the members with the method of evaluation.

3. To review the evaluation documents and clarify any uncertainties about their relation to the specified requirements or the proposal submittals.

4. To select an approach or strategy for the evaluation.

5. To encourage a comprehensive, accurate, fair, and expedient proposal evaluation.

Evaluation Approach

Either of two approaches may be used for the proposal evaluation: evaluation by the team, or distribution by tasks.

The team approach enables all aspects of the proposal to be discussed. Members who are experts in one technical area may also be better able to judge the impact of their particular area on other building subsystems, and vice versa. However, some areas of evaluation could take longer than others, thus incapacitating the entire team.

The task distribution approach assigns specific technical areas to individual team members. Members may work independently and spend only the time necessary to evaluate their assignment areas. Communication should still be maintained among team members to insure that no building item's design impacts adversely on other elements.

Technical Evaluation

For each evaluation criterion, the following procedure should be applied.

1. Identify the criterion specified in the RFTP. It may be either a descriptive statement or a performance criterion and will give a characteristic, value, or measure to be provided in the proposal.

2. Identify the RFTP-required submittals for the proposal. These may include proposal drawings, engineering analyses, test results, specifications, or manufacturers' literature.

3. Verify that the proposer has submitted all required documentation. If not, the proposal can be ruled nonresponsive to the criterion.

4. Study the proposal documentation for all applicable characteristics.

5. Identify the characteristic, value, or measure of the attribute for all occurrences in the proposal. If any fail to satisfy the specified criterion, the proposal can be ruled nonresponsive to the criterion.

6. Verify the validity or accuracy of the characteristic, value, or measure presented in the proposal by making a qualitative observation of graphic or written material, certifying test results, reviewing and approving engineering analyses, or inspecting specifications or manufacturers' data. If any supporting data are faulty in technical logic or method, the proposal can be ruled nonresponsive to the criterion.

7. Record the conformance or the nonconformance of the proposal to the criterion.

Judgment of Proposal Responsiveness

After the proposal's evaluation is complete and a decision made as to its conformance to each specification criterion, the proposal should be rated as "responsive," "conditional," or "nonresponsive." A "responsive" rating means that the proposal conforms to each criterion in the RFTP and is eligible for bidding in step two. A "conditional" rating means the proposal requires only minor modifications to make it "responsive." Proposals requiring extensive modifications to conform to the criteria in the RFTP should be rated "nonresponsive" and will not be eligible to bid in step two.

The District may also allow conditional proposals that have been made acceptable to participate in bidding, especially when decreased competition will be disadvantageous to the Corps. The distinction between "conditional" and "non-responsive" must be clear and equitable to avoid any inference of favoritism to one proposer and not another.

In this case, the evaluation team must prepare a statement for each such proposer, describing the proposal's deficiencies. These descriptions, however, must not prescribe any corrective measures; that is the responsibility of the proposer. The District may require whatever submittals are necessary to verify compliance with the RFTP. Submittals may be a simple written statement indicating use of a different material that will be satisfactory, or may be a redesign of a major building component accompanied with new specifications. These submittals will become part of the proposal and will be binding as such.

Bidding and Award

The second step of a two-step procurement is the bidding of proposals. The District will issue an IFB to proposers whose proposals have been judged responsive and, if appropriate, to proposers whose conditional proposals have been judged responsive. The bidding process should be conducted in the same manner as a conventional MCA project. The lowest cost proposal must be recommended for contract award.

If life-cycle cost is not included directly in the bid, bidding and award will be conducted in the same manner as a conventional MCA project. Contract award is based on lowest construction cost.

If life-cycle costs are included directly in the bid as a component of bid price, contract award will be based on the lowest overall cost of construction and life-cycle costs. The contract award amount, however, will be the construction cost component of the bid.

7 CONSTRUCTION ADMINISTRATION

Construction Administration Objectives

The objectives of the Corps and industry during administration of a performance-based construction contract are the same as those of conventional construction contracts. All parties want the project to be completed as swiftly and smoothly as possible.

Corps Objectives

As in conventional construction, the Corps objectives during construction administration should include the following:

Eliminate delays. Work should be sequenced (in detail) to eliminate unnecessary delays. This is particularly important when using systems or subsystems because of the speed of erection and the lead time required for factory fabrication.

Comply with specifications. Since some final details are not completed until after contract award, the final design must comply with the facility's program needs. To verify compliance, final construction documents should be reviewed by District Engineering Division personnel.

Maintain proposed quality. Once the proposal shows the method of construction, the District Construction Division must verify that the proposed level of quality is maintained throughout the construction process.

Minimize changes and extra costs. Since the contractor, not the AE, prepares final documentation, one source of change orders is eliminated. If errors do occur, their cost cannot be passed on to the Corps.

Industry Considerations

Many of the Corps objectives in administering a project are also in the best interest of the systems building industry. Specifically, some of industry's needs are:

Payment. Payment for completed work as well as for materials stored on or off the site is important because systems-oriented projects often involve a significant amount of work before delivery to the building site. Thus, systems contractors often must be paid before the system's installation.

Quick processing of submittals. Because the contractor develops many documents after the project is started and because lead times are sometimes greater, submittals must be quickly approved to prevent scheduling delays.

Minimize design changes by the user. Once construction is started, it is very hard and costly to make changes. Generally, schedules must then be altered, which can add to the contractor's cost.

Final Design

After a contract has been awarded, further design development is required and the construction documents must be completed. For most systems-oriented, two-step projects, a substantial portion of the design process occurs during RFTP and proposal development -- up to 50 percent or more. The balance of the design work will be to develop construction documents to coordinate various subsystems and products.

Construction Documents

The construction documents used in a two-step procurement are similar to those used in a conventional MCA project. The contractor must complete working drawings and specifications, and submit them to the District for approval before construction, or a phase of construction, can commence. During the course of construction, the contractor must also submit the appropriate shop drawings for details and characteristics of certain items not appropriate for the working drawings.

Working drawings and specifications hold a somewhat different purpose in a two-step process. In a conventional bidding situation, construction drawings and specifications must be developed in sufficient detail for a contractor to develop a bid. However, since the contractor in a two-step process is already under contract, such detail is no longer necessary. The purpose of working drawings and specifications in a two-step process, therefore, is to (1) enable the contractor, for his/her own purposes, to complete those details not fully developed in the proposal, and (2) exhibit to the Corps the definitive configuration of the design and details. Also, unlike a conventional bidding situation, the contractor will be familiar with many proprietary products and components selected for the proposal, so detail on the working drawings is not necessary. The District, therefore, should not require the level of detail in working drawings for a two-step procurement that it might expect if prepared for a conventional bid package. This will expedite the drawings' production and approval, and therefore, the commencement of construction. Requirements for working drawings and submittals must be expressed in the RFTP, section 01300 - submittals.

Shop drawings should be required of the contractor in a similar manner to a conventional MCA project. Shop drawings may also be required for those details not fully developed in the working drawings, as explained above. Requirements for shop drawings and submittals must be expressed in the RFTP, section 01300 - Submittals.

When developing final construction documents, the contractor is obliged to adhere to his/her proposal and to all performance, descriptive, and graphic criteria contained in the RFTP, as would an AE developing a conventional MCA design. Final approval of the construction documents is subject to a final review. If any further engineering analysis, calculation, performance testing certification, or product samples are required in addition to those submitted with the proposal, they should be submitted as part of the final design.

The contractor should report any unexpected conditions and request product substitutions in a manner similar to that used for conventional MCA design. If the contractor asks to deviate from any criterion contained in the

RFTP, the request should be reviewed as a waiver or variance to a provision in the contract documents and should be approved by the Contracting Officer or his/her representative. The contractor usually will not have to submit a value engineering proposal on his/her own design or in-systems work, but may do so on any descriptive material furnished in the RFTP, especially where a subsystem interface is involved. Value engineering proposals should be reviewed by District Construction Division personnel in a manner similar to that used for a conventional MCA project.

Final design review and approval of the contractor's construction documents should be conducted in a manner similar to that used for a conventional MCA design. District Engineering Division personnel should examine the drawings and specifications, the engineering analyses, calculations, performance certifications, and product samples to insure that all criteria are met.

Once the construction documents have been approved, the contractor is obliged to adhere to them in all construction operations. The District Construction Division should enforce these documents as they would for a conventional MCA project. Any changes should be handled by the District Contracting Officer or his/her representative.

Scheduling

Conventional management techniques such as the Critical Path Method and the Program Evaluation Review Technique should be used to schedule construction. The major difference in systems-oriented construction occurs not in scheduling, but in maintaining the schedule. Since longer lead times may be anticipated when a large percentage of the work is factory preassembled, scheduling becomes critical. Delays that can be corrected in conventional construction are often difficult to overcome when using systems or subsystems. Generally, as the scope of factory assembly increases, the ability to adjust the schedule decreases. In most cases, when a noncritical subsystem or component is delayed, adjustments can be made in the schedule to minimize the impact of the delay, often by shifting crews to other work. But, as the in-systems work gets more complex, fewer schedule adjustment options are left to the contractor. For example, if the systems are as complex as complete volumetric units, the contractors may be limited to a very small amount of conventional work, e.g., site work, foundations, and utilities. For the most part, such work is completed before the system or subsystem units are shipped. Certain finish work and landscaping that could be done in a conventional project may not always be completed until the volumetric units arrive and are set into place.

Construction Phasing

The two-step procurement process offers the District the opportunity to reduce overall construction time by phasing construction documentation with certain construction activities. All work need not be delayed until completion of the final architectural details or finish schedules.

If definitive site drawings and specifications are included in the RFTP, the contractor should be permitted to start site work upon award of the contract, similar to a conventional MCA project. Working drawings and final engineering analyses can be completed while site work is in progress. If the contractor is to complete the definitive site design, site work should commence upon completion and approval of site drawings and specifications.

Similarly, other phases of construction may commence upon completion and approval of their construction documents, while documents for subsequent stages are still being developed. Foundation and structural work may start during development of architectural drawings, architectural work may start during development of mechanical drawings, and so forth.

Phasing construction in this way should not create any additional complications or risks for the District. Unlike a true Construction Management process, with which phased construction (or "fast-tracking") is commonly associated, all responsibilities for coordinating work in-design with work in-place still rests with the single prime contractor. He/she is still obliged to deliver a completed facility adhering to the proposal and all provisions of the RFTP.

Construction phasing requirements or opportunities must be expressed in the RFTP. A proposer's bid will be affected by the anticipated length of construction time. The sequencing of submittal and approval of construction documents must also be included and referenced in Section 01300 - Submittals.

Factory Quality Assurance

Off-site quality assurance for systems construction is the only significant departure from conventional MCA construction administration. The District Construction Division usually does not become involved in factory inspection for construction materials or products. In most cases, a Certificate of Compliance (COC) is enough. System and subsystem fabrication, however, often involves work conducted off-site that would normally occur onsite under the monitoring of the District Construction Division field office in a conventional MCA project.

The District may or may not implement any in-plant quality assurance measures. This decision depends on the extent of the anticipated in-systems work and the nature of the systems or subsystems likely to be used. Early in the design stage, a consensus should be reached among the District Engineering Division, the AE, the District Construction Division, and the District Contracting Officer on how to provide in-plant quality assurance. For a particular facility, some subsystems may require in-plant quality assurance, while others may not. The following situations are ones in which in-plant quality assurance may not be necessary:

1. Where in-systems work is likely to be common enough in the building community for the District to be confident in the state of the art.

2. Where in-systems work would normally be approved with a COC from the manufacturer.

3. Where in-systems work is likely to use essentially one primary material.

4. Where in-systems work is likely to use only fabrication or products assembly rather than manufacture or production from raw materials.

5. Where in-plant operations are likely to be evident in the system or subsystem, so quality can be assured when the material is delivered to the site.

The following situations are ones in which in-plant quality control may be necessary:

1. Where the state of the art is not yet developed enough to allow acceptance without in-plant quality assurance.

2. Where in-systems work is likely to be of a higher level of technical sophistication than common construction products.

3. Where in-systems work is likely to use a significantly higher level of prefabrication or component integration than common construction products.

4. Where in-systems work is likely to integrate several primary materials into a single integrated system or subsystem.

5. Where in-systems work is likely to be manufactured from raw material rather than assembled from improved products.

6. Where in-plant operations may not be readily evident in a system or subsystem when delivered onsite.

7. Where in-systems work is likely to use sensitive chemical or environmentally controlled processes in-plant.

8. Where fabrication, tolerances, or interface details are dimensionally critical or sensitive.

9. Where District Construction Division personnel may not be familiar with the systems or subsystems likely to be used.

Decisions regarding which in-systems work or operations, if any, will require off-site quality assurance must be made on a project-specific basis. This decision should be based on the nature or complexity of the facility and the nature of the systems or subsystems available and likely to be used for the project. These determinants should become evident during the development of the RFTP.

It may be impractical for the District Construction Division to place personnel in each manufacturing facility which requires off-site quality assurance. Furthermore, such measures are seldom necessary and will generally not prove significantly advantageous to the Corps. Therefore, when factory inspection is necessary, the District may employ an independent third party inspection method, e.g., a private testing or inspection agency such as Underwriter's Laboratories, or a Government or military inspection agency such as the Defense Contract Administrative Service Agency.

During the design state of the project, the District should define its quality assurance requirements. The appropriate provisions, requirements, and method descriptions should be included in the contract documents. After a contractor is selected, the contractor should submit to the Corps the quality assurance programs used by the appropriate manufacturers and a third party agency to certify manufacturers' quality assurance.

The quality assurance program may be the manufacturer's standard program or a program developed specifically for the project. The independent third party may be a practicing consultant, inspection agency, testing laboratory, or other impartial agency qualified in both the technical field and in quality assurance. The District Construction and Engineering Divisions, if requested, should examine these submittals and either approve them or request revisions.

After the quality assurance program and the third party are approved, the contractor will retain the third party as his/her agent. Rather than per rm actual inspection tasks, the third party will certify to the contractor . t the manufacturer is executing a quality assurance program approved by th Corps. The contractor should also furnish the Corps with this certifica

Site Fabrication -- Quality Assurance

The contractor may use a system or subsystem employing a mobile factory, mobile fabrication equipment, or other extensive onsite fabricating techniques. In these cases, quality assurance should be done onsite under the monitoring of the District Construction Division field office, in a manner similar to that used for conventional MCA construction.

If the possibility exists that onsite techniques may require more comprehensive quality assurance than conventional field procedures can provide, in-plant procedures may be necessary. Such contingencies should be included in the quality assurance provisions of the contract documents.

Payment Procedures

In a systems-oriented procurement, it may be necessary to modify payment procedures to preserve the fiscal base of the contractor, as appropriate. While there may not appear to be much activity at the job site during early construction, much of the preliminary work associated with systems building may have already been completed. This situation is most likely to occur when large volumetric units are being fabricated for shipment to the site.

When extensive component preassembly occurs off-site, the contractor must be paid for materials and labor on a regular basis. While most contractors will accept a 30- to 60-day lag in receiving compensation, any additional delay discourages them from using systems building techniques or procuring materials and services early. To help the contractor reduce costs on larger projects, the Corps should pay for storage both on and off the site.

Retainage for materials and labor must be the same. Much of the labor of a conventional project becomes material expenses in a systems-oriented project. If stored materials are given a reduced payment, as is often the case, the contractor will be penalized for using system techniques.

Close-Out

In closing out a systems-oriented project, many of the activities are the same or similar to those used for conventional construction.

Close-out activities will generally include: (1) requiring final submittals before final payment, (2) cleaning and removing temporary services and equipment, (3) providing keys and keying schedules, (4) final inspection, and (5) warranty requirements.

Other activities may vary, depending on factors such as the method for procurement. These activities include: (1) beneficial occupancy, (2) relocatability, (3) multiple siting, (4) record drawings, and (5) spare parts and materials.

One possible advantage of systems construction is early occupancy, so it is important that related activities be coordinated.

When buildings are designed as temporary structures or the design program requires that the building be dismantled and rebuilt elsewhere, documentation must be provided. The instructions should include information on what parts will have to be replaced (e.g., gaskets and other small parts) and where they can be procured. Buildings that require uncommon expendable parts should be specified to include a guarantee of multiple sources for future procurement. These requirements must be stated in the RFTP.

Multiple sites may complicate the project close-out. In most cases, individual building schedules may be staggered to better use factory and job-site labor forces. Close-out will generally follow the same schedule as a conventional MCA project.

Record Drawings

In systems construction, most construction documentation is prepared by the contractor or subcontractors. As a result, there should be fewer changes required to convert the proposal documents into record drawings. Changes made after the proposal must be documented in a manner similar to that used for conventional construction.

Spare Parts and Materials

If changes in the building's occupancy or configuration are anticipated, some subsystems may require that a source of spare parts and materials be identified. The AE may anticipate that finish materials may be discontinued or that parts critical to a subsystem will be needed for immediate replacement. Provisions for spare parts must be expressed in the RFTP.

8 SUMMARY

This report has defined a systems approach for acquiring industrialized building systems for Army facility construction. It has also provided technical and procedural guidance in the areas of facility selection, predesign using a systems approach developing RFTP documentation, developing design and construction performance specifications, evaluating technical proposals, and construction administration. This information will be useful to Corps District personnel, the AE with whom the District contracts for a facility design, the installation FE, Corps Divisions, OCE, and the Major Commands.

GLOSSARY

AE (Architect-Engineer): The Corps agent responsible for expressing a facility's requirements in terms of performance criteria and soliciting proposals in response to performance specifications. In a conventional MCA project, the AE develops a facility's design and construction documents.

aggregation: The treatment of a group of similar building projects (possibly at several installations, or scheduled to be built in different years) as a single project.

bidder: An offeror or proposer in two-step bidding whose proposal has been found acceptable and who is being invited to bid.

building component (or component): A manufactured assembly or unit installed as part of a building subsystem. For example, a wall panel would be a component of an exterior wall subsystem.

building subsystem (or subsystem): A coordinated assembly of materials or products that performs a related function and can be designed, manufactured, shipped, and installed as a unit. For example, an exterior wall subsystem would include all elements of the enclosure, its support, exterior surface, thermal protection, moisture protection, sealants, fasteners, doors, windows, frames, etc.

building system (or system): An interdependent set or assembly forming a functional building whole, consisting of the arrangement of building elements as well as the principles or rules linking these elements. The term is commonly used in the context of preengineering and manufacturing.

conditional proposal: A proposal which requires only minor modifications to meet the requirements contained in the RFTP.

contractor: The party responsible for all aspects of a facility's construction.

conventional construction: Site-coordinated construction using combinations of field-crafted and factory-fabricated components which are not generally predesigned or precoordinated. The term also implies the traditional process of design and contracting.

DD Form 1391 (military construction project data): A form which identifies a need for and provides a basic description of a facility.

descriptive specifications: A precise, written description of requirements for construction indicating materials, shapes, sizes, and methods used to establish standards and to provide a product.

design alternatives: The design strategy chosen to achieve the appropriate balance of responsibility between the Corps and the contractor; that is, the extent to which performance specifying and systems or subsystems may be used to benefit the design and construction of a facility. Thus, the design alternatives available to the Corps range from a descriptive design of the facility and virtually all of its systems, to the delegation of all design and engineering responsibilities to the contractor.

design/build: A general category for a procurement process which integrates design and construction responsibilities held by a single participant.

design program: A written statement describing, in various levels of detail, the conditions and requirements of a facility. The program includes such design requirements as minimum areas, arrangement, personnel capacity, etc.

evaluation criteria: The tool with which the Corps evaluation team identifies a proposal's conformance to the requirements contained in the RFTP. Evaluation criteria are identical in content to the specification criteria contained in the RFTP, and serve as a guide to compare the proposed to the specified.

explicit form of specification: A form of specification in which the requirements, criteria, and tests are individually identified in the specification statement.

first generation systems: Building systems and subsystems which are researched and developed to satisfy user requirements if the state of the art does not provide the technology necessary to meet the client's requirements.

functional requirements: Expressions of the performance characteristics required of a facility -- in general, technical terms.

implicit form of specification: A form of specification which includes a statement of requirements, criteria, and tests, but does not specifically identify each category.

industrialized building systems: Building systems or subsystems produced by industrialized methods as opposed to organized labor- and site-intensive activity. Industrialized principles include the economy of scale, predesign and preengineering, standardization of production techniques, and automation. The term also applies to process-oriented activities.

in-systems: All portions of a facility which are part of a building system or subsystem.

interface: A common boundary of dimensional fit between components. The act or process of insuring a positive and functional fit at that common boundary. The point of contact of construction activities.

invitation for bid (IFB): That portion of the bidding requirements used to solicit bids for a construction project.

levels of performance: The degree of sophistication with which performance characteristics are used to describe facility requirements or elements.

life-cycle costing: A method of economic building analysis which adds initial construction costs to those costs likely to be incurred during the life of the building; for example, costs for maintenance, insurance, operation (including energy), repair, and replacement.

nonresponsive proposal: A proposal which fails to meet the RFTP requirements.

nonsystems: See the "out-of-systems" section.

one-step procurement: A procurement option in which competing technical proposals and dollar bids are evaluated according to a predetermined scoring scheme. The contract is awarded to the proposal scoring the highest value, and not necessarily to the proposal offering the lowest bid.

out-of-systems (or nonsystems): All portions of a facility designed and constructed in a conventional manner.

performance attribute (or attribute): A performance characteristic described and defined by requirements and criteria.

performance concept: The organized procedure by which an element is described by the results to be achieved, rather than by the specific means used to achieve a solution.

performance criterion (or criterion): A definitive, quantitative, or qualitative statement of a performance level for a particular requirement. A criterion must be either measurable or observable.

performance level: The measure of a system's or subsystem's performance according to a specified criterion.

performance requirement (or requirement): A (usually) qualitative statement of desired end results.

performance specification: A statement of required results which can be verified as meeting stipulated criteria. This statement must be free from unnecessary process limitations.

performance test: The verification of performance; that is, the method used to measure the actual or predicted performance level of a building element.

preconcept control data (PCCD): Data prepared by the District to reflect preliminary concepts. These data indicate construction requirements and substantiate the estimated project cost. These data are used by the Department of the Army during budget hearings before Congress.

program development brochure (PDB): The document which establishes a facility's functional and design requirements.

proposal: A design and technical solution submitted by a proposer in response to an RFTP.

proposal evaluation: The examination of proposals to determine whether they are responsive to RFTP requirements.

proposer: A party who responds to an RFTP with a proposal.

request for technical proposal (RFTP): A solicitation for proposals containing design and technical criteria plus administrative and legal provisions.

responsive proposal: A proposal which meets RFTP requirements.

scope of performance: The interrelationship between the degree to which systems are used in a facility, and the latitude or constraints expressed in the performance specifications.

second generation systems: Building systems and subsystems which are produced and marketed and are available for general use. Such products are frequently outgrowths of first generation systems that have been developed for a more specific market.

submittals: Proposal material which describes the proposer's solution. The Corps needs submittals if it is to conduct an accurate and fair evaluation. The proposer needs submittals to develop an accurate estimate for facility construction.

systems approach: The process which links elements of planning, design, procurement, construction, and administration in the building delivery sequence. Commonly used to refer to the application of the performance concept to systems building methods.

systems building (or systems construction): A method of construction using functionally integrated elements with positive interfacing relationships designed for an effective combination of production, installation, and performance.

systems selection: The process whereby the Corps selects a facility or a group of facilities from the MCA construction program for which a systems approach should be pursued. The selected facilities can be at several installations or can be scheduled to be built in different years. This process can also include the selection of one or more subsystems common to the facilities being considered for a systems approach.

technical feasibility: The determination of compatibility between the capabilities of building systems or subsystems and the facility's functional requirements.

technological innovation: An advance attributable to a technical method or a new product which achieves a particular purpose. It can also be a significant change in the means used to achieve a superior system of service.

turnkey: A procurement method in which the owner specifies only the end product. The design and construction (and sometimes site acquisition) are the responsibility of the contractor, who must execute the work for the agreed sum within the agreed time limits.

two-step procurement: A procurement option where technical proposals are received without dollar bids and evaluated against specified criteria. Those firms whose proposals are deemed "responsive" are then asked to submit a bid to construct the facility according to their own proposals. The contract is awarded to the lowest bidder.

user needs: Those conditions which the user of a building considers necessary or desirable as environment and support for his/her activities, without particular reference to how such conditions are to be physically produced.

user requirements: Criteria based on occupant (not necessarily owner) needs, translated into performance of functional criteria.

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Constructability Review, ER 1110-345-803 (Office of the Chief of Engineers, 31 January 1978).

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Design Analysis, ER 1110-345-700 (Office of the Chief of Engineers, 1966).

Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes, TM 5-809-11 (Department of the Army, 1973).

Design for the Physically Handicapped, ER 1110-1-102 (Office of the Chief of Engineers, 1976).

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Design Policy for Military Construction, ER 1110-345-100 (Office of the Chief of Engineers, 1966).

Drawings, ER 1110-345-710 (Office of the Chief of Engineers, 1969).

Economic Studies, ETL 1110-3-296 (Office of the Chief of Engineers, 1978).

Energy Conservation in New Building Design, ASHRAE 90-75 (ASHRAE, 1975).

Engineering Weather Data, TM 5-785 (Department of the Army, 1978).

Evaluation Criteria Guide for Water Pollution Prevention, Control, and Abatement Programs, TM 5-814-8 (Department of the Army, 30 July 1976).

Fire Prevention Manual, TM 5-812-1 (Department of the Army, 1977).

Fire Tests of Building Construction, ASTM E-113 (American Society for Testing and Materials [ASTM], 1981).

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Interlaboratory Evaluation of Smoke Density Chamber, Technical Note 708 (National Bureau of Standards, December 1971).

Load Assumption for Buildings, TM 5-809-1 (Department of the Army, 1966).

Manual of Practice, MP1-12, "Performance Specifying" and MP2-6, "Format for Performance Specifying" (The Construction Specifications Institute [CSI]).

MCA Program Development, AR 415-15 (Department of the Army, 1975).

National Electrical Safety Code, ANSI C2 (ANSI, 1981).

National Fire Codes (National Fire Protection Association, 1982).

One-Step Competitive Negotiation and Two-Step Formal Advertising, ER 1180-1-7 (Office of the Chief of Engineers, 1974).

Project Development and Design Approval, AR 415-20 (Department of the Army, 1974).

Project Development Brochure, TM 5-800-3 (Department of the Army, 1974).

Recommended Practice for Electrical Equipment Maintenance, ANSI C1 (NFPA 70) (ANSI, 1977).

Seismic Design for Buildings, TM 5-809-10 (Department of the Army, 1982).

Specification for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People, ANSI A117.1 (ANSI, 1980).

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Test for Density of Smoke From the Burning or Decomposition of Plastics, ASTM D-2843 (ASTM, 1977).

Test for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine, ASTM D-2047 (ASTM, 1981).

<u>Test for Surface Burning Characteristics of Building Materials</u>, ASTM E-84 (ASTM, 1981).

<u>Two-Step Formal Advertising</u>, ETL 1110-2-182 (Office of the Chief of Engineers, 1974).

<u>Wastewater Collection and Treatment Policy</u>, ER 1105-2-180 (Office of the Chief of Engineers, 1975).

<u>Water and Wastewater Laboratory Quality Control</u>, ETL 1110-2-244 (Office of the Chief of Engineers, 1979).

METRIC CONVERSION TABLE

1 ft = .3048 m

1 sq ft = .0929 m^2

1 lb = .4535 kg

1 psf = 4.882 kg/m^2

1 in. = 25.4 mm

1 Btu/lb = 2.326 KJ/kg

1 Btu/sq ft = 1.135×10^4 J/m^2

$^{o}F = (^{o}F - 32)\ 5/9$

APPENDIX A:

TECHNICAL FEASIBILITY CHECKLIST

General

The checklist in this appendix can help District Engineering Division personnel determine the technical feasibility of systems building techniques for a given facility. Depending on each facility's requirements, this checklist may suggest the use of a complete building system, or, where conditions are not favorable to the use of a complete system, the use of selected subsystems. The checklist is open-ended and may be edited or expanded according to the conditions of the specific project. Its items may also be weighted in value according to the priorities of a specific project.

How To Use Checklist

District Engineering Division personnel should respond "yes" or "no" to each item on the checklist, then note the rating associated with each response. A "____" in the YES column indicates a positive response has a positive impact on the use of systems building techniques. Similarly, a "____" in the NO column indicates a negative response has a negative impact. If a "/////" appears in either the YES or the NO column, a positive or negative response, respectively, will have no impact on the suitability of systems building techniques.

Each of the criteria in this appendix represents only a component of the condition favorable to the use of building systems and subsystems. District Engineering Division personnel must consider these criteria in combination to determine an overall indication of favorable or unfavorable conditions. Although no single criterion should be the only factor used to determine technical feasibility, one strongly favorable condition may outweigh other marginally favorable conditions, as any strongly negative condition may outweigh other favorable conditions. In addition to the criteria listed in this appendix, the technical feasibility of building systems and subsystems must be determined based on the qualitative experience of Corps personnel within the construction community.

Item	YES	NO
1. GENERAL		
a. Time		
(1) If conventional construction techniques are used, the required occupancy date may not be met without accelerating the construction schedule.	____	/////
(2) The using agency or District can realize significant operational or economic advantage from early occupancy.	____	/////
(3) The using agency or District will suffer significant operational or economic disadvantage from delayed occupancy.	____	/////
b. Site/Location		
(1) The site is not severe in terrain (under about 20 percent in grade)	/////	____
(2) The site is not restrictive in shape or dimension.	/////	____
(3) The site is not restricted to access by large vehicles or large prefabricated components.	/////	____
(4) The site is remote.	____	/////
c. Occupancy		
(1) The design program requires flexibility in interior configuration.	____	/////
(2) Occupancy or functional change within the life of the facility will require building expansion or rearrangement of the interior configuration.	____	/////
2. ARCHITECTURAL		
a. Plan Configuration		
(1) The plan configuration can be rectangular.	____	/////
(2) The plan configuration can be basically rectalinear.	____	____
(3) There are no functional requirements requiring severe recesses or protrusions in the building's perimeter.	____	____
(4) The plan may be appropriate for a bay or a grid layout.	____	/////
b. Spatial/Dimensional Characteristics		
(1) Interior spaces will not require structural clear spans of more than about 80 to 100 ft, except for industrial- or athletic-type facilities*	____	____

*Verify dimensions with current product data.

	YES	NO
(2) Interior spaces will not require structural clear areas of about 50 x 80 to 50 x 100 ft, except for industrial- or athletic-type facilities.*	____	____
(3) Plan dimensions can be modular or incremental.	____	____
(4) Plan dimensions can be incremental in divisions of 2, 4, 5, 8, or 10 ft.	____	____
(5) The building can be of three stories or fewer, with the exception of housing facilities.*	____	____
(6) Ceiling heights for administrative-type spaces should not exceed 9 or 10 ft.	____	____
(7) Ceiling heights for high-bay areas should not exceed about 30 to 40 ft.*	____	____

c. Aesthetics

(1) There are no extraordinary design or aesthetic requirements for building proportion, roof outline, or exterior feature arrangement.	____	____
(2) The desired aesthetic characteristics can be achieved with conventional exterior building materials.	____	____

3. SUPERSTRUCTURE

a. Acceptable Structural Types

(1) Concrete masonry and steel-bar-joist construction is acceptable.	____	____
(2) A steel-frame superstructure would be acceptable in any of the following types: truss frame and column, beam and column, rigid frame, space-grid, geodesic, or lightgauge.	____	____
(3) A concrete superstructure would be acceptable in any of the following types: precast and prestressed frame and deck or precast and prestressed loadbearing panel.	____	____

*Housing systems may have mid- and/or high-use configurations. Various precast and prestressed concrete building systems can be used for mid- or high-rise administrative-type facilities.

YES NO

(4) A wood superstructure would be acceptable in any of the following types: glue-laminated, timber, or lightframe. _____ _____

b. Structural Requirements

(1) There are no extraordinary structural requirements for the superstructure. _____ _____

(2) Uniform loads, snow loads, wind loads, lateral loads, seismic loads, and other live or dynamic loading requirements are comparable to local or applicable model building codes. _____ _____

4. EXTERIOR WALLS

a. Acceptable Exteriors

(1) A brick masonry exterior is not required. _____ /////

(2) Metal exterior panels would be acceptable for the building's exterior in any of the following types: pre-formed metal insulated panels, architectural metal insulated panels, or metal/glazed curtain walls. _____ /////

(3) Precast and prestressed concrete panels would be acceptable for the building's exterior in any of the following types: structural (plain), textured, exposed aggregated, or architectural. _____ /////

(4) Composite panels would be acceptable for the building's exterior in any of the following types: fibrous-reinforced cement (FRC), fibrous-reinforced plastic (FRP), or cementitious/metal composite. _____ /////

b. Performance Requirements

(1) Fire safety or life and safety requirements are comparable to local or applicable model building codes. _____ _____

(2) Thermal requirements for the building envelope are comparable to commonly accepted standards. _____ _____

(3) There are no extraordinary noise conditions external to the building. _____ _____

(4) The building is not in an excessively corrosive or abrasive environment. _____ _____

(5) The building's exterior will not be subject to excessive high-abuse conditions. _____ /////

	YES	NO
5. ROOF AND ROOFING		
a. Acceptable Roof/Roofing		
(1) Roof pitch for the building may be 1/8:12 to 4:12.	____	/////
(2) Built-up roofing is acceptable.	____	/////
(3) A standing seam metal roof would be acceptable for a slope greater than 1/4:12.	____	____
(4) Single-ply roofing would be acceptable for a flat roof.	____	____
b. Performance Requirements		
(1) Fire safety or life and safety requirements are comparable to local or applicable model building codes.	____	____
(2) Loading and uplift requirements are comparable to local or applicable model building codes.	____	____
(3) Thermal requirements for the building envelope are comparable to commonly accepted standards.	____	____
6. INTERIOR PARTITIONS		
a. Acceptable Construction		
(1) Concrete masonry or gypsum block construction is not essential for most of the building's partitions.	____	____
(2) Partitions would be acceptable in any of the following types: wood stud, steel stud, or honeycomb.	____	____
(3) Finishes of any of the following types would be acceptable: painted gypsumboard, painted asbestos cement board, paneling, or wall covering.	____	____
b. Performance Requirements		
(1) Fire safety or life safety requirements are comparable to local or applicable model building codes.	____	____
(2) There are no extraordinary security, acoustic, or privacy considerations among most interior spaces.	____	____
(3) Partitions will not be subject to extraordinary high-wear or excessive high-abuse conditions.	____	____

	YES	NO
c. Flexibility Considerations		
(1) There is a probability of change in the facility's occupancy, function, or mission within 10 years of its construction.	____	/////
(2) The facility's design requirements suggest flexibility in interior configuration.	____	/////

7. CEILING

a. Acceptable Ceilings

	YES	NO
Ceilings of any of the following types would be acceptable: suspended and lay-in, or integrated.	____	____
b. Performance Requirements		
(1) Fire safety or life safety requirements are comparable to local or applicable model building codes.	____	____
(2) There are no extraordinary security, acoustic, or privacy considerations among most interior spaces.	____	____
(3) There are no extraordinary ceiling illumination requirements for most interior spaces.	____	____
c. Flexibility		
There is a probability that a change in arrangement will be necessary for any of the following elements: lighting, air distribution, or electrical distribution.	____	/////

8. MECHANICAL

a. HVAC

	YES	NO
(1) The interior spatial arrangement may suggest a repetitive or modular air-distribution network.	____	____
(2) Rearrangement in the air-distribution network is probable within 10 years of the facility's construction.	____	____
b. Electrical		
(1) The interior spatial arrangement may suggest a repetitive or modular electrical-distribution network.	____	____
(2) Rearrangement in the electrical-distribution network is probable within 10 years of the facility's construction.	____	____
(3) Wiring in rigid conduit is not essential for the facility.	____	____

YES NO

c. Plumbing .

The interior spatial arrangement may suggest a repetitive or modular plumbing network. _____ _____

APPENDIX B:

REQUIRED TECHNICAL SUBMITTALS FOR PROPOSAL

Purpose of Submittals

The purposes of the submittals for a proposal for an MCA facility are:

To provide enough design information for the using agency and the Corps to determine whether the proposed facility meets their functional requirements for operational use during the anticipated life of the facility.

To provide the Corps with enough data to determine the engineering sufficiency and soundness of the design of each of the facility's technical disciplines.

To allow the proposer to develop an accurate construction estimate so that he/she can present a fair and reasonable bid to the Corps.

Materials

The required submittal material will vary according to the complexity of the facility, the proposer's responsibilities for design, the extent of in-systems work, and the degree of required design completion. The following text lists many of the submittal requirements for facility subsystems. Reviewers can add or delete items as appropriate for their particular project. Required proposal submittals can include, but need not be limited to, the following:

Siting

Where site design is the proposer's responsibility.

Site analysis narrative addressing each site design criterion presented in the RFTP.

Base layout and site area plan.

Site plan, displaying:

1. Facility outline.
2. Finish contours.
3. Floor elevations.
4. Sidewalks, roads, service areas, parking, and ramps.
5. Existing buildings as appropriate.
6. North and south orientation.

7. Landscape design and materials.

8. Retaining walls.

9. Site fixtures and accessories.

Site civil plans, displaying:

1. Storm drainage plan, including inlets, culverts, pipes, materials, and rough sizes.

2. Pavement design, including materials, surfaces, curbing, and sections.

3. Water supply, including pipe material, equipment, and rough sizes.

4. Sanitary sewer, including pipe material, equipment, grades, and rough sizes.

5. Gas supply, including pipe material, fixtures, and rough sizes.

6. Electric supply, including materials, equipment, and rough sizes.

Where site design is not the proposer's responsibility, site plans are provided in the RFTP displaying:

1. Building outline.

2. Site plan details within any area of proposer's responsibility.

3. Site civil details within any area of proposer's responsibility.

Architectural

Narrative description of the building system, indicating:

1. Building system and nonsystem items.

2. Building configuration as appropriate.

3. Structural materials and configuration.

4. Architectural treatment.

5. Construction techniques.

Floor plans, displaying:

1. Walls, partitions.

2. Doors, windows, openings.

3. Dimensions of interior and overall exterior; sizes and location of windows, doors, and openings; stairs; and other plan features.

4. Room or area titles.

5. Statement of gross and net areas.

6. Door swings.

7. Personnel occupancy.

8. Furnishings and equipment.

Elevations, displaying:

1. Exterior materials.

2. Fenestration, openings, and doors.

3. Foundation outline.

4. Grills, rails, and other architectural specialties.

5. Vertical dimensions of floor elevations, building heights, windows and door head heights, window sill heights, other critical vertical dimensions.

Building sections, displaying:

1. Floor and wall thicknesses.

2. Ceiling heights.

3. Overhangs, balconies, parapets, and other relief features.

Typical wall sections, displaying:

1. Materials.

2. Wall thickness.

3. Wall structure.

4. Surfaces and finishes.

5. Thermal protection.

6. Water, moisture, and vapor protection.

7. Wall and roof details.

8. Wall and ceiling details.

9. Wall and floor details.

10. Wall and foundation details.

11. Wall and window and door details.

Other construction details, such as:

1. Roof and roofing.

2. Roof drainage.

3. Foundation details.

4. Stair details.

Structural

Layout or framing drawings, where not indicated in the floor plans.

Detail drawings, as required.

Structural analyses and calculations specifically addressing each strength criterion of the specifications, including roofs, walls, partitions, and ceilings.

Test certification, where required in the specifications.

Explanation of any innovative structural concepts not readily evident in drawings or analyses.

Exterior Enclosure (Roof, Walls)

Layout and/or detail drawings of subsystems, where not indicated in architectural drawings.

Preliminary thermal analyses and calculations of building envelope, addressing each thermal performance criterion of the specifications.

Preliminary acoustic analyses and calculations of building envelope, addressing each acoustic performance criterion of the specifications.

Test certifications, as required in the specifications.

Manufacturers' literature (as appropriate).

Interior Subsystems

Layout and/or detail drawings of subsystems, where not indicated in architectural drawings.

Acoustic analyses and calculations, addressing each acoustic criterion of the specifications.

Test certifications, as required in the specifications.

Manufacturers' literature (as appropriate).

HVAC

Description of the HVAC system, indicating:

1. Energy source.
2. Equipment.
3. Zoning and controls as appropriate.
4. Other general subsystem features.

Basic design analysis, including:

1. Inside and outside conditions.
2. Personnel load.
3. Equipment heat release.
4. Ventilation requirements.
5. U-factors.
6. References to criteria and/or design manuals.

Drawings, displaying:

1. Equipment, fixtures, and distribution layouts.
2. Details as required.
3. Attachment and/or concealment of equipment or distribution components.

Preliminary design calculations, addressing each criterion of the specifications, indicating:

1. Rough sizing of equipment.

2. Rough sizing of distribution network.

Test certification, as required in specifications.

Manufacturers' literature as appropriate.

Plumbing

Description of the plumbing system, indicating:

1. Supply system.

2. Drain-waste-vent system.

3. Hot water generation.

4. Fire protection.

5. Other general subsystem features.

Basic design analysis, indicating:

1. Building population.

2. Supply demand.

3. Water generation volume.

4. Toilet requirements.

5. Other fixture requirements, as required in the specifications.

6. References to criteria and/or design manuals.

Drawings, displaying:

1. Equipment, fixtures, and distribution layouts.

2. Details (as required).

3. Attachment and/or concealment of equipment or distribution components.

Preliminary design calculations, addressing each criterion of the specifications.

1. Rough sizing of equipment.

2. Rough sizing of distribution network.

Test certifications, as required by specifications.

Manufacturers' literature as appropriate.

Electrical

Description of the electrical system, indicating:

1. Distribution network.

2. Equipment.

3. Circuit organization.

4. Lighting, room, and fixture type.

5. Alarm system.

6. Communication system.

7. Other special electrical features.

Basic design analysis, indicating:

1. Demand.

2. Required lighting levels and quality of lighting.

3. References to criteria and/or design manuals.

Drawings, displaying:

1. Equipment and fixture layouts.

2. Riser diagrams.

3. Details as necessary.

4. Attachment and/or concealment of equipment or distribution components.

Preliminary design calculations, addressing each criterion of the specifications, indicating:

1. Rough sizing of equipment.

2. Rough sizing of distribution network.

Test certifications, as required by the specifications.

Manufacturers' literature as appropriate.

Hardware and Specialties

1. Hardware schedule.

2. Specialties schedule (as appropriate).

3. Test certifications, as required by the specifications.

4. Manufacturers' literature as appropriate.

Equipment and Appliances (Non-Government Furnished)

1. Equipment schedule.

2. Test certifications, as required by the specifications.

3. Manufacturers' literature as appropriate.

Project Specifications

Complete descriptive project specifications must be in CSI 16-division format.

Life-Cycle Cost Data

If life-cycle cost is to be included as an evaluation factor or a component of the bid, the following information should be provided, as appropriate.

1. Life-cycle cost analysis performed according to a specified method.

2. Life-cycle data required for an analysis by others, as required by the specifications.

APPENDIX C:

SAMPLE REQUIREMENT AND CRITERIA CONTENT

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
SAFETY AND PROTECTION			
11 Fire Safety			
(01) Fire Code Compliance	R:	Insure that national fire protection standards are satisfied.	
	C:	Require compliance with specific fire codes and fire protection criteria.	1,2,5
(02) Fire Areas	R:	Control fire hazard from neighboring structures.	
	C:	State distance limits between structures; limit area within fire barriers; limit ceiling height.	1
(03) Fire Barriers	R:	Control the spread of fire.	
	C:	State criteria for fire walls, fire stops, fire-resistant separation between egress openings; require that barrier penetrations maintain rated fire endurance; require fire dampers.	1

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1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(04) Egress Means	R:	Provide means for emergency evacuation.	
	C:	State minimum number of exits, maximum travel distance to exits, and other means of egress; require minimum width for public corridors and public stairways; limit obstruction by door swing or equipment installation; require exit signs.	1
(05) Protective Devices	R:	Provide fire warning devices and automatic fire extinguishing equipment.	
	C:	State conditions under which automatic fire detection systems, smoke detection systems, sprinkler systems, extinguishing systems, or other protection devices must be provided.	1,5
(06) Fire Resistance/ Combustibility	R:	Maintain integrity for sufficient time to permit evacuation or control of fire.	
	C:	Require use of non-combustible materials;	1,3

1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(06) Fire Resistance/ Combustibility (Cont'd)		state minimum hours of fire resistance or level of fire protection; state fire resistance classification.	
(07) Fire Load/Fuel Contribution	R:	Control fuel contribution of materials.	
	C:	State maximum potential heat (contribution to fire load) in Btu per hour or Btu per square foot of material.	3
(08) Surface Spread of Flame	R:	Control surface spread of flame.	
	C:	State maximum flame spread or flammability rating.	3
(09) Flame Propagation	R:	Control propagation of flame through enclosed spaces.	
	C:	State maximum flame propagation index.	1,3
(10) Smoke Generation	R:	Control amount and toxic effect of smoke produced.	
	C:	State maximum smoke development rating; state maximum optical density and maximum time to reach critical density; limit toxicity of smoke, require that smoke be nonnoxious.	3

1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(11) Smoke Propagation	R:	Control propagation of smoke through enclosed spaces.	
	C:	State criteria for smoke-tight joints, provide for venting of smoke areas.	1,3
(12) Accidental Ignition	R:	Protect against accidental ignition of fire.	
	C:	Design to prevent spark formation; limit equipment overheating; require equipment mounting to permit adequate ventilation.	1
12 Life Safety (other than fire)			
(01) Physical Safety	R:	Protect against physical hazards.	
	C:	State criteria for guardrails, handrails, protective covers on moving parts; require slip-resistant surfaces.	1,2
(02) Electrical Safety	R:	Protect against electrical hazard.	
	C:	State criteria for protective covers, insulation, and grounding; require safety controls and interlocks.	1

1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Toxicity	R:	Control dangerous materials and substances.	
	C:	Limit toxicity of materials, surfaces, and finishes; limit toxic emissions below stated temperatures; limit toxic venting and leakage.	3
(04) Chemical Safety	R:	Protect against hazard from chemical substances.	
	C:	Identify chemicals and agents, including concentration and anticipated frequency of use to which the subsystem will be exposed; indicate the level of atmospheric pollution permitted.	1
(05) Protection Against Biological Growth	R:	Protect against infection from biological sources.	
	C:	Identify insects, vermin, fungi, microorganisms, and other biological contaminants likely to be encountered; state level of protection to be provided.	1,3

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1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
13 Property Protection			
(01) Theft Security	R:	Protect equipment and contents against theft.	
	C:	Design to control unauthorized entry and access. Design to prevent unauthorized removal of equipment.	1
(02) Security Against Vandalism	R:	Protect against malicious damage.	
	C:	Design to resist malicious damage. Define conditions for which protection must be provided.	1,5
(03) Resistance to Misuse	R:	Protect against accidental or deliberate misuse.	
	C:	Design to prevent improper usage. Design for fail-safe operation. Perform factory adjustment. Label parts and connections. Provide instructions. Define conditions for which protection must be provided.	1,5
14 Handicapped Usage			
(01) Handicapped Access	R:	Provide for physical access by handicapped individuals, if appropriate.	

Attribute	Sample Requirement (R)/ Criteria Content (C)	Test
(01) Handicapped Access (Cont'd)	C: Design to provide at least one means of ingress and egress.	1
(02) Physically Impaired Usage	R: Provide for building usage by physically impaired individuals, if appropriate.	
	C: Design to permit physically impaired individuals access to restrooms, drinking fountains, vending machines, and elevators.	1
(03) Vision-Impaired Usage	R: Provide for building usage by blind persons, if appropriate.	
	C: Design to permit blind individuals access to restrooms, drinking fountains, vending machines, and elevators.	1
(04) Hearing-Impaired Usage	R: Provide for building usage by persons with hearing deficiencies, if appropriate.	
	C: Design to permit persons with hearing deficiencies usage of communication systems and alarms.	1

1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
FUNCTIONAL			
21 Code Compliance	R:	Comply with applicable design code references.	
	C:	List relevant codes.	1,2,3,5
22 Strength			
(01) Static Loading	R:	Sustain gravity loads and superimposed and specified vertical and lateral loads.	
	C:	State dead loads to be supported, including forces transmitted from other subsystems. State applicable design methods or formulas.	2
(02) Live Loading	R:	Sustain dynamic loads.	
	C:	Describe live loads to be supported, including snow load; identify concentrated loads and state design floor loads.	2
(03) Horizontal Loading	R:	Sustain wind loads and other lateral loads.	
	C:	For exterior walls, state design wind speeds and other live loads. State typhoon or hurricane design conditions. For partitions, state	2

1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Horizontal Loading (Cont'd)		lateral design load per square foot of partition area.	
(04) Deflection	R:	Limit deflection.	
	C:	State maximum acceptable deflections under the stated conditions.	2
(05) Thermal Loading	R:	Sustain loads due to temperature change.	
	C:	State the temperature extremes to be used for design, including loads encountered in process as well as in place.	2
(06) Structural Serviceability	R:	Retain serviceability under load and deflection.	
	C:	State conditions under which the subsystem is to sustain design loads without causing local damage.	2
(07) Seismic Loading	R:	Sustain earthquake loads and applicable seismic design method references.	
	C:	State the seismic zone to be used for design.	2
(08) Impact Loading	R:	Sustain impact loads and forces.	
	C:	Describe the source and magnitude of any	2,3

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1. Inspection of Design Drawings
2. Inspection of Design Calculations
3. Laboratory Certification
4. Prototype or Sample Testing
5. In-place Inspection

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(08) Impact Loading (Cont'd)		impact loads to be sustained and maximum acceptable deflection or damage.	
(09) Penetration Resistance	R:	Protect against damage from concentrated loads.	
	C:	Describe magnitude and location of concentrated loads and maximum acceptable indentation or damage.	2,3
23 Durability			
(01) Impact Resistance	R:	Resist surface degradation due to point impact.	
	C:	State limits to surface indentation due to specified impact load.	3
(02) Moisture Resistance	R:	Resist degradation when exposed to water or water vapor.	
	C:	Design for use in specified range of humidity; state limit of permanent effect of exposure to water, water retention, and absorption.	3

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Thermal Resistance	R:	Resist degradation when exposed to temperature ranges expected in normal use.	
	C:	State limits of physical change when exposed to specified temperature range.	3
(04) Corrosion Resistance	R:	Resist degradation when exposed to corrosive agents.	
	C:	State limits of corrosive effect observed after specified exposure to salt spray or fog; require corrosive-resistance surface treatment; design to avoid contact of dissimilar metals. State conditions under which subsystem must resist corrosion.	3
(05) Chemical Resistance	R:	Resist degradation when exposed to chemicals; resist staining or damage from soluble and insoluble salts, alkali attack, and oxidation.	
	C:	State limits of changes in appearance or other specified property after exposure to specified chemicals.	3

Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(06) Weather Resistance	R:	Resist degradation when exposed to out-side environmental conditions.	
	C:	State limits of changes observed after exposure to specified period of simulated weathering.	3
(07) Ultraviolet Resistance	R:	Resist degradation due to exposure to ultraviolet light.	
	C:	State limits of discoloration after specified ultraviolet exposure.	3
(08) Surface Stability	R:	Resist cracking, spalling, crazing, blistering, delam-inating, chalking, and fading.	
	C:	State limits of sur-face changes observed after exposure to specified simulated conditions of use.	3
(09) Stain Resistance	R:	Resist permanent discoloration when exposed to staining agents and chemicals.	
	C:	State limits of visual evidence of permanent stains due to treat-ment with identified agents.	3

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(10) Absorbency	R:	Resist tendency to absorb and retain water.	
	C:	State limits of quantity of water retained after specified exposure.	3
(11) Cleanability	R:	Resist damage from routine maintenance and cleaning, permit removal of identified stains.	
	C:	State limits of discoloration or surface change after simulated cleaning with specified cleaning agents.	3
(12) Color Resistance	R:	Resist fading over time.	
	C:	State limits of discoloration after stated period.	3
(13) Friability/Frangibility	R:	Resist crumbling and brittle fracture.	
	C:	State limits of damage observed after specified loading.	3
(14) Abrasion Resistance	R:	Resist degradation due to rubbing.	
	C:	State maximum weight loss after specified number of abrasion cycles.	3

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(15) Scratch Resistance	R:	Resist degradation due to scratching.	
	C:	Specify rating on Pencil Hardness Scratch scale.	3
(16) Dimensional Stability	R:	Control dimensional changes resulting from changes in environment.	
	C:	State limits of volume change and movement under specified exposure to moisture and temperature variation.	3
(17) Cohesiveness/Adhesiveness	R:	Resist peeling and delamination.	
	C:	State limits of peeling or delamination failures under specified simulated loading.	3,4
(18) Subsystem Life	R:	Function properly for identified period.	
	C:	Describe and limit modes of failure under accelerated life test; design life of components consistent with specified life of subsystem.	2

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
24 Transmission Characteristics			
(01) Heat	R:	Control heat transmission.	
	C:	Design for specified Thermal Transmittance ("U" value) for composite building envelope or components thereof.	2
(02) Light	R:	Control light transmission.	
	C:	Design for specified percentage of light or radiation transmission; design for specified natural lighting levels.	1,2,3,4,5
(03) Air Infiltration	R:	Resist air leakage.	
	C:	State limits of infiltration under specified pressure or wind load; design for specified maximum leakage	2,3,4,5
(04) Vapor Penetration	R:	Resist vapor penetration.	
	C:	Design vapor barrier for minimum vapor permeability.	2,3,4,5
(05) Water Leakage	R:	Resist water leakage.	
	C:	Limit infiltration under specified pressure or wind load; design for specified maximum leakage.	2,3,4,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(06) Condensation	R:	Control admission and condensation of moisture.	
	C:	Design to provide moisture barriers and thermal breaks.	2,5
25 Waste Products and Discharge			
(01) Solid Waste	R:	Control production of solid waste; provide for elimination or emission and prevent undesired accumulation.	
	C:	Design to accommodate waste produced or accumulated; require identification of wastes produced.	1,2
(02) Liquid Waste	R:	Control production of liquid waste; provide for elimination or emission and prevent undesired accumulation.	
	C:	Design to accommodate waste levels produced, accumulated, or emitted; require identification of wastes produced.	2
(03) Gaseous Waste	R:	Control production of gases; provide for elimination and prevent undesired accumulation.	
	C:	Design to accommodate specified levels of gas accumulated or emitted; require	1,2

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Gaseous Waste (Cont'd)		identification of gaseous wastes emitted.	
(04) Odor	R:	Control formation and persistence of odors.	
	C:	Design to prevent odor formation.	1
(05) Particulate Discharge	R:	Control production of particulate wastes; provide for collection of waste and prevent undesired accumulation.	
	C:	Design to accommodate specified amount of particulate waste produced; state limits of particulate concentration.	1,2
(06) Thermal Discharge	R:	Limit emission of thermal energy and vibration; provide for control or reabsorption.	
	C:	Design to control thermal discharge produced below specified levels.	2
(07) Radiation	R:	Limit emission of radiation; provide for control or reabsorption.	
	C:	Design to control radiation discharge produced below specified levels.	2

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Attribute	Sample Requirement (R)/ Criteria Content (C)	Test
26 Operational Characteristics		
(01) Method of Operation	R: Provide operating methods consistent with function.	
	C: List desired operating modes.	1,2,3,4,5
(02) Results of Operation	R: Provide output consistent with function.	
	C: List desired output quantities and rates.	2,3,4,5
(03) Cycle Time/Speed of Operation	R: Provide cycle times to accommodate functional requirements.	
	C: List desired repetition rates.	2,3,4,5
SENSIBLE		
31 Aesthetic Properties		
(01) Arrangement	R: Provide order, organization, or relationship appealing to visual perception.	
	C: Describe desired relationships between elements and components. Describe any undesirable features to be avoided.	1

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(02) Composition	R:	Provide unified appearance appealing to visual perception.	
	C:	Describe desired visual relationships. Describe undesirable features to be avoided.	1
(03) Texture	R:	Provide surface finishes appealing to tactile and visual perception.	
	C:	Describe desirable tactile and visual surface characteristics. Describe undesirable features to be avoided.	1,4
(04) Color/Gloss	R:	Provide finishes with pattern or luster appealing to visual perception.	
	C:	Describe desired characteristics of color. Describe desired chromatic criteria. State limits of chromatic differences in color matches.	1,3,4,5
(05) Uniformity/Variety	R:	Provide appropriate consistency or variety of visual environment.	

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
	C:	Describe desired variety of colors, textures, and glosses; limit visual confusion.	1,4
(06) Compatibility/Contrast	R:	Provide appropriate consistency or variety of visual environment.	
	C:	Describe desired characteristics of architectural, stylistic, chromatic, textural, or material compatibility or contrast.	1,4
32 Acoustic Properties			
(01) Sound Generation	R:	Control undesirable sound and vibration generation.	
	C:	State limits of sound generation; provide specified decibel rating.	2,3,4,5
(02) Sound Transmission	R:	Control transmission of sound.	
	C:	Design for specified sound transmission classification; provide STC or SPP rating, INR, or Sound Reduction Coefficient at specified frequency of sound.	1,2,3,4,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Reflectance	R:	Control reflection, reverberation, and echo production.	
	C:	Design for specified reverberation time, sound path length.	1,2,3,4
33 Illumination			
(01) Level	R:	Control quantity and quality of illumination provided.	
	C:	Design for specified illumination intensity level; design to provide specified level of natural light.	2,5
(02) Color	R:	Control color (wavelength) of illumination.	
	C:	Require lamp color and specified range of correlated color temperature.	2,3,4
(03) Shadow/Glare	R:	Control illumination uniformity.	
	C:	Design for specified variation in illumination level over room area.	2,5
(04) Reflection	R:	Control undesirable reflection.	
	C:	State limits of reflected light.	2,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
34 Ventilation			
(01) Air Quality	R:	Control air quality.	
	C:	Design for specified natural ventilation; design to control rate of air removal and supply; design to control odors.	1,2
(02) Velocity	R:	Control air movement.	
	C:	Design to maintain air motion between specified limits. State limits of air velocity.	1,2
(03) Distribution	R:	Control temperature gradients.	
	C:	Design to control temperature gradients within specified limits.	1,2
(04) Pressurization	R:	Control pressure differential.	
	C:	Design to specified limits of air leakage.	2
(05) Temperature	R:	Control air temperature content.	
	C:	State exterior design conditions; design to control rate of change of mean radiant temperature within specified range.	2

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(06) Moisture	R:	Control air moisture content.	
	C:	State exterior design conditions; design to provide specified range of relative humidity.	2
35 Measurable Characteristics			
(01) Levelness	R:	Control deviation from identified horizontal.	
	C:	Require level installation; design for ease of level installation. State acceptable limits of deviation.	4,5
(02) Plumbness	R:	Control deviation from identified vertical.	
	C:	Require plumb installation within specified tolerance; design for ease of plumb installation.	4,5
(03) Dimension/Tolerance	R:	Control spatial extent for installation or fit within available space.	
	C:	State specified spatial dimensions and tolerances. State limits of incremental growth. State limits of cumulative growth.	4,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(04) Volume	R:	Control volumetric measure or capacity.	
	C:	State limits of volume or capacity.	4,5
(05) Flatness	R:	Control planar surface characteristics.	
	C:	State limits of deviation from flat, smooth, or planar surface.	4,5
(06) Shape	R:	Control surface configuration, contour, or form.	
	C:	State specified shape limitations.	4,5
(07) Weight/Density	R:	Control weight or density.	
	C:	State specified weight or density limitations.	4,5
36 Material Properties			
(01) Hardness	R:	Control resistance to penetration.	
	C:	State limits of penetration under specified load.	3
(02) Ductility/Brittleness	R:	Control capability to shape by drawing; control tendency to shatter.	

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(02) Ductility/Brittleness (Cont'd)	C:	State percentage of elongation or percent change in cross section before rupture.	3
(03) Malleability	R:	Control capability to shape by hammering.	
	C:	Limit choice of materials.	3
(04) Resilience	R:	Control capability to store energy.	
	C:	State limits of residual deformation after specified impact load.	3
(05) Elasticity/Plasticity	R:	Control capability to regain original shape when load is removed.	
	C:	State limits of residual deformation after removal of load.	3
(06) Toughness	R:	Control capability to change shape without rupture.	
	C:	State limits of energy absorption before rupture.	3
(07) Viscosity	R:	Control fluid resistance to flow.	
	C:	Specify coefficient of viscosity.	3

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(08) Creep	R:	Control permanent change in shape after prolonged exposure to stress or elevated temperature.	
	C:	State limits of permanent deformation under specified load or temperature conditions.	3
(09) Friction	R:	Control tendency of two bodies in contact to resist relative motion.	
	C:	State maximum or minimum coefficient of friction.	3
(10) Thermal Expansion	R:	Control change in unit dimension resulting from change in temperature.	
	C:	State coefficient of thermal expansion.	3

PRACTICAL

41 Interface Characteristics

(01) Fit	R:	Control size and shape of interface elements.	

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(01) Fit (Cont'd)	C:	Design for physical compatibility with specified elements.	1,4,5
(02) Attachment	R:	Control physical and electrical connection at interface.	
	C:	Design to use specified connections.	1,4,5
(03) Tolerance	R:	Control variation in interface dimension.	
	C:	Design to accommodate specified tolerance.	1,4,5
(04) Modularity	R:	Control standardized unit dimensions or repeating dimensions.	
	C:	Design for compatibility with the specified module.	1,4,5
(05) Rotatability	R:	Control orientation at interface.	
	C:	Design to provide or permit specified orientations.	1,4,5
(06) Relocatability	R:	Control ability to disassemble, move, or relocate.	
	C:	Design to provide specified flexibility to dismount and re-erect. State limits of relocation time under specified conditions.	1,4,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(07) Erection Sequence	R:	Control order of erection or installation.	
	C:	Design to permit erection or installation in specified sequence with other components or subsystems. Design to prevent progressive disassembly for repair.	1,4,5
42 Service			
(01) Repairability	R:	Provide for repair or replacement of damaged or inoperative elements.	
	C:	Design for ease of repair; limit use of special tools; limit amount of labor required.	1,4,5
(02) Interchangeability	R:	Provide for interchangeability of elements.	
	C:	Design for interchangeability. State components or elements which must interchange.	1,4,5
(03) Accessibility	R:	Provide access for service and maintenance.	

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(03) Accessibility (Cont'd)	C:	State provisions for access panels; avoid placing connections in inaccessible locations.	1,4,5
(04) Replaceability	R:	Provide for substitution of equivalent elements.	
	C:	Design to permit substitution. Describe acceptable substitutes.	1,4,5
(05) Inconvenience	R:	Limit disturbance during maintenance and repair.	
	C:	Design to minimize inconvenience; provide backup or alternate elements. State conditions for which interruption must be avoided.	1,4,5
(06) Extendibility	R:	Provide for capability to increase capacity.	
	C:	Design to permit or accommodate extension or expansion. State degree of expansion desired.	1,4,5
(07) Adaptability	R:	Provide for alteration or modification.	
	C:	Design to use industry standard connectors and interface elements. Describe conditions of adaptations.	1,4,5

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
(08) Replacement Sequence	R:	Provide for identified order for removal and replacement.	
	C:	Design for specified replacement sequence.	1,4,5
(09) Service Frequency	R:	Control repair and maintenance frequency.	
	C:	Design for identified failure rates and maintenance schedules.	2,4,5
43 Source			
(01) Multiple Source	R:	Insure number of sources available.	
	C:	State minimum number of potential suppliers.	
(02) Guaranteed Source	R:	Insure existence of source for identified period.	
	C:	State time source must be available; require security bond.	
(03) Stability of Producers	R:	Insure future source of replacement parts and maintenance.	
	C:	State acceptable evidence of stability of replacement parts from suppliers and maintenance organization.	

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Attribute		Sample Requirement (R)/ Criteria Content (C)	Test
44 Personnel Needs			
(01) Maintenance Personnel	R:	Control skill levels required for maintenance.	
	C:	Design for maintenance by personnel with identified skills.	
(02) Training	R:	Control availability of trained personnel.	
	C:	State desired provisions for training operators and maintenance personnel.	
(03) Labor Organization Requirements	R:	Control labor organization jurisdictional requirements.	
	C:	Require identification of trade union and professional organizational jurisdictions; design for noninterference between conflicting jurisdictions.	

APPENDIX D:

SAMPLE SPECIFICATION

General

This appendix is an example of a comprehensive project specification section.

Test Data

The test data used in this example was developed from a master specification prepared by the Public Building Services, General Services Administration. This example is not intended to be a guide specification and should not be used as such.

SECTION 13070

INTEGRATED CEILING AND BACKGROUND (ICB) SUBSYSTEM

PART 1 -- GENERAL

1.01 WORK INCLUDED

A. Ceiling Panels and Suspension System.

B. Background Sound Masking Distribution System.

C. Luminaires.

D. Installation of Air Distribution Components Interfacing with ICB Subsystem.

E. Coordination with Interfacing Systems.

F. Grounding of Luminaires to Outlet Boxes.

1.02 RELATED WORK

A. 05552 -- Drapery Pockets.

B. 10610 -- Demountable Partitions.

C. 15501 -- Sprinkler System.

1.03 WORK INSTALLED BUT FURNISHED BY OTHERS

A. 15800 -- Air Terminals and Related Flexible Connections.

1.04 SUBSYSTEM DESCRIPTION

A. Provide an Integrated Ceiling and Background (ICB) System composed of the following:

1. Suspended finished ceiling.
2. Means of controlling airborne sound generation and transmission within habitable space.
3. Electrical illumination.
4. Means of admitting and exhausting supplied conditioned air through the suspended finished ceiling into the inhabited space.
   a. Air supply must be dispersed throughout the habitable space.
   b. Air supply must be controllable.

B. Definitions.

1. Planning Module: Gridwork of imaginary lines which indicate possible locations of ceiling-high partitions.
2. Proposer: Entity responsible for the design, assembly, and installation of system. Proposer may be a single firm or group legally bounded as a single entity.

1.05 QUALITY ASSURANCE

A. Verify airborne sound transmission and photometric data (including calculations verifying conformance) with an Independent Testing Agency.

1.06 REFERENCES

A. Federal Specifications (FS).

SS-S-118A(3):	Sound Controlling Blocks and Board (Acoustical Tiles and Panels, Prefabricated).
QQ-N-281D:	Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip Wire, Forgings, and Structural and Special Shaped Sections.
W-F-1662A:	Fixture, Lighting (Fluorescent, Alternating-Current, Recessed and Surface Ceiling).
W-L-00116D:	Lamps, Fluorescent.

B. American Society for Testing and Materials (ASTM).

D-1925-70:	Yellowness Index of Plastics, Test for.
D-1499-64:	Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics, Recommended Practice for Operating.
2843-77:	Density of Smoke from the Burning or Decomposition of Plastics, Test for.
D-1929-77:	Ignition Properties of Plastics, Method of Test for.
G-23-69: (R 1975)	Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials, Recommended Practice for.
E 580-76:	Recommended Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
C 635-76:	Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
C 636-76:	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels, Recommended Practice for.

C. National Fire Protection Association (NFPA).

No. 70-1978 National Electrical Code.

D. Underwriters Laboratories (UL).

Applicable listings.

E. Illumination Engineering Society (IES).

IES Lighting Handbook, Fifth Edition, 1972.

F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook.

G. General Services Administration, Public Buildings Service (GSA/PBS):

Test Method PBS-C.1: Method for the Direct Measurement of Speech Privacy Potential (SPP) Based on Subjective Judgments, August 1978 Revision.

Test Method PBS-C.2: Method for the Sufficient Verification of Speech Privacy Potential (SPP) Based on Objective Measurements Including Methods for the Rating of Functional Interzone Attenuation and NC-Background, May 1975 Revision.

1.07 SUBMITTALS

A. Submit in Accordance With Section 01340.

B. Submittals Prior to Bid.
1. Submit to AE 3 weeks prior to bid date.
2. Product/Data:

Written description and/or catalog cuts describing each component of subsystem, including technical data to substantiate compliance with specifications.

3. Certification:

Provide certification signed by an office of the proposer's company attesting that subsystem proposed meets the specifications (for multiple firms, an officer from each must sign).

C. Submittals with Bid:
1. Test data:
a. Laboratory test report indicating compliance with performance requirements for control of airborne sound transmissions.
b. Photometric data, including calculations, verifying conformance with specified illumination levels and brightness.
2. Shop Drawings.
a. Reflected ceiling plan of each floor at a minimum scale of 1/8-inch per foot, showing, by dashed lines, the location of all building planning modules and their relationship to the elements in the installed configuration.
b. Reflected ceiling plans at a minimum scale of 3/4-inch per foot of at least four typical planning modules, indicating luminaires in each of the possible locations with luminaires located both parallel to and at right angles to the installed configuration.
c. Installation details showing suspension system, lay-in panels, luminaire, air-distribution components, jointing and methods of anchoring and fastening, including terminations at margins of ceilings and at intersections with vertical surfaces, including columns.
d. Layout of the background sound masking distribution components, including location of central console and control, power requirements, typical mounting components, and shop drawings of all elements of the system.
e. Layout showing coordination with the fire protection sprinkler subsystem for the building.

f. Details showing interface with the work of other trades, including connections to the air-distribution system for the building and connection of ceiling-high demountable partitions to the ceiling both parallel and perpendicular to the main runners of the ceiling suspension components.

D. Submittals Prior to Final Acceptance.

Operating and maintenance data: Submit operating and maintenance manuals, three final corrected copies of all catalog data and shop drawings, critical spare parts lists, and manufacturer's operation and maintenance data applicable to the equipment furnished. Deliver such material to the contracting officer not less than 2 weeks before occupancy.

PART 2 -- SYSTEM

2.01 TOTAL SUBSYSTEM

A. Fire Safety Requirements.
1. Flame spread: 0-25 (ASTM E-84).
2. Smoke generation: 0-25 (ASTM E-84).

B. Electrical Safety Requirements.
1. Comply with National Electrical Code.
2. Electrical components classified by UL shall meet applicable UL requirements.

C. Strength Requirements.
1. Static Loading: support gravity and superimposed loads with a luminaire in every planning module (ASTM C-635). In no case shall rating be less than intermediate duty.
2. Seismic Loading: provide seismic restraint (ASTM E-580).
3. Deflection: 1/180 maximum at any loading condition.

D. Required Arrangement.
1. Luminaires:
a. Locate one luminaire (minimum) in every group of four planning modules forming a 10'-0" x 10'-0" square.
b. Install in a regular geometric pattern.
c. Locate at right angles to exposed grid main runners.
2. Air-Distribution Components.
a. Locate one supply and one return air terminal (minimum) in every group of four planning modules forming a 10'-0" x 10'-0" square.
b. Install in a regular geometric pattern.
c. Linear air bus (if used): locate at exposed grid members not occurring on a planning module line.
d. Rectangular air diffuser (if used): locate between exposed grid members not occurring on a planning module line.
3. Sprinkler Systems Components:
a. Coordinate location of sprinkler heads and piping to prevent interference with relocation of luminaires or other components.
4. Exposed Grid Members:
a. Main runners: locate on planning module line running parallel to long axis of building.

b. Secondary runners: locate at right angles to main runners.

E. Required Acoustical Properties.

Speech-Privacy Potential (SPP): 60 minutes (PBS-D1, Procedure II, lab and field tested).

Elements meet criteria if the sum of the SPP Noise Isolation Class (NIC), and a compatible NC-background (not exceeding 40) shall be not less than 60 (PBS-C.2, Procedure II).

F. Required Interface Characteristics.

1. Modularity:

a. Accommodate ceiling-high partitions on any planning module.

b. Provide illumination and conditioned air (supply and return) in any planning module 10'-0" x 10'-0" or greater without relocating any ceiling or plenum elements.

2. Relocatability:

a. Allow relocation of luminaires without modifying suspension or lay-in panels, within ten (10) minutes by one person, to any of three adjacent planning modules which form a square.

b. Allow planning module to accept a luminaire without modification.

c. Allow rotation of luminaires 90 degrees from installed configuration in any planning module. Additional cross-ties and ending of lay-in panels are permitted in this configuration.

G. Service Requirements.

1. Interchangeability:

a. Make subsystem components of equal dimension and orientation interchangeable in the planning module.

b. Coordinate with installation of interfacing subsystems to prevent impairment of interchangeability requirement.

2.02 FINISHED SURFACE COMPONENTS

A. Suspension Members.

1. Type: Exposed grid.
2. Color: Factory-finished white (feature strips -- flat black).

B. Ceiling Lay-in Panels.

1. FS SS-S-118, CLASS 25, factory-finished white.
2. Type and pattern optional to meet other requirements.
3. Grade and thickness optional to meet other requirements.

C. Luminaires.

1. Metal parts: FS W-F-1662.
2. Lens pattern (if used): conical, hexagonal, linear octagonal prisms, or spherical segments.

2.03 BACKGROUND SOUND MASKING DISTRIBUTION COMPONENTS

A. Adjustment.

1. Provide capability to deactivate or adjust volume for each zone pair as defined by PBS-C.1, Procedure II, without disturbing system performance.

2. Provide individual volume controls for each speaker.

3. Hide sound distribution components from view.

2.04 AIR DISTRIBUTION COMPONENTS

A. Flexibility Requirements.

1. Coordinate to allow air-distribution components to provide supply and return at the ceiling plan for any four planning modules forming a 10'-0" x 10'-0" square.

B. Air Volume and Deflection Capability.

1. Provide adjustment capability for air volume control and deflection from inhabited space without moving any components of the installed system.

2. Provide rebalancing capability without the use of special tools.

2.05 LUMINAIRES

A. Illumination Requirements.

1. Level:

a. Provide minimum average maintained task-oriented lighting level 00 of 50 footcandles over the surface of a 12-square-foot work station or a plane 30 inches above the finished floor, within at least one planning module in each group of four adjacent planning modules which form a square.

b. Test: lighting levels are based on the following criteria in a hypothetical room used for calculations.

1) Size of room: 30 x 30 x 9 feet high.

2) Calculated illumination (at least 4 feet from any wall and anywhere within the space between luminaires): 30 footcandles.

3) Reflectors: ceilings -- 80 percent; walls -- 50 percent; floors -- 20 percent.

4) Lamp Lumen Depreciation (LLD): 0.87.

5) Luminaire Dust Depreciation (LDD): 0.82 (if baffled, 0.92).

6) Assume 2-1/2 percent voltage drop and 85°F ambient temperature in the return air plenum.

2. Brightness:

a. Shield light source by a lens or baffle assembly.

b. Calculated Visual Comfort Probability (VCP), arranged as specified in a 40 x 60 x 10-foot-high standard test room: 70 minimum.

c. Ratio of maximum-to-average luminaire luminance: 5 to 1 at 45, 55, 65, 75 and 85 degrees from NADIR, crosswise and lengthwise.

d. Maximum luminaire luminance (crosswise and lengthwise using 3100 lumen lamps):

Angle above NADIR (Degrees)	Maximum Luminance (Footcandles)
65	1125
75	750
85	495

e. Tests: complete photometric tests for luminaires in accordance with IES Lighting Handbook test procedures.

B. Luminaire Materials and Contribution.

FS W-F-1662 except as modified herein. Lens specified in this reference is not required if a baffle is used.

C. Lamps and Ballast

1. Ballast maximum hot spot temperature: 90°F when total planning module is operating at 87°F ambient.
2. Voltage: 277 volts.
3. Lamps: FS W-L-00116.

D. Power Input

1 watt per square foot (maximum) of ICB subsystem area.

E. Lens Element (if used).

1. Sag: 1/180 maximum
2. Materials:
   a. Clear glass or 100 percent virgin acrylic plastic.
   b. Smoke density: 50 maximum (ASTM D2843).
   c. Acrylic lenses must remain in place for 15 minutes at 175°F, but fall free at 200°F ambient temperature below ignition temperature of plastic (ASTM D-1929).
   d. Provide removable lens elements without use of tools.
      (1) If hinged, design to prevent accidental disengagement in open positions.
      (2) Permit normal serving of fixture in a quick and efficient manner (field demonstration).
   e. Plastic lenses manufactured from clear resin are resistant to yellowing. Maximum change: 3 (ASTM D 1499 and D 1925).

F. Parabolic Baffle Assembly (if used).

1. Material: 0.025-inch-thick specular aluminum with anodized finish.
2. Construction:
   a. Interlock blades to provide rattleproof assembly.
   b. Hinge baffle or provide rattleproof assembly.
   c. Design baffle to be removable without tools or requiring touching or reflector assembly (field demonstration).

PART 3 -- EXECUTION

3.01 INSPECTION

A. Examine conditions under which ICB subsystem will be installed.

B. Notify contractor in writing of unsatisfactory conditions.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General.

Install work in accordance with manufacturers' approved product installation procedures and as specified herein.

B. Suspension System.
1. Install in accordance with the IES Lighting Handbook and the National Electrical Code.
2. Correct luminaires to lighting outlet boxes.
3. Correct an equipment ground conductor from each lighting outlet box to the ground terminal of each luminaire.

3.03 FIELD QUALITY CONTROL

A. Field Acceptance Tests for Airborne Sound Transmission.
1. Perform in an open planned portion of the building in a location where the complete ICB subsystem encompasses no less than two adjacent unpartitioned structural bays.
2. The contractor shall provide necessary furnishings and equipment required for performance of the test.

B. Field Demonstrations.
1. Perform the following demonstrations in the specified time limitations on the completed ICB subsystem in the presence of the architect:
a. Remove and replace luminaire lens or baffle assembly to permit servicing, relamping, and maintenance.
b. Remove and replace a lay-in panel (20 times).
c. Relocate a luminaire to an adjacent planning module, and rotation of a luminaire 90 degrees from from the installed configuration.
d. Interchange any two components of the installed system selected by the architect having equal dimensions and orientation.

3.04 ADJUSTING AND CLEANING

A. Perform final adjustment and timing of the background masking component to insure specified performance.

B. Post instructions indicating proper settings of NC-background levels in a conspicuous location on or near the control equipment.

END OF SECTION

APPENDIX E:

TEST METHODS ASSOCIATED WITH SELECTED ATTRIBUTES

Use of Test Methods

Appendix E is a compilation of industry test methods frequently associated with various performance attributes. It is intended to assist the specifier in identifying performance criteria and tests appropriated for a specific application.

This appendix represents formal laboratory test methods cited in building systems and subsystems manufacturers' performance data, previous work in performance specifying, and industry standards organization sources. It is not comprehensive of all tests appropriate for a particular attribute. Conversely, all tests associated with an attribute will not be appropriate to every specific application.

The specifier should review the tests associated with an attribute when applying it to a specific building element in a specific application and select which, if any, are appropriate to that specific application. This is critical to insuring that user's performance requirements are accurately represented in the RFTP, and that the building industry will be capable of responding to the specific requirements.

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ASTM C635-69 (1975), Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, Spec. for, 18

ASTM E90-75, Airborne-Sound Transmission Loss of Building Partitions, Rec. Practice for Laboratory Measurement of, 18

ASTM E336-71, Airborne Sound Insulation in Buildings, Rec. Practice for Measurement of, 18

ASTM E413-73, Sound Transmission Class, Classification for Determination of, 18

ASTM E492-73T, Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine, Laboratory Measurement of, 18

ASTM E497-73T, Installation of Fixed Partitions of Light Frame Type for the Purpose of Conserving Their Sound Insulation Efficiency, Rec. Practice for, 18

ASTM E557-75, Architectural Application and Installation of Operable Partitions, Rec. Practice for, 18

ASTM E597-77T, Acoustic Isolation for Neighboring Rooms in a Building, Determining Single Number Rating, Recommended Practice, 18

ASTM, Proposed Measurement of the Interzone Attenuation of Ceiling System Assemblies for Open-Plan Spaces

PBS-C.1, Method for the Direct Measurement of Speech Privacy Potential (SPP) Based on Subjective Judgment, September 1978 Revision

PBS-C.2, Method for the Sufficient Verification of the Speech Privacy Potential Based on Objective Measurements Including Methods for the Rating of Functional Interzone Attenuation and NC Background, 1978 Revision

33 ILLUMINATION

(04) Reflectance

ASTM C523-68 (1974), Light Reflectance of Acoustical Materials by the Integrating Sphere Reflectometer, Test for, 18, 46

35 MEASURABLE CHARACTERISTICS

(03) Dimension/Tolerance

ASTM C167-64 (1970), Thickness and Density of Blanket or Batt-Type Thermal Insulating Materials, Tests for, 18

ASTM C209-72, Insulating Board (Cellulosic Fiber), Structural and Decorative Testing, 18

ASTM D542-50 (1970), Index of Refraction of Transparent Organic Plastics, Tests for, 35

ASTM D751-73, Coated Fabrics, Testing, 38

ASTM D1204-54 (1971), Changes in Linear Dimensions of Nonrigid Thermoplastic Sheeting or Film, Measuring, 35

ASTM D1777-64 (1975), Thickness of Textile Materials, Measuring, 32

ISO 2178-1972, Non-Magnetic Metallic and Vitreous or Porcelain Enamel Coatings on Magnetic Basis Metals - Measurement of Coating Thickness - Magnetic Method

(05) Flatness

ASTM D1604-63 (1975), Flatness of Plastics Sheet or Tubing, Measuring, 36

(07) Weight/Density

ASTM C167-64 (1970), Thickness and Density of Blanket or Batt-Type Thermal Insulating Materials, Test for, 18

ASTM C209-72, Insulating Board (Cellulosic Fiber), Structural and Decorative Testing, 18

ASTM C302-56 (1972), Density of Preformed Pipe-Covering Type Thermal Insulation, Test for, 18

ASTM C303-56 (1972), Density of Preformed Block-Type Thermal Insulation, Test for, 18

ASTM C519-65 (1975), Density of Fibrous Loose Fill Building Insulation, Test for, 18

ASTM C520-65 (1975), Density of Granular Loose Fill Insulations, Test for, 18

ASTM C771-74, Weight Loss After Heat Aging of Preformed Sealing Tapes, Test for, 18

ASTM D1505-68, Density of Plastics by the Density Gradient Technique, Test for, 35

36 MATERIAL PROPERTIES

(01) Hardness

ASTM C569-68 (1975), Indentation Hardness of Preformed Thermal Insulations, Test for, 18

ASTM C661-70 (1976), Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer, Test for, 18

ASTM D2240-75, Rubber Property-Durometer Hardness, Test for, 35, 37

ASTM D2583-75, Indentation Hardness of Plastics by Means of a Barcol Impressor, Test for, 35

ASTM D3363-74, Film Hardness by Pencil Test, Test for, 27

ASTM E103-61 (1973), Rapid Indentation Hardness Testing of Metallic Materials, 7

(02) Ductility/Brittleness

ASTM D1181-56 (1971), Warpage of Sheet Plastics, Test for, 35

ASTM D1790-62 (1970), Brittleness Temperature of Plastic Film by Impact, Test for, 35

(04) Resilience

ASTM C635-69 (1975), Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceiling, Spec. for, 18

(05) Elasticity/Plasticity

ASTM C711-72, Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants, Test for, 18

ASTM C734-76, Low-Temperature Flexibility of Latex Sealing Compounds After Artificial Weathering, Test for, 18

ASTM C765-73, Low-Temperature Flexibility of Preformed Sealing Tapes, Test for, 18

ASTM C638-76, Tensile Properties of Plastics, Test for, 35

ASTM D695-69, Compressive Properties of Rigid Plastics, Test for, 35

ASTM D882-75b, Tensile Properties of Thin Plastic Sheeting, Tests for, 35

(06) Toughness

ASTM C203-58 (1972), Breaking Load and Calculated Flexural Strength of Preformed Block-Type Thermal Insulation, Test for, 18

ASTM C209-72, Insulating Board (Cellulosic Fiber), Structural and Decorative Testing, 18

ASTM C297-61 (1976), Tension Test of Flat Sandwich Constructions in Flatwise Plane, 25

ASTM C393-62 (1976), Flexure Test of Flat Sandwich Constructions, 25

ASTM C686-76, Parting Strength of Mineral Fiber Batt- and Blanket-Type Insulation, Test for, 18

ASTM D638-76, Tensile Properties of Plastics, Test for, 35

ASTM D751-73, Coated Fabrics, Testing, 38

ASTM D790-71, Flexural Properties of Plastics, Test for, 35

ASTM D882-75b, Tensile Properties of Adhesive Bonds, Test for, 22

ASTM D905-49 (1976), Strength Properties of Adhesive Bonds in Shear by Compression Loading, Test for, 22

ASTM D906-64 (1976), Strength Properties of Adhesives in Plywood Type Construction in Shear by Tension Loading, Test for, 22

ASTM D1002-72, Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal), Test for, 22

ASTM C1335-67 (1972), Tuft Bind of Pile Floor Coverings, Test for, 32

ASTM D1737-62 (1973), Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus, Test for, 27

ASTM D2095-72, Tensile Strength of Adhesives by Means of Bar and Rod Specimens, Test for, 22

ASTM D2295-72, Strength Properties of Adhesives in Shear by Tension Loading at Elevated Temperatures (Metal-to-Metal), Test for, 22

ASTM D2370-68 (1973), Elongation and Tensile Strength of Free Films of Paint, Varnish, Lacquer, and Related Products with a Tensile Testing Apparatus, Test for, 27

ASTM D3165-73, Strength Properties of Adhesives in Shear by Tension Loading of Laminated Assemblies, Test for, 22

(07) Viscosity

ASTM C639-69 (1976), Rheological (Flow) Properties of Elastomeric Sealants, Test for, 18

<u>(08) Creep</u>

ASTM D674-56 (1969), Long-Time Creep and Stress-Relaxation of Plastics Under Tension or Compression Loads at Various Temperatures, Rec. Practices for Testing, 35

ASTM D1780-72, Creep Tests of Metal-to-Metal Adhesives, Rec. Practice for Conducting, 22

ASTM D2293-69 (1975), Creep Properties of Adhesives in Shear by Compression Loading

ASTM D2294-69 (1975), Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal), Test for, 22

ASTM D2990-76, Tensile Creep and Creep Rupture of Plastics, Test for, 35

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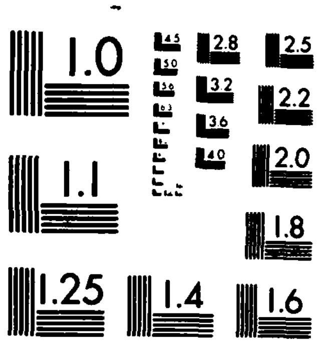

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FTMS 406/GEN. 1961, Plastics: Methods of Testing

(09) Friction

ASTM D2394-69, Simulated Service Testing of Wood and Wood-Base Finish Flooring, 22

ASTM E303-74, Surface Frictional Properties Using the British Portable Tester, Test for Measuring, 15

(10) Thermal Expansion

ASTM C351-61 (1973), Mean Specific Heat of Thermal Insulation, Test for, 18

ASTM D696-70, Coefficient of Linear Thermal Expansion of Plastics, Test for, 35, 44

ASTM D1037-72a, Wood-Base Fiber and Particle Panel Materials, Evaluating the Properties of, 22

APPENDIX F:

HOW TO DEVELOP DEFINITIVE CRITERIA WHEN PREPARING PERFORMANCE SPECIFICATIONS

Attribute 11: Fire Safety

Minimum fire safety criteria applicable to MCA programs are stated in Chapter 13 of DOD 4270.1-M[2] and, by reference, in applicable sections of the NFPA National Fire Codes.[3] Additional fire safety criteria are given in TM 5-812-1.[4]

Fire Safety Criteria

Fire safety criteria depend on facility type, hazard of contents, and the particular subsystem. In most cases, reference criteria can be adapted to performance specifications only if criteria terms are used consistently. Facility type definitions referenced in non-Government publications are similar to the categories in NFPA 101, Section 4-1. Terms used in this report which are equivalent to those used in NFPA 101 are listed in Table F1.

Table F1

Equivalent Occupancy Classifications

Facility Type Used in This Report	NFPA Reference
Administrative	Business
Operations	Business
Training	Educational
Quarters	Residential/Dormitories
	Residential/Hotels
Community Facility	Assembly
Installation/Maintenance	Industrial
Production	Industrial
Storage	Storage

[2] Construction Criteria, DOD 4270.1-M (Department of Defense, 1978).
[3] National Fire Codes (National Fire Protection Association, 1982).
[4] TM 5-812-1, Fire Prevention Manual (Department of the Army, April 1977).

Fire Safety Criteria Sources

Specific sources of fire safety criteria for each attribute listed in Table F1 are given below.

(01) Fire Code Compliance

As a minimum, criteria should require compliance with the most recent editions of DOD 4270.1-M, TM 5-812-1, and the NFPA National Fire Codes.

(02) Fire Areas

Criteria for maximum fire area for certain facility types are given in the sections of DOD 4270.1 listed in Table F2.

(03) Fire Barriers

Fire barrier criteria for enclosure of stair and elevator shafts, heater and boiler rooms, and storage areas are given in DOD 4270.1-M, Section 12-6.4. Other fire barrier criteria are given in NFPA 101, Section 6. Criteria for installation of fire doors and windows are given in NFPA 80.

(04) Egress Means

Chapter 5 of NFPA 101 gives criteria for the design of egress means.

(05) Protective Devices

Criteria for requiring installation of fire protection systems are given in DOD 4270.1-M, Section 12-2. Criteria for design of automatic sprinkler systems are given in NFPA 13. Criteria for the installation of smoke detection equipment are given in NFPA 1012 and 72E.

Table F2

Fire Area Criteria References

Facility Type	Section of DOD 4270.1-M
Storage (Warehouse)	Section 13-4.7
Quarters	Section 13-5
Other Facility Types	Section 13-6.3 and, by reference, the Uniform Building Code

(06) Fire Resistance/Combustibility

Criteria for this attribute are stated in terms of using fire-resistive or noncombustible materials for particular functional systems and facility types. Definitions of fire-resistive and noncombustible materials are given in NFPA 101 and usage requirements for various subsystems are given in DOD 42701.-M, Section 12-6.4. Criteria for buildings higher than three stories are given in NFPA 220. Final criteria are given in NFPA 101. Structural member noncombustibility is determined by ASTM E-119.[5]

(07) Fire Load/Fuel Contribution

Construction materials should not contribute a significant amount of heat to a building fire; however, no definitive Army criteria are currently available for this attribute. Recommended criteria based on past projects are listed in Table F3. Elements are defined as noncombustible if their potential heat does not exceed 32,000 Btu/lb and they meet the requirements of NFPA 220 for noncombustible materials, as measured by ASTM E-84.[6]

Table F3

Maximum Potential Heat for Building Elements*

Subsystem	Maximum Heat Contribution (Btu)
Structural elements	1000 Btu/lb
Fire protection treatment	5000 Btu/sq ft
Interior walls (including finish)	8000 Btu/sq ft
Floor and ceiling	5000 Btu/sq ft

*Based on criteria used in Guide Criteria for the Evaluation of Operation Breakthrough, NBS Report 10-200 (National Bureau of Standards). Other values may be specified as appropriate to building type and occupancy; these values should be determined by the AE and District personnel.

[5] Fire Tests of Building Construction, ASTM E-119 (American Society for Testing and Materials [ASTM], 1981).

[6] Test for Surface Burning Characteristics of Building Materials, ASTM E-84 (ASTM, 1981).

(08) Surface Spread of Flame

Interior finish materials are grouped into classes according to their flame-spread rating. Section 6-2 of NFPA 101 defines these classes and DOD 4720.1-M, Section 12-6.4 establishes criteria for their use. Criteria for allowable flame-spread ratings for roof deck and insulation are given in DOD 4270.1-M, Section 13-6.6. Criteria for flame-spread ratings of carpets are given in DOD 4270.1-M, Section 5-3.

(09) Flame Propagation

Criteria for the maximum allowable flame propagation index for carpets are given in DOD 4270.1-M, Section 5-3.

(10) Smoke Generation

Maximum smoke generation properties of thermal and acoustical insulation are given in DOD 4270.1-M, Section 12-6.6. Materials used should not give off vapor or particles defined by the American Conference of Government Industrial Hygienists at temperatures up to 600°F. Smoke density should be measured in accordance with ASTM D-2843.[7] Plastic light-diffusing elements must comply with UL-5; the maximum area in the ceiling is limited by 30 percent. Area limitations can be waived if sprinkler protection is provided. Smoke generation in flooring is measured in accordance with NBS TN 708.[8]

(11) Smoke Propagation

Criteria for the design of techniques to control and vent smoke from uncontrolled fires are described in NFPA 101, Section 6-6 and NFPA 204.

(12) Accidental Ignition

Criteria for lighting protection are given in NFPA 78. Criteria for grounding electrical conductors are given in NFPA 70.

Attribute 12: Life Safety (Other Than Fire)

Criteria for attributes in this grouping can be obtained from the sources listed below.

(01) Physical Safety

Physical safety criteria responsive to requirements of the Occupational Safety and Health Act of 1970 are listed in the General Industry Standards published in 29 CFR 1926 and are applicable to all Department of Defense facilities that will serve as places of public employment. Safety standards

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[7] Test for Density of Smoke From the Burning or Decomposition of Plastics, ASTM D-2843 (ASTM, 1977).

[8] Interlaboratory Evaluation of Smoke Density Chamber, Technical Note 708 (National Bureau of Standards, December 1971).

for architectural glazing materials are published in 16 CFR 1201. Flooring safety can be measured in accordance with ASTM D-2047.[9]

(02) Electrical Safety

Criteria for electrical safety are given in ANSI C1 (NFPA 70) and ANSI C2.[10] Components and materials used in electrical subsystems should be listed by and comply with the appropriate commercial standards of the Underwriters Laboratories and the National Electrical Manufacturers Association.

(03) Toxicity

Threshold values for toxic materials are listed by the American Conference of Governmental Hygienists.

(04) Chemical Safety

Criteria for blower and exhaust systems are given in NFPA 91.

(06) Erection Safety

Criteria for erection safety and other safety precautions to be observed on construction sites are given in EM 385-1-1; these criteria should be adapted to the type of facility being planned.

Attribute 13: Property Protection

Property protection criteria should be based on an appraisal of local conditions and judgments concerning the potential for vandalism or civil disturbances which would require maximum security and/or protection of life. Criteria for the use of fencing are in DOD 4270.1-M, Section 4-8. Other property-protection measures to be considered include lock and keying, intrusion-resistant construction, restricted access areas, intrusion detection and alarms, visual surveillance by personnel and/or equipment, protection lighting, and the protection of building elements from accidental damage related to the facility's use, occupants, or equipment; for example, the protection of fixtures, doorjambs, walls and corners, or other building equipment vulnerable to damage by vehicular movement. The AE must develop definitive criteria for this application.

Attribute 14: Handicapped Considerations

According to ER 1110-1-102,[11] Corps-designed facilities which are open to the general public and/or facilities which may provide employment opportunities for handicapped persons must provide for ease of access by the

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[9] Test for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine, ASTM D-2047 (ASTM, 1981).

[10] Recommended Practice for Electrical Equipment Maintenance, ANSI C1 (NFPA-70) (ANSI, 1977); National Electrical Safety Code, ANSI C2 (ANSI, 1981).

[11] Design for the Physically Handicapped, ER 1110-1-102 (Office of the Chief of Engineers, 1976).

handicapped. Appropriate criteria are given in ANSI A117.1 and EM 1110-1-103.[12]

Attribute 21: Code Compliance

Design code compliance criteria for structural elements are discussed in the Strength section below. These criteria depend on the type of materials used in the facility. Design codes applicable to other subsystems are summarized in Table F4. DOD 4270.1-M, Section 2-62 also requires compliance with applicable State and local codes pertaining to environmental pollution during construction operations.

Attribute 22: Strength

Criteria that must be specified for this attribute include design loads, design methods, and allowable stresses and load factors.

Design criteria for the factors listed above are given in ASA 58.1 and TM 5-809-1.[13] They include:

Table F4

Code Compliance Criteria

Subsystem	Applicable Design Code
Electrical	ANSI C1 (NFPA 70) National Electrical Code ANSI C2 National Electrical Safety Code
Plumbing	TM 5-810-5 Plumbing ANSI 40.8 National Plumbing Code FS WW-P-541 Plumbing Fixtures
Heating and Cooling	ASHRAE Guide and Data Book ASHRAE 90-75

[12] Specification for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People, ANSI A117.1 (ANSI, 1980); Design for the Physically Handicapped, EM 1110-1-103 (Office of the Chief of Engineers, 1976).

[13] Building Code Requirements for Minimum Design Loads in Buildings, and Other Structures, ANSI A58.1-1972 (American National Standards Association, 1972); Land Assumption for Buildings, TM 5-809-1 (Department of the Army, 1966).

1. Floor loads as a function of occupancy type (TM 5-809-1, Table I).

2. Wind and snow loads as a function of facility location (TM 5-809-1, Table II and Figures 1 through 4).

Criteria for earthquake design loads and design methods are given in TM 5-809-10[14] and Recommended Lateral Force Requirements and Commentation (Structural Engineers Association of California) as a function of facility location and loss-potential for the occupancy type.

Design criteria for facilities in areas subject to hurricanes and typhoons are given in TM 5-809-11.[15]

Working stresses for structural design are given in EM 1110-1-2101. Additional criteria related to design methods, stress allowances, and load factors are material-dependent, and should be obtained from the current edition of the appropriate code or specification listed in Table 6-1 of DOD 4270.1-M.

Sources for additional material-dependent design criteria are listed in Table F5. These criteria can be used if a particular project's scope of performance requires the specification of a material-specific subsystem. Partitions can be tested using the procedure given in ASTM E-72,[16] Section 13. Flooring can be tested in accordance with Method 3231 of FTMS 501a using a 50-lb load for 7 days and a 24-hour recovery period.

Attribute 23: Durability

Criteria for material and finish durability usually are material-dependent. Materials permitted by DOD 4270.21-SPEC can be used, if appropriate. Durability specifications for newly developed materials should require that the new materials' durability attributes be equal to or better than those of comparable materials listed in DOD 4270.1-SPEC or other equivalent Government specifications. Alternatively, manufacturers' association standards can be used to establish appropriate criteria for materials for particular applications. Specifications for conventional construction materials which will be applied in a manner similar to that anticipated for a planned functional system should be carefully reviewed. Criteria and tests used for the conventional material should be included in the performance specification. For example, if an exterior wall subsystem is performance specified, it should satisfy the same criteria for exterior finish durability as a conventional wall panel, including surface durability, and color change, fade, abrasion, and humidity resistance.

[14] Seismic Design for Buildings, TM 5-809-10 (Department of the Army, 1982).

[15] Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes, TM 5-809-11 (Department of the Army, 1973).

[16] Conducting Strength Tests of Panels for Building Construction, ASTM E-72 (ASTM, 1980).

Table F5

Design Criteria References

Material	Army Number	Title
Concrete	TM 5-809-2	Concrete Structural Design for Buildings
Masonry	TM 5-809-3	Masonry Construction for Buildings
Steel	TM 5-809-4	Structural Steel, Open-Web Joist and Light Gauge Steel for Buildings
Wood	TM 5-809-5	Wood Structural Design for Buildings

Attribute 24: Transmission

Maximum allowable U-factors depend on the temperature zone in which a facility is being constructed. Appropriate temperature zones can be obtained from TM 5-785.[17] Given the temperature zone, the criteria used to choose U-factors can be obtained from DOD 4270.1-M; for example, roof insulation criteria for storage facilities are given in Section 3-9.4K. Recommended U-factors are also listed in ASHRAE 90-75.[18] When specifying thermal transmission performance, the AE should consider the composite U-factor of the building envelope as a whole, rather than only the roof, walls, or floors. For example, U-value specifications for a wall must reflect the composite nature of a wall, including its windows, doors, and structural components. Provisions for thermal breaks and other such thermal considerations should also be provided.

Attribute 25: Waste Products and Discharge

The documents which give criteria for waste product and discharge attributes are EM 1110-2-501, ER 1105-2-180, TM 814-8, and ETL 1110-2-244.[19]

[17] Engineering Weather Data, TM 5-785 (Department of the Army, 1978).
[18] Energy Conservation in New Building Design, ASHRAE 90-75 (ASHRAE, 1975).
[19] Design of Small Systems Wastewater Treatment Facilities, EM 1110-2-501 (Office of the Chief of Engineers, 1978, 1980); Wastewater Collection and Treatment Policy, ER 1105-2-180 (Office of the Chief of Engineers, 1975); Evaluation Criteria Guide for Water Pollution Prevention, Control, and Abatement Programs, TM 5-814-8 (Department of the Army, 30 July 1976); Water and Wastewater Laboratory Quality Control, ETL 1110-2-244 (Office of the Chief of Engineers, 1979).

Attribute 26: Operational Characteristics

Criteria sources for operational characteristics (which include electrical, heating and cooling, and plumbing systems) are listed in Table F6. The characteristics of other operating components also can be considered under this attribute; for example, PBS Test d.1 can be used for door opening force, door slamming force, etc.

Attribute 31: Aesthetics

Section 1-4.2 of DOD 4270.1-M requires that facility design be "aesthetically compatible with the type and importance of the facility and local environments..."; this section also requires that the quality of construction be compatible with intended use. Section 5-1.2 requires "...an attention to architectural detail and concern for an aesthetic solution to the problem of integrating the overall design of the facility within its functional requirements," and states that a prime requirement of the architectural design shall be the attractiveness of both the interior and exterior of the facility. Thus, criteria for this attribute should interpret these requirements in terms of local conditions and should state aesthetic objectives for the project being performance specified.

Where the scope of performance allows the contractor latitude in the facility's design and appearance, any specific aesthetic considerations such as color, texture, and material compatibility; scale and massing; feature composition and arrangement; architectural compatibility; or architectural uniqueness should be expressed in clear and precise terms.

Color selection criteria should comply with TM 5-807-7, Section 5.1. Exterior and interior paint colors used in military construction should comply

Table F6

Criteria Sources for Operational Characteristics

System	Criteria Source DOD 4270.1-M
Electrical	Section 7-2.2
Heating and Cooling	Sections 8-5.4 and 9-1.5
Plumbing	Chapter 10

with FS No. 595. Criteria for color choice are provided in TM 5-807-7[20] as a function of building occupancy and use.

Attribute 32: Acoustics

When specifying acoustic performance, the AE should consider the performance of the space as a whole, rather than only the individual components of space division. PBS tests C.1 and C.2 may be used to specify and test space-to-space acoustic performance.

Attribute 33: Illumination

Criteria for interior, exterior, and sports lighting are in DOD 4270.1-M, Section 7-1 and, by reference, in the IES Lighting Handbook. Criteria for lighting level and color depend on occupancy and use. Cross references between facility designations used by IES and this report are given in Table F7. Illumination criteria for storage facilities are provided in DOD 4270.1-M, Table 7-3.

Table F7

Equivalent Occupancy Classifications for Illumination Criteria

Facility Type Used in This Report	Facility Designation In IES Handbook
Training	Schools
Quarters	Hotels
Maintenance	Garages
Storage	Warehouses

[20] Color for Buildings, TM 5-807-7 (Department of the Army, 15 July 1974).

Attribute 34: Ventilation

Performance criteria applicable to the planned facility location should be obtained from TM 5-785 and DOD 4270.1-M, Table 8-3. Instructions for necessary design calculations should cross reference U-factor values specified under that attribute. Other performance criteria can be obtained from DOD 4270.1-M, Sections 8-5 and 8-6. Design calculation procedures are given in the ASHRAE Handbook of Fundamentals.

Attribute 35: Measurable Characteristics

Measurable characteristics are material-dependent to a great extent. For example, it would be unreasonable to require the same tolerances for a precast concrete panel as for a metal panel. Guidance in determining these characteristics can be found in Corps guide specifications and product association standards, as well as in the Federal specifications for a particular material or component.

Attribute 36: Material Properties

Material properties are material-dependent; guidance in determining these characteristics can be found in Corps guide specifications and product association standards.

Attribute 41: Interface Characteristics

Specific military criteria are not available for these requirements. The AE must be explicit in specifying interface conditions, especially involving in-system and out-of-system interfaces.

Attribute 42: Service

No military guidance is currently available which is specifically applicable to service requirements. However, the following should be considered when specifying the service requirements:

(02) Interchangeability

The design should make it easy to replace components likely to fail during the life of the system. The use of special tools should be limited to components that are subject to vandalism or theft.

(03) Accessibility

Access doors should be provided where periodic maintenance or cleaning is necessary.

Attribute 43: Source

Specific military criteria are not available for this attribute.

Attribute 44: Personnel Needs

Specific military criteria are not available for this attribute. However, the following should be considered:

Maintenance Personnel

For some subsystems, 24-hour emergency service might be required. The availability of maintenance personnel within a reasonable distance should be demonstrated.

Training: Out-of-House Personnel

The training level of out-of-house service personnel should be demonstrated for the operation or maintenance associated with sophisticated subsystems.

Training: In-House Personnel

In-house personnel should be trained for the operation or maintenance associated with sophisticated subsystems.

APPENDIX G:

EVALUATION CRITERIA AND DEVELOPMENT

General

This appendix presents examples of how the District evaluation team may develop and use evaluation criteria and documentation. These examples show how to systematically examine a proposal to determine whether it complies with all items specified in the RFTP. The District may use the formats shown in this appendix or may develop comparable documentation appropriate for the specific conditions of a particular project. The cited specification paragraphs are used as examples only and are not to be interpreted as guide specifications of any sort.

Tabular Examples

The following text describes how to use a tabular approach to determine a proposal's compliance to all performance specification criteria. This format is a one-to-one association among the specified performance levels and those provided in the proposal. Statements such as those shown in Figures G1 and G2 should be tabulated for each performance criterion specified in the RFTP.

The District can use this tabular approach to evaluate compliance in the following cases:

1. Where there are no extraordinary performance requirements for the facility; i.e., the requirements are fairly straightforward and conventional.

2. Where proposals are likely to use well understood building technology.

3. Where the evaluation team is familiar with the performance tests cited in the performance specifications.

4. Where the District feels it is unnecessary to evaluate proposals in any greater detail.

5. Where the District is under such time constraints that a more detailed evaluation would be impossible.

While Figure G1 appears more complicated, it provides the evaluator with more information, expediting evaluation and avoiding continual cross-referencing with the RFTP document. A format comparable to Figure G1, therefore, is recommended over the one shown in Figure G2.

The performance specification criterion evaluated in Figures G1 and G2 is given in Table G1.

Table G1

Performance Specification Sample 1

10600 Interior Partition Subsystem
2.01 Total Subsystems

05. Color stability.

Criterion a: The exposed surface of this subsystem in use shall not differ from reference specimens not subjected to color fading conditions, when tested according to FTMS No. 501a, Method 5421. Variegated, irregular, or translucent finishes shall be visually evaluated for acceptability of color change using Method 5421.

06. Surface color variation.

The exposed surface of this subsystem in use shall not differ more than three "e" units in color overall or when compared with reference samples, when tested according to FTMS No. 141a, Method 6123.

07. Cohesion/adhesion.

All coatings on exposed metal and plastic surfaces of this subsystem under 0.005 inches thick shall not delaminate, when tested according to PBS-D.4.

08. Point impact resistance.

Any part of this subsystem which is exposed to view shall withstand 18 inches/pound of impact on its exposed surface without indentation greater than 1/6-inch measured 24 hours after impact, and without any other permanent damage, when tested according to FTMS NO. 406, Method 1074.

Performance Criterion Evaluation Example

The following text describes how to examine a proposal for compliance with all aspects of a performance criterion: the conditions of the criterion, the specified performance, the test method, and the data required to verify performance. The evaluation criterion reflects, on a one-to-one basis, all aspects of the performance criterion specified in the RFTP. It will be easier for the evaluation team to decide whether a proposal satisfies all requirements of the performance specification if the RFTP gives a precise explanation of required submittals. Thus, a form such as that shown in Figure G3 should be developed for each performance criterion specified in the RFTP. The District can then use this figure to help evaluate compliance in the following cases:

1. Where achieving the specified performance levels will be critical for the facility.

2. Where proposals are likely to use innovative or nonstandard construction technology with which evaluation personnel may not be familiar.

3. Where the District evaluation team may not be familiar with the performance tests cited in the performance specifications.

4. Where the District feels it is necessary to make a detailed evaluation.

5. Figure G4 shows how performance criteria can be evaluated to verify compliance with a performance specification criterion. (The performance criterion evaluated in Figure G4 is given in Table G2.)

Table G2

Performance Specification Sample 2

10600-Interior Partition Subsystem
2.01 Total Subsystem

08. Point Impact Resistance
Any part of this subsystem exposed to view shall withstand 18 inch pounds of impact with indentation of no greater than 1/16-inch measured 24 hours after impact, and without other permanent damage when tested according to FTMS No. 406, Method 1074.

10600 INTERIOR PARTITION SUBSYSTEM (Cont'd)

DISTRICT REVIEWER: JOHN DOE

REVIEWER'S TECHNICAL AREA: ARCHITECTURAL SEC.

PLACE: SAVANNAH DIST. OFFICE DATE: 1 APR 81

	REFERENCE	SPECIFIED	PROPOSAL	COMPLIANCE	
2.01.05a	Color stability	no change	NO CHANGE	/ yes	__ no
2.01.05b	Color stability	no damage	NO DAMAGE	/ yes	__ no
2.01.06	Colar variation	max. 3 "e" units	"e" UNITS	/ yes	__ no
2.01.07	Cohesion/adhesion	no delamination	NONE	/ yes	__ no
2.01.08	Point impact resistance	max. 1/16" indentation	3/64" ACTUAL	/ yes	__ no
		no other damage	NONE	/ yes	__ no

etc.

etc.

Figure G1. Tabular example 1.

10600 INTERIOR PARTITION SUBSYSTEM (Cont'd)

DISTRICT REVIEWER: JOHN DOE

REVIEWER'S TECHNICAL AREA: ARCHITECTURAL SEC.

PLACE: SAVANNAH DIST. OFFICE DATE: 1 APR. 81

	REFERENCE	PROPOSAL DOES	/ DOES NOT COMPLY
2.01.05a	Color stability	/	
2.01.05b	Color stability	/	
2.01.06	Color variation	/	
2.01.07	Cohesion/adhesion	/	
2.01.08	Point impact resistance	/	

etc.

etc.

Figure G2. Tabular example 2.

SUBSYSTEM COMPONENT: ____ DISTRICT REVIEWER: ____

ATTRIBUTE: ____ REVIEWER'S TECHNICAL AREA: ____

REFERENCE: ____ PLACE: ____ DATE: ____

PROPOSED SUBSYSTEM DESCRIPTION: ____

PERFORMANCE RESULTS

SPECIFIED		PROVIDED AS SPECIFIED: yes	no	alternative (if provided)
CRITERION:				
conditions	*(the conditions under which the subsystem's performance is to be achieved, as specified in the RFTP. example: "after 300 standard fading hours exposure" or "dead load=100psf")*	___	___	___
measure	*(the performance level the subsystem is to achieve, as specified in the RFTP. example: "no changes in color" or "max. deflection=1/360")*	___	___	___
TEST METHOD:	*(the method by which performance is to be determined)*	___	___	___
SUBMITTAL:	*(the data the District requires from the proposer as specified in RFTP section 01300-submittals)*	___	___	___
FORMAT:	*(the format in which the District requires the proposer's data, as specified in RFTP section 01300-submittals)*	___	___	___

PROPOSAL ____ DOES ____ DOES NOT COMPLY

Figure G3. Performance criteria format.

SUBSYSTEM/COMPONENT: Interior Partition/Total Subsystem

ATTRIBUTE: Point Impact Resistance

REFERENCE: 10600, 2.01.08

DISTRICT REVIEWER: JOHN DOE

REVIEWER'S TECHNICAL AREA: ARCHITECTURAL SPEC

PLACE: SAVANNAH DIST. OFFICE DATE: 1 APR 81

PROPOSED SUBSYSTEM DESCRIPTION: DEMOUNTABLE PARTITION, METAL STUD W/CEMENT-ASBESTOS FACE

PERFORMANCE RESULTS

SPECIFIED		PROVIDED AS SPECIFIED yes	no	alternative (if provided)
CRITERION:				
conditions	any parts exposed to view	/		
	18 inch-pounds impact	/		
	measured 24 hours after impact	/		MEASURED 20, 24 & 26 HRS. AFTER
measure	indentation no greater than 1/16"	/		3/64" ACTUAL
	no other permanent damage	/		
TEST METHOD:	FTMS No. 406 Method 1074	/		
SUBMITTAL:	lab test report, displaying values & conditions tests	/		
FORMAT:	8 1/2 x 11, written and graphic	/		PHOTOGRAPHS ALSO

PROPOSAL / DOES ____ DOES NOT COMPLY

Figure G4. Evaluation criteria format.

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Fort Lesley J. McNair 20319
Fort Myer 22211

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ATTN: Facilities Engineer
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Bayonne MOT 07002
Sunny Point MOT 28461

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