

CHAPTER 4

**PRECONCEPT DESIGN STUDY SUBMITTAL (FOR ARMY
PROJECTS)
10 PERCENT**

**CONCEPT DESIGN SUBMITTAL (FOR AIR FORCE PROJECTS)
20 PERCENT**

4.1 General. The concept submittal (10 or 20 percent) shall consist of an analysis of design, schematic drawings, and a cost estimate. The requirements for the analysis of design and the drawings will be defined in this chapter by discipline. The preparation of the cost estimate is covered in Cost Estimating, "Code A," in volume 2.

4.2 Objective. The concept submittal shall provide sufficient information to demonstrate that the users' project requirements can be met within the programmed budget and scope of work. The concept submittal shall indicate the designer's proposed design approach demonstrating up to three alternate schemes for review. Applicable criteria shall be listed and major design constraints and opportunities addressed. Any information needed to support the designer's approaches shall be provided for review.

4.3 Civil Design.

4.3.1 Basis for Design. The various aspects of the civil site design shall be shown at this phase. A narrative shall describe the type and extent of the civil design features under consideration and the designer's recommendation for their design. This shall include such elements as storm drainage, roads and paved areas, fencing, environmental impact, landscaping, site efficiency, and future expansion if appropriate.

4.3.2 Computations. Computations shall include estimated grading and excavations and an approximation of site utilities involved as well as any paving and miscellaneous site improvements. These computations shall be consistent with the level of detail of design involved in a 10- or 20-percent submittal.

4.3.3 Drawings. The drawings shall include a location map indicating the relationship of the site to the surrounding area. All major existing structures and/or streets shall be shown to facilitate identification of the proposed site. The schematic site plan(s) showing building orientation, paving and access, and landscaping, shall be provided.

4.4 Architectural Design.

4.4.1 Basis for Design. Indicate how the structure relates to existing structures. Themes for the architectural treatment and the possible types of building construction shall be shown stating the reasons for the selections made. The occupancy and barrier free access requirements must be defined and criteria listed. Describe how the location and orientation of the structure relates to environmental considerations. Describe any additional or unusual features which will affect further design development.

4.4.2 Computations. The gross floor areas of finished and unfinished space shall be provided. The floor areas of specific programmed areas and/or rooms shall be calculated to indicate compliance. The floor areas of additional covered or uncovered spaces related to the structure must also be computed and described.

4.4.3 Drawings. The drawings shall include the schematic floor plan(s) showing the overall size of the structure, the functional arrangement, occupancy, and circulation spaces. The floor plan shall indicate major zoning requirements and building organization. A building section indicating the structures vertical relationship to the site as well as internal floor to floor heights shall be shown.

CHAPTER 5

CONCEPT DESIGN SUBMITTAL (FOR ARMY PROJECTS)

35 PERCENT

**EARLY PRELIMINARY DESIGN SUBMITTAL (FOR AIR FORCE
PROJECTS)**

35 PERCENT

5.1 General. The concept (Army) and early preliminary (Air Force) submittals (35 percent) are essentially the same and consist of an Analysis of Design, drawings, outline specifications, and a cost estimate. This chapter shall define, by discipline, all the specific requirements of the Analysis of Design and the drawings. Guidance for the preparation of the outline specifications is described in the General Instructions, Volume 3, Specifications. Requirements of the Code B cost estimate are provided in the General Instructions, Volume 2, Cost Estimating. It is especially important to provide a useable cost estimate at this submittal. Refer also to Chapter 3, "Presentation of Data." Volume 4, Design Criteria, presents design criteria which consists of specific criteria references for developing the design.

5.2 Objective. The concept and early preliminary submittals shall be of sufficient detail to show the user how his functional and technical needs will be met, to indicate the designer's approach to solution of technical aspects to all reviewers, to show compliance to the criteria or justification for noncompliance, and to provide a valid estimate of construction cost. The submittal shall be heavily oriented toward creating the proper architectural treatment and establishing the design of the basic structural, mechanical, and electrical systems, and in general, show the District that the project has been sufficiently thought-out to enable it to proceed with no major changes in design. All deviations from applicable criterion such as military construction criteria, building code, fire protection, life safety, OSHA, and safety manual, shall be summarized and enumerated in design analysis. Identify deviation, citing source and paragraph, what criteria requires and nature of deviation, followed by authority granting waiver and date. If waiver has not been granted, indicate NONE.

5.3 Civil Design.

5.3.1 Basis for Design. Establish basic criteria for each aspect of the overall civil design. Provide justification for the selection of criteria and proposed features over alternate options or possible solutions.

5.3.1.1 Water Distribution.

5.3.1.1.1 Develop basic and controlling water demands and show required residual pressures. Include fire, domestic, and industrial average and/or peak demands as applicable. Show adequacy of distribution system to supply controlling demands and include information basic to this determination such as known flow tests and/or computations. State whether additional fire hydrants are needed and indicate the recommended location of each hydrant. If the water requirements for the project are considerable, state whether a determination has been made regarding the capability of the existing system to meet the additional demand or if future analysis is needed.

5.3.1.1.2 For service lines, distribution main extensions, and new distribution systems, state the propose friction coefficient, approximate controlling elevations, special material requirements, and any special features of the design such as pressure reducing or regulating values. For irrigation systems, indicate types of sprinkler heads, effective coverage, proposed spacing, and sectionalization.

5.3.1.2 Water Supply. Water supply (including sources, treatment, storage, pumping, and supply lines) for new systems or additions.

5.3.1.2.1 Give basic information such as population, capacity factor, per capita allowances, industrial, and irrigation requirements, and fire demands.

5.3.1.2.2 Provide information on type, condition, and adequacy of existing units such as well, pumps, reservoirs, etc., and current water consumption. If these items are already described in detail in an existing report, give summary statement and appropriate reference.

5.3.1.2.3 In describing proposed works, including functional design concepts basic to selection of type of units, materials, economy of operation, controls, etc. Provide statement of tentative sizes or capacities of major components, any critical elevations or dimensions, and essential related items as estimated from preliminary computations.

5.3.1.2.4 Identify the requirement for a new or additional source of water and the use of such water at an early stage. Normally, the District will provide data on additional water supply after the requirements have been identified. Where the scope of work specifically includes the determination of new or additional water supply, the following should be included: For new sources, include data on existing supplies and alternatives for new sources such as wells and surface supplies. Provide data for all proposed water wells and test drilling programs with full explanation of geological and other factors affecting choice of location, type, diameter, depth, and important related characteristics.

5.3.1.3 Water Treatment. Where water treatment is included in the job, the designer shall provide a copy of the water analysis and describe the elements of the design, including the capacities and number of units, monitoring equipment, and controls. The alternatives that were considered and the reason for selecting the design over the alternatives shall be discussed demonstrating how the design will correct the objectionable characteristics of the water.

5.4.1.4 Sewage.

5.4.1.4.1 Sewage Collection. Discuss peak and average flow determinations for building connections, individual sewer lines, and force mains based upon population data, measurements, or computations from the number of fixture units. Indicate controlling elevations and compliance with slope and size criteria. Confirm adequacy of existing sewers to carry additional flow.

5.3.1.4.2 Provide basic information, such as population, capacity factor, per capita flows, quantity, and nature of waste, etc., as applicable and develop required size and capacity for sewage lift stations.

5.3.1.4.3 Sewage Treatment. Where waste treatment is included in the job, explain the degree of treatment required to meet the applicable discharge standards. A complete description of the nature of the waste shall be included. Describe the elements of the design, including the capacities and number of units, monitoring equipment, and controls. The alternatives that were considered and the reason for selecting the design over the alternatives shall be discussed demonstrating how the design will achieve the treatment goals. Pilot plant testing programs which are to be conducted will be described, and in the case of land treatment, a soil testing program will be developed and described.

5.3.1.5 Storm Drainage and Grading. Discuss the proposed drainage design. The discussion shall include the rainfall intensity and return period, concentration times, infiltration rates, the size of the contributing area, method of computation, and the reasons behind the selection of each of the above. Describe the grading plan and the controlling slopes which will be used in the design.

5.3.1.6 Roads. Street. Open Storage Areas. Hardstands. and Walks. Discuss the geometric features of the paved areas such as widths of traffic lanes, shoulders, parking spaces, and walks. Data relating to the design such as type, volumes and composition of traffic; vertical and horizontal controls; and the class and category of road or street shall be included. The design section for all exterior pavements will be provided by the District in the geotechnical report. This section will be used in preparation of bidding documents and all other items related to pavements will be developed by the designer using applicable criteria and instructions. This report shall be referenced and a copy appended to the Basis for Design as an appendix.

5.3.1.7 Fencing. Describe the type and height of fences and gates. The description shall include features such as outriggers, barbed wire, or tape and gate controllers.

- 5.3.1.8 Dust and Erosion Control. Include a statement of the proposed type and method of accomplishing dust and erosion control, reasons for selection, extent of area treated, etc. If no treatment is proposed, justify omission.
- 5.3.1.9 Railroads. Include the type of service, volume, and traffic; the condition and weight of rails; type and thickness of ballast; ruling grade; type of treatment and size of ties; subgrade compaction requirements; types of track accessories, turnouts, and switches; and the name of the operating agency.
- 5.3.1.10 National Pollution Discharge Elimination System (NPDES) Permit. In projects where wastewater is not discharged into an existing collection and disposal system, the NPDES permit will be referenced and appended to the Basis for Design. Excepted from this requirement are small storm drainage facilities where no separate permit is issued.
- 5.3.1.11 Economic Analysis. Furnish economic comparisons between feasible alternatives for site layout, facility orientation, utilities systems, paved areas, and other site improvements.
- 5.3.1.12 Environmental Impact. Review the environmental impact analysis (environmental impact assessment or environmental impact statement) to determine whether any design feature changes the conclusions or recommendations of the analysis. Should changes to the analysis be required as a result of the design, a complete description of the required changes shall be included in the Basis for Design. If no changes are required to the analysis, the designer shall indicate this conclusion in the Basis for Design.
- 5.3.1.13 Energy Efficiency. Where the civil design includes energy consuming processes, provide studies on comparative energy conservation measures.
- 5.3.1.14 Landscaping. Include a statement of need and justification for proposed landscaping and description of existing and proposed plantings. State any unusual climatic or soil conditions or other local factors which affect the design or selection of plant species. State that no landscaping is required if this is the case.
- 5.3.1.15 Corrosion Mitigation. Refer to Paragraph 5.8, Corrosion Design.
- 5.3.1.15 Airfield Pavements. The District will furnish the pavement section design in the geotechnical report consisting of a brief description of foundation explorations, materials investigations, field tests, a statement of foundation conditions, results of field tests, a statement of values used in pavement design, basis for selection of pavement section, a diagram of the geometric layout of pavement joints, and a description of the adopted pavement sections. A copy of the report shall be attached to the basis for design as an appendix.
- 5.3.1.17 Future Expansion. Where buildings are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. State that no provisions have been made for future expansion if this is the case.
- 5.3.2 Computations. Computation appropriate to level of 35 percent design.
- 5.3.3 Drawings. The site plans shall show existing and proposed features such as buildings, paved areas, utilities with actual or tentative sizes, hydrants, valves, fences, and landscaping. The new facility shall be superimposed on existing topography. Reference the source of the survey data and the location where filed. The drawings shall have sufficient horizontal and vertical control to clearly indicate the proposed siting of the facility in relation to existing features. A small scale location map shall be provided showing the location of the project on the base and the general relation between the new facility and major existing structures and/or streets to facilitate identification of the proposed site.

5.4 Architectural Design.

5.4.1 Basis for Design.

5.4.1.1 State what general type of architectural treatment exists both on the installation and in the immediate vicinity of the subject project. Although selected design features of this structure should be repeated from existing structures, the design need not necessarily be identical. Motif must follow the most recent, predominant, existing theme of the installation to insure future long range design continuity. Give description as to how this design satisfies these requirements. Give a description of particular framing and wall systems selected, others considered, and reasons for selection.

5.4.1.2 Provide a statement as to type of construction per criteria, e.g., fire-resistive, noncombustible, noncombustible protected, etc.

5.4.1.3 Building Wall and Roof Construction. Provide statement of required type of construction based on occupancy, area, and height, i.e., noncombustible, etc., per fire protection analysis.

5.4.1.4 The "U" or overall heat transmission factor as required by AEI.

5.4.1.5 Provide an economic comparison of the in-place costs of three or more wall systems. The comparison will only consider systems which meet criteria for type of construction and the required "U" factors, are suitable to the seismic zone, and meet the durability and esthetic requirements for the project and life cycle costs. Present the first costs for each component of the wall system, combine these, and arrive at an overall cost per square foot of wall surface. Describe the maintenance requirements for each system studied. Provide a section through each wall system and show all components of the wall. Attach the economic comparison to the Basis for Design as an appendix.

5.4.1.6 Building Orientation. State how location on the site relative to local climate effects the placement of entries, fenestration, and roof overhangs due to prevailing wind, sun, and noise. Discuss architectural features resulting therefrom and relative costs thereof, i.e., tinted or thermal glass if required as opposed to glass ordinarily used.

5.4.1.7 Provide a tabulation of all equipment in the project to show the following: (If none, so state for each subparagraph below).

5.4.1.7.1 Contractor Furnished-Contractor Installed (CF-CI).

5.4.1.7.2 Government Furnished-Contractor Installed (GF-CI).

5.4.1.7.3 Government Furnished-Government Installed (GF-GI) or not in contract (NIC).

5.4.1.8 Provide a description of materials for all major building components and of all interior and exterior finishes. The description shall include type of exterior wall construction, window types, panel materials, etc.

5.4.1.9 Provide a discussion of the designer's reasons for selecting specific materials, plan solutions, and architectural treatment in all cases in which the reason for selection is not obvious.

5.4.1.10 Color Boards. Submit in a standard 8-1/2 inch by 11 inch three-ring binder. Fold outs may be employed to 25-1/2 inch by 33 inch as long as they refold within the standard binder. Provide two color schemes for projects which involve building construction or building modification.

5.1.4.10.1 Actual material samples shall be displayed showing color, texture, pattern, finish, thickness, etc., for all appearance-related items where choice exists. These samples shall be large enough to indicate true patterns. However, care should be taken to present materials in proportion to that which will actually be installed in a given situation. Samples shall be organized by color schemes with a separate sample for each scheme. The schemes shall be coordinated by room names and numbers shown on the architectural floor plans. Colors shall be labeled with generic color names.

5.1.4.10.2 Project title and base shall occur in the lower right-hand corner of each module.

5.1.4.10.3 Where special finishes such as architectural concrete, carpet, or prefinished textured metal panels are required, samples not less than 12 inches square shall be submitted with the boards.

5.4.1.11 Provide a systematic criteria/code analysis of building construction and fire protection/life safety requirements by citing applicable criteria and paragraph reference indicating what is "required" by the referenced citation and "actual" design condition for the following features. This shall include Fire Protection Life Safety Plan and Narrative similar to the example attached in exhibit A. Where there is a conflict among the different codes, the most restrictive shall govern.

5.4.1.11.1 Building construction requirements:

5.4.1.11.1.1 Ground floor area, total area, height, and number of stories.

5.4.1.11.1.2 Occupancy use classification as defined in UBC, table 5-A, for purposes of determining area and occupancy separations.

5.4.1.11.1.3 Building height limit per UBC, table 5-D, and MIL-HDBK-1008 section 2-2.

5.4.1.11.1.4 Fire area limit per UBC section 505-507, table 5-C, AEI ch. 9, and MIL-HDBK-1008 section 2-2.

5.4.1.11.1.5 Fire resistive requirements of type of construction required to meet area/height/story limits. List from UBC, table 17-A. Also specific type of construction requirements for military projects under AEI chapter 9.

5.4.1.11.1.6 Mix occupancy/occupancy separation per UBC 503, table 5B, and NFPA 101.

5.4.1.11.1.7 Area separation UBC 505, 503a, and requirements for separation between structures.

5.4.1.11.2 Spacing between structures per AFR-88-15, table 13-3, and MIL-HDBK-1008, tables 2-4 and 2-5.

5.4.1.11.3 Life safety requirements, NFPA 101.

5.4.1.11.3.1 Occupancy load for exiting.

5.4.1.11.3.2 Means of egress requirements for the occupancy-occupant load, capacity of means of egress, exit units, number, arrangement, travel distance, illumination, emergency lighting, exit marking, and panic hardware requirements.

5.4.1.11.4 Additional Fire Protection and Life Safety Requirements.

5.4.1.11.4.1 Protection of vertical openings (UBC and NFPA). The codes are specific in regards to fire rating requirements but the exceptions to the requirements are not specific. The A-E is advised to obtain an acceptable interpretation from authority having jurisdiction before proceeding with design of unprotected floor openings.

- 5.4.1.11.4.2 Protection from hazards per NFPA 101, AEI, and AFR 88-15.
- 5.4.1.11.4.3 Corridor separation per UBC and NFPA. (For sprinkled building the UBC is more restrictive than the NFPA.) The A-E shall coordinate with local authority having jurisdiction to applicable criteria.
- 5.4.1.11.4.4 Smoke barrier if required by occupancy.
- 5.4.1.11.4.5 Fire rated door.
- 5.4.1.11.4.6 Fire rated glass.
- 5.4.1.11.4.7 Fire alarm system
- 5.4.1.11.4.8 Interior finish per MLL-HDBK-1008 and AFR 88-15, ch. 15.
- 5.4.1.11.5 Extinguishing and/or fire sprinkler system
 - 5.4.1.11.5.1 Show extinguisher location.
 - 5.4.1.11.5.2 Fire sprinkler system requirements per NFPA, AEI ch. 9, and AFR 88-15, ch. 15.
- 5.4.1.11.6 Operation involving use or storage of flammable and explosive liquids, gases, or dusts. (Describe type of electrical equipment, lighting fixtures, ventilation, and other related fire protection features.)
- 5.4.1.11.7 Physical handicapped (requirements per Uniform Federal Accessibility Standard).
- 5.4.1.12 State whether a fallout shelter has or has not been provided. If fallout protection is required, state protection factor and number of shelter spaces being provided.
- 5.4.1.13 Future Expansion. Where buildings are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. State that no provisions have been made for future expansion if this is the case.
- 5.4.2 Computations. Gross floor area computations. The floor area for each room shall be presented in tabular form in the computations. These areas will not be shown on the drawings. Break down the area into two categories, those calculated on the basis of full area and those calculated on the basis of one-half area, then show the grand total. Also show the programmed area for each room
 - 5.4.2.1 Calculate full areas (including all openings in floor slabs) measured to the outer surface of the inclosing walls for the following:
 - 5.4.2.1.1 Floors, including basements.
 - 5.4.2.1.2 Mezzanines and balconies.
 - 5.4.2.1.3 Penthouses.
 - 5.4.2.1.4 Inclosed passages and walks.
 - 5.4.2.1.5 Finished usable spaces with sloping ceilings with an average height of 7 feet and minimum of 5 feet at perimeter walls.
 - 5.4.2.1.6 Appended covered shipping and receiving platforms measured from the face of the building wall to edge of the platform

5.4.2.2 One-half of the actual area of the following shall be calculated:

5.4.2.2.1 Covered open porches.

5.4.2.2.2 Appended, uncovered, shipping and receiving platforms at truck or railroad car floor height, measured from the face of the building wall to the edge of the platform

5.4.3 Drawings.

5.4.3.1 Floor Plan. Show overall dimensions, functional arrangement, type of occupancy of all areas, major pieces of equipment, and interior/ exterior colors and finishes in tabular form

5.4.3.2 Elevations. Provide all principal elevations showing any exterior electrical/mechanical equipment affecting the appearance of the structure. Also include story heights, fenestration, control joints, and site adaptation to the finished grades.

5.4.3.3 Building Section. Provide at least one principal section showing floor and roof framing, suspended ceilings, floor to floor heights, concealed or open ducts, relation of fenestration to supporting columns or walls, etc. If necessary to show special features, other primary transverse or longitudinal sections may be shown.

5.4.3.4 Provide exterior wall section for each type of wall system. These wall sections are to be cut from the floor plan not the elevation.

5.5 Structural Design.

5.5.1 Basis for Design. Outline and define the structural methods and materials of design and construction and enumerate all criteria and assumptions on the following items:

5.5.1.1 Provide a statement referencing the geotechnical report which will be attached as an appendix to the Basis for Design. The geotechnical report will normally be provided by the District. Describe the type of foundation proposed, estimated depth of bearing, allowable bearing values, compaction requirements, and any other measures mentioned in the geotechnical report or recommended by the designer. In some projects, the geotechnical report may recommend two foundation types as being acceptable. In these cases, an economic comparison between the two shall be presented and the more cost effective type selected.

5.5.1.2 Provide an economic comparison of at least three structural framing systems for each area of the building that has a distinctly different framing scheme. Availability of local labor and materials will be considered in selecting the systems. A portion of the structure large enough to be representative of the entire building will be designed in enough detail to provide for a labor and materials estimate that will be the basis of the structural system selection. Each of the systems shall be presented on a sketch indicating the sizes of all the framing members for each area of the building with a different framing scheme. For a one-story structure, the comparison shall be done for the roof structure. For a multistory facility, one cost comparison shall be presented for the floor system and one for the roof system. Attach the comparison to the Basis for Design as an appendix. Provide a word description of all the candidate solutions and indicate that the most economical has been selected. The comparison shall consider the fire protection requirements for the specific structural features being investigated.

5.5.1.3 Describe the lateral force resisting system by defining the location and number of shear walls, materials to be used for a diaphragm, seismic joint locations, foundation ties, and any other components of the lateral force resisting system.

5.5.1.4 List all design live loads identifying them with use and area; show wind velocity and load; ground and roof snow load; and state the seismic zone, K, C, I, K, and S values. Indicate loading combinations for which structure will be designed. List documents used in determining loads with all applicable factors used in determining loads.

5.5.1.5 State the strength (working stresses or yield stresses) for all structural materials on the project.

5.5.1.6 For structures designed for blasts, list all appropriate design parameters such as for the donor system amount, type, TNT equivalent, and location of explosive material in each area. For the receiver system, state the personnel, equipment, and other explosive material which requires protection in each area. Also define the protection categories for each area to prevent the following: (a) communication of detonation by fragments and high blast pressures and (b) mass detonation of explosives as a result of subsequent detonations produced by communication of detonation between two adjacent areas. Define blast wall, blast door, and frangible element locations to complete the description of the protective construction design approach.

The design shall be signed off by the holder of a current accreditation in blast design as given by Federal Emergency Management Agency (FEMA).

The requirements for FALL OUT SHELTERS shall be covered in the basis of design. The A-E shall address whether a full area or partial area shelter is appropriate. Economic comparison of both types shall be included in the basis of design.

5.5.1.7 Future Expansion. Where buildings are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. State that no provisions have been made for future expansion if this is the case.

5.5.2 Computations. Provide those design calculations required by the economic comparison to size the framing members.

5.5.3 Drawings.

5.5.3.1 Foundation and Floor Plan. Show type of foundation proposed, depths of footings, relation of walls and floor slab to foundation system, overall dimensions, column spacing, joint pattern in slab-on-grade, tie beams, grade beams, etc.

5.5.3.2 Floor Framing Plan. Show spacing of framing members, overall depth of floor structure, column spacing, principal dimensions, and shape of the building.

5.5.3.3 Roof Framing Plan. Show locations of framing members, overall shape and dimensions, diaphragm, etc.

5.6 Mechanical Design.

5.6.1 Basis for Design.

5.6.1.1 Provide a statement of indoor and outdoor design temperatures for heating and cooling and proposed "U" factors for walls, ceilings, floors, etc.; personnel load; equipment heat release (if any); outside air or ventilation requirements; and any other special conditions.

5.6.1.2 State type of heating plant and justification for selection, operating pressure and temperature, and approximate capacity. Provide discussion of temperature control system. Indicate type of conducting system, e.g.; forced warm air with direct fired furnace or hot water coil, forced hot water or steam with direct radiation, or single zone variable volume air system with baseboard heating. Type of heat distribution outside of buildings; steam or high temperature hot water and whether above ground or under ground. State requirement for outside air and basis for determination of quantity, i.e.; number of air changes per hour, of CFM per person, or other.

5.6.1.3 Economic Comparison. When specific Army or AF criteria does not indicate the preferred method of heating, ventilating, and air conditioning, the designer is to discuss the alternatives considered and the final selected based on economics, fuel cost, ease of maintenance, etc. Provide a present worth, life cycle cost economic study of the candidate systems. The study shall show the annual costs of fuel and maintenance for each system over its service life. These costs shall then be brought back to the present and combined with the first costs to determine the most economical system. Attach the economic study as an appendix. The District will provide such economic study parameters as interest rates, fuel escalation rates, energy costs, etc.

5.6.1.4 Computer of the Building. When the SOW requires a computer simulation of the building, compare a minimum of three heating and air-conditioning systems. Multizone, variable volume, or constant volume air handling equipment in combination with water or air cooled reciprocating chillers; reciprocating chillers with cooling towers; double bundle condensers; and other system combinations shall be considered. Variation of the "U"

factor from the stated criteria may also be integrated into the study. Following guidance referenced in the Criteria Index Volume 4 under "HVAC, Computer Simulation for Buildings," present the installed first cost, energy consumption (BTU's/6q. ft./yr.), total annual owning and operating cost, annual operating cost, etc., for each system considered. Then select the best system based on the life cycle costing/energy analysis.

5.6.1.5 Energy Budget. Provide an energy budget unless the SOW indicates otherwise. If a computer simulation of the building is required, then a separate energy budget need not be performed. The energy budget is the sum total of the energy consumed in a year within the boundaries of the building for space heating and cooling, ventilation domestic hot water, and lighting. The analysis shall not be performed on candidate building systems but only on the final, selected systems, and shall be presented in BTU's per square foot per year. For additional guidance, refer to the Criteria index under "HVAC, Computer Simulation for Buildings," Volume 4.

5.6.1.6 For air-conditioning systems, provide a statement as to the extent authorized and as to any authority for waiver of these criteria. State whether for comfort cooling or according to technical requirements or both. For technical requirements, show the authorized tolerances for temperature and humidity control, the degree of air cleaning or purity required, and any other special considerations involved. A description of the air-conditioning system proposed, including the approximate capacity, location of the major components, cooling media (water or DX), zoning and duct arrangement, and type of controls. State requirement for outside air and basis for determination of quantity, i.e., number of air changes per hour, for CFM per person, or others

5.6.1.7 For evaporative cooling, show approximate criteria reference or state any authorized waiver of this criteria. Note if single or two-stage process.

5.6.1.8 For cold storage project, indicate room holding temperatures and commodities to be held in cold storage. Also show approximate equipment sizes.

5.6.1.9 Determine the approximate capacity of compressed air, vacuum, or other service piping systems.

5.6.1.10 Fuel. State type, source, firm, or interruptible gas and metering arrangements. Indicate type of standby fuel for interruptible gas. Designs must meet Environmental Protection Agency emission standards or local emission standards when standards are enforced by local air pollution control agency, whichever is more stringent. when No. 5 fuel oil, No. 6 fuel oil, or coal is burned as fuel and when other hazardous emissions are produced.

5.6.1.11 Determine plumbing fixtures by listing quantity and type referred to in the Federal Specifications. Indicate male and female building population. Describe domestic water heating and storage equipment including capacity, materials, piping types, and insulation requirements.

5.6.1.12 Provide a list of energy saving features which have been incorporated into the project such as run-around coils, thermal wheels, and double bundle condensers. Additional energy saving ideas may be found in the Criteria Index under "HVAC, Computer Simulation for Buildings," Volume 4.

5.6.1.13 Provide a statement indicating if there is a base wide energy monitoring and control system (EMCS) and if 80, indicate the pieces of equipment and controls that will be tied into the system. If an EMCS does not exist, provide for future installation by providing such items as empty conduits from remote mechanical rooms to future field interference device locations, thermometer wells in hot and chilled waterlines, etc.

5.6.1.14 State procedures to be used for seismic support and anchorage of mechanical equipment.

5.6.1.15 For physically handicapped requirements, state whether or not provisions have been incorporated.

5.6.1.16 Provide the following information for liquid petroleum storage and distribution systems: describe the unloading facilities, the type of system such as LPG vapor or central air mix, state the basis for storage capacity, rate of pumping and number of dispensing outlets, equipment power requirements, and a description of the tank.

5.6.1.17 Fire Protection. Coordinate with the architect to ensure all aspects of the fire protection plan are addressed.

5.6.1.17.1 For sprinkler systems, provide evidence that the system is in compliance with criteria referenced in Criteria Index, Volume 4.

5.6.1.17.2 For carbon dioxide, foam, dry chemical, and other special extinguishing systems, show information justifying the arrangement, size, and coverage of each system.

5.6.1.18 Future Expansion. Where buildings are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. State that no provisions have been made for future expansion if this is the case.

5.6.2 Computations.

5.6.2.1 Provide all calculations necessary to justify the systems selected on the basis of economic and environmental impact.

5.6.2.2 Provide all calculations for heat gain/loss and all equipment sizing calculations, including the method for handling diversities in the air-conditioning load and method of sizing boilers or furnace. Show all air-conditioning load calculations, including the building peak loads. Detailed room calculations are required.

5.6.2.3 Show plumbing calculations as necessary to determine number of fixtures, cold and hot water capacity requirements, and equipment or capacities of miscellaneous and special systems.

5.6.3 Drawings.

5.6.3.1 Prepare a floor plan showing heating, ventilating, and air-conditioning equipment layout; chillers or refrigeration compressors; boilers, pumps, condensers, or cooling towers; air handling units; fans; typical air distribution duct layout (may be single line); hoods; and other items of major equipment required for the facility. Sprinkler system layout shall be diagrammatic in contract drawings. Specifications shall require shop drawings of the sprinkler system be submitted by the installation contractor before construction.

5.6.3.2 Show plumbing fixture and equipment layout.

5.7 Electrical Design.

5.7.1 Basis for Design

5.7.1.1 Provide electrical characteristics (phase, voltage, and number of wires) or circuits. Show characteristics of any subsequent transformation on the load side of the service entrance and a statement of why specific voltage was selected. State also, alternative systems or equipment considered and reasons a given system was selected.

5.7.1.2 Provide an economic comparison to justify selection of major pieces of electrical equipment such as transformer types or main switchboards. The study will only consider alternatives which meet the design criteria and perform the functions intended. Provide the first cost for each alternative considered and list advantages/disadvantages of each. Attach the economic comparison to the Basis for Design as an appendix.

5.7.1.3 Provide a present worth, economic/energy study for the various types of lighting fixtures considered. The study will show the annual costs of power and maintenance for each fixture type over its service life. These costs will then be brought back to the present and combined with the first cost to determine the most economical fixture type. Economic parameters to be used in the life cycle cost analysis will be provided by the District. Advantages and disadvantages of each will also be noted.

5.7.1.4 State type of service entrance equipment (circuit breakers and/or fusible switches) and reason for selection.

5.7.1.5 Show an estimate of total connected kilowatt (kW) load and demand factors, diversity, and resulting total demand kW load. Break down the loads to show lighting load, convenience receptacle load, air-conditioning loads, heating loads, pump loads, power roof ventilator loads, power receptacle loads for special equipment, load allocated for spare capacity, and special loads such as air compressors, generators, etc. State the total estimated power factor, the resulting kilovoltampere load, and size of transformers selected. Estimate separately the above for the service entrance transformers and subsequent transformers (such as dry-type transformers within the building).

5.7.1.6 Provide a statement describing the proposed standards of design for voltage drop used regarding service entrance, panel feeders, and branch circuits.

5.7.1.7 Discuss proposed wiring methods to be used indicating type of conductors, insulation, rigid metal conduit, EMT, NMS cable, etc.

5.7.1.8 Provide a brief description of the interior lighting systems indicating types, lighting intensities, and discuss energy conservation measures such 1-8 task lighting and selection of most efficient type of lighting fixtures. Provide a tabulation indicating the following:

5.7.1.8.1 Room name and number.

5.7.1.8.2 Lighting intensity for each room (state design basis such as AEI Design Criteria, IES, Definitive Drawings, etc.).

5.7.1.8.3 Type of fixtures, either standard COE 40-06-04 drawings by number or description. Where standard COE fixtures are not proposed, submit catalog cuts with narrative indicating what are proposed.

5.7.1.9 Provide a brief description of the exterior lighting system for street lighting, security lighting, parking lot lighting, sidewalk lighting, area lighting, etc. Include lighting intensity, types, and discuss energy conservation measures which were examined for selection of exterior lighting fixtures.

5.7.1.10 Provide a description of type of exit and means of egress, emergency lighting fixture systems with intensities, if none, so state. Coordinate with Fire Protection/Life Safety narrative.

5.7.1.11 Provide a description of type of hazardous area fixtures which will be used.

5.7.1.12 Provide a description of the physical limits of each hazardous area and the class, division, and group of equipment and wiring.

- 5.7.1.13 Describe the features of the fire detection and fire alarm system and means for transmission of signal.
- 5.7.1.14 Comment on the electrical characteristics of the power supply to the base, including circuit interrupting requirements and voltage regulation. Provide a statement on the adequacy of the existing power supply at the point of takeoff.
- 5.7.1.15 Discuss the basis for selection of primary and secondary distribution voltage and of overhead or underground construction. Indicate characteristics and standards of design for overhead or underground line. Include justification for underground line.
- 5.7.1.16 Provide an abbreviated short circuit study of the system, including interrupting requirements for major components of the distribution system.
- 5.7.1.17 Provide a description of all automatic and/or manual transfer devices being used.
- 5.7.1.18 Discuss signal systems provided such as program clock, MATV, central sound systems, intrusion detection, etc.
- 5.7.1.19 Discuss provisions for a telephone system relative to use of existing or new telephone cable. Provide discussion of special control, e.g., generator paralleling, switchgear remote control, telemetering, central supervisory control, etc.
- 5.7.1.20 Discuss the following: lightning protection, motor control centers, standby electric power, special purpose receptacles and outlets D.C., high frequency or other special systems, intercommunication system, controls for supervisory control systems, static grounding or any other special grounding requirements, specialize electronics equipment installation requirements, etc.
- 5.7.1.21 For airfield lighting projects, state whether cable is to be direct burial or in duct; discuss provisions for standby power; comment on type of lighting system (such as high intensity or medium intensity, runway, approach, or taxiway lighting) and lighting equipment and any conditions peculiar to the installation; as well as provisions for standby electric power.
- 5.7.1.22 For protective lighting systems, provide a statement of requirements for fence lighting, area lighting, building security lighting, etc. Include proposed type of luminaire, wattage of lamp, type of lamp beam spread, and how mounted on poles, buildings, etc.; clear zones illuminated, design foot-candle illumination at clear zones, fence, etc., and uniformity ratios.
- 5.7.1.23 If cathodic protection is required, provide a description of the location, type, and extent of the system to be installed and basis for the design proposed, including field survey data.
- 5.7.1.24 Generating Plants. In addition to a discussion of the design approach, provide the following for generating plants: estimates connected load, maximum demand load, number and size of units including kW and pF ratings, engine governor and voltage regulating requirements, voltage and basis for selection, and justification for use of special equipment such as load sensing governors.
- 5.7.1.25 Future Expansion. Indicate spare capacity allocated to electrical distribution system. Where buildings are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. State that no provisions have been made for future expansion if this is the case.
- 5.7.1.26 Provide a sample of all schedules, tables, calculations, etc., which will be used on the project drawings and in design analysis, i.e.:

5.7.1.26.1 Lighting calculations.

5.7.1.26.2 Lighting fixture schedules.

5.7.1.26.3 Panel schedules.

5.7.1.26.4 Symbol schedule (legend).

5.7.1.26.5 Panel sizing calculations.

5.7.1.26.6 Voltage drop calculations.

5.7.1.26.7 Outline of final design analysis.

5.7.1.26.8 Outline of catalog cuts pertaining to all proposed equipment or systems used in the project.

5.7.1.26.9 Lighting fixtures.

5.7.1.26.10 Transformer schedule.

5.7.2 Computations. Provide calculations to back up sizing of major pieces of electrical equipment. The degree of completion shall be comparable to that of the narrative and drawings.

5.7.3 Drawings

5.7.3.1 Exterior electrical to be shown on utility site plan.

5.7.3.1.1 Existing and new electrical lines, both overhead and underground, properly identified.

5.7.3.1.2 Show removals and relocations, if any.

5.7.3.1.3 Indicate electrical characteristics, voltage, phase, conductor size, etc.

5.7.3.1.4 Show new construction and location of transformation.

5.7.3.1.5 Indicate the service to the facility and whether overhead or underground.

5.7.3.2 Interior Electrical.

5.7.3.2.1 Floor plans shall show the proposed location of all major items of electrical equipment, including vaults, transformers, equipment rooms, switchgear, motor control centers, distribution panels, telephone terminal cabinets, and power and lighting panelboards. Include space required for maintenance and future expansion.

5.7.3.2.2 Partial Lighting Layouts. Show a partial layout of typical lighting in the building indicating proposed fixtures and spacing. Locate exterior lighting on plans when applicable. Lighting intensities shall be based upon the requirements of AEI Design Criteria and applicable ETS's, I.E.S. Lighting Handbook, and criteria as applicable.

5.7.3.2.3 Single-line diagrams shall be provided for interior distribution systems. Diagrams of high and low voltage interior electrical distribution and communication systems shall show all of the important features such as the following:

5.7.3.2.3.1 Auto transfer switches.

5.7.3.2.3.2 Emergency generators.

5.7.3.2.3.3 Emergency systems.

5.7.3.2.3.4 Major subpanels.

5.7.3.2.4 Riser Diagrams. Show the proposed riser diagram. Sizes of all conduits, wires, cables, panels, etc. need not be included if shown elsewhere.

5.8 Corrosion Design. Satisfactory design and construction of CP, protective coatings, and water treatment are functional requirements for virtually all projects. Project design and construction without these items is not acceptable. CP shall be provided on all new facilities and repair or replacement of existing facilities. This includes all buried or submerged ferrous piping (gas/heat distribution/fuel/water), buried tanks, and related facilities regardless of soil resistivity.

Exceptions. Ductile or cast iron pipe may not require CP or protective coatings in soil resistivities about 10,000 ohm-cm. Aboveground tanks in contact with the earth built to present criteria (on an oil filled sand pad with plastic liner underneath) do not require CP.

5.8.1 National Association of Corrosion Engineers (NACE) Certified Designers. For each project with utilities systems and/or metallic features that are buried, submerged, or in contact with the ground or other reasons, a corrosion specialist. Sufficient surveys, calculations, details, and 1-line diagrams to show the magnitude and layout of the CP system shall be provided. Deletion of CP work shall not be made without the specific approval of the MAJOM corrosion engineer (Air Force) or the equatable Army corrosion engineer.

5.8.2 General Requirements.

5.8.2.1 All cathodic protection design shall be based upon specific field tests made at the construction site. Tests shall include, but not be limited to, soil resistivity and water conductivity. Design drawings shall show location of anodes, rectifiers, etc.; installation details, insulators, and bond connections.

5.8.2.2 Existing cathodic protection systems in the vicinity of the construction shall be identified as to location, type, and level of protection. New and supplemental cathodic protection shall be compatible to the existing cathodic protection systems. Other piping systems in the areas of ground beds shall be considered when locating ground beds to prevent interference problems.

5.8.2.3 If the project contains an underground heat distribution system (prefabricated insulated pipe), the pipe supplier shall be made responsible for the preliminary survey, design, and testing of the CP system. In addition, the construction contract specification particularly shall provide for the following:

5.8.2.3.1 That the system supplier shall use a NACE accredited corrosion specialist for survey, design, inspection, and testing of the CP system for their piping system. The system supplier shall be held responsible for correcting all CP construction deficiencies and must provide additional CP at no cost to the Government where required to achieve or meet NACE RP-01-69 CP criteria.

5.8.2.3.2 That the construction contractor shall not proceed with the CP work until the shop drawings have been approved by the contracting officer's technical representative (CP technician or corrosion engineer).

CHAPTER 6

**PREFINAL DESIGN SUBMITTAL (FOR ARMY PROJECTS)
60 PERCENT**

**REGULAR PRELIMINARY DESIGN SUBMITTAL (FOR AIR
FORCE PROJECTS)
60 PERCENT**

6.1 General. This chapter will define by discipline the basic requirements of a prefinal design submittal or a regular preliminary design submittal (60 percent) pertaining to the analysis of design and drawings. This submittal will incorporate all the requirements of a 35 percent concept or early preliminary design plus additional information to complete this level of design. Basis of design narrative and computations developed and submitted at concept design shall be expanded during preliminary design to include review comments and changes addressed during concept review. Guidance for preparation of the "Code B" cost estimate if not submitted at a previous submittal is provided in volume 2. The "Code B" cost estimate should reflect a level of detail consistent with 60 percent submittal. The specifications, if not submitted at a previous submittal, shall be provided per the guidance in volume 3 for outline specifications. The prefinal or regular preliminary design shall incorporate the responses to previous submittal reviews.

6.2 Objective. The 60 percent design submittal is intended to provide a thoroughly thought-out design conforming to all the applicable criteria. The 60 percent design will be a logical further development of the concept design. The design shall define all the elements to be incorporated into the project to a level demonstrating a complete functional design consistent with a 60 percent design effort.

6.3 Review Comments and Revisions. Any major design changes which are necessary due to review comments or other reasons shall be resolved at this design submittal. Any changes at this time should only be for the purpose of coordination and refinement of the complete design package.

6.4 Civil Design.

6.4.1 Basis of Design. The narrative provided at the concept submittal shall be expanded to give a thorough description of each of the civil design features included in the project.

6.4.2 Computations. The computations shall support the narrative and be expanded from the previous submittal to be consistent with the 60 percent design effort. Each area of the design shall have sufficient computations to demonstrate basic design feasibility.

6.4.3 Drawings. The design drawings shall cover all aspects of the project design. The drawings should be of sufficient detail to indicate a complete and coordinated design effort appropriate for review. The drawings shall include all the sheets that will be in the final set to indicate what the final package will include.

6.5 Landscape Architectural Design.

6.5.1 Basis for Design. The narrative shall completely explain and substantiate the design provided and expand upon what was provided in the previous submittal. State that no landscaping is required if this is the case. Also state whether or not irrigation will be included in the project.

6.5.2 Drawings. The landscape plan shall show the general placement of plant material, lawn, and all other pertinent landscape features. A legend shall indicate mature height and/or spread of all plant material whether deciduous or evergreen and whether shrub, tree, or ground cover. Specific plant names may be indicated as well, if known in this phase. The level of detail shown for other landscape features such as benches, planter walls, tree grates, bollards, etc., shall be consistent with the percentage of design completed.

6.6 Architectural Design.

6.6.1 Basis for Design. The narrative description shall be expanded upon and any changes in color board or scheme boards shall be made for resubmittal.

6.6.2 Computations. Revise any floor plan area computations as necessary to reflect changes from the concept submittal.

6.6.3 Drawings. The design drawings shall be sufficiently complete to describe the complete architectural design effort in a form appropriate for review. Every sheet that will be in the final set shall have sufficient Completeness to indicate what type of information will be provided.

6.7 Structural Design.

6.7.1 Basis for Design. The narrative description must completely explain and substantiate the design provided. This shall be an expanded document from the previous submittal.

6.7.2 Computations. Design calculations covering all the major structural elements must be presented. The calculations must support the design to a level consistent with the percentage of design completion.

6.7.3 Drawing . The design drawing must be sufficiently complete to explain the total structural design. Pertinent structural criteria will be noted on the drawings, and any other information consistent with a 60 percent design. Each sheet that will be in the final set will be provided to illustrate the extent of the complete set.

6.8 Mechanical Design.

6.8.1 Basis for Design. Design aspects affecting the types of systems will be described. The systems designs shall be sufficiently described to demonstrate design functionality.

6.8.2 Computations. The calculations must support the design assumptions made to this stage and be descriptive enough to allow adequate review.

6.8.3 Drawings. A complete design drawing set showing all mechanical systems in the project is required. The drawings must include any information required to permit a design review consistent with at least 60 percent of design completion. All sheets which will be in the final set shall be included.

6.9 Electrical Design.

6.9.1 Basis for Design. The narrative shall explain the electrical design. Any detection, alarm, or miscellaneous systems will also be explained. These descriptions will represent an extension of those in the previous submittal to a level of detail consistent with the percentage of design completed.

6.9.2 Computation. The calculations will also be expanded to reflect a percentage of completion consistent with the design submission.

6.9.3 Drawings. All sheets which will be in the final set shall be provided. These sheets shall be complete to a level of detail consistent with the percentage of design completion.

6.10 Corrosion Design.

6.10.1 Basis for Design. The narrative shall explain the corrosion design. Any detection, alarm, or miscellaneous systems shall also be explained. These descriptions shall represent an extension of those in the previous submittal to a level of detail consistent with the percentage of design completed.

6.10.2 Computations. The calculations shall also be expanded to reflect a percentage of completion consistent with the design submission.

6.10.3 Drawings. All sheets which shall be in the final set shall be provided. These sheets shall be complete to a level of detail consistent with the percentage of design completion.

CHAPTER 7
FINAL DESIGN SUBMITTAL
100 PERCENT

7.1 General. This chapter will define, by discipline, all specific requirements of a final design submittal pertaining to the drawings and the Analysis of Design. Guidance for preparation of the final cost estimate and the final specifications is provided in volumes 2 and 3, respectively. The final submittal will be reviewed as described in volume 1. The A-E response to Government review will then be backchecked. If all review comments are not satisfied, rechecks and resubmittals will continue until all comments are resolved or withdrawn.

7.2 Objective. The final submittal is intended to present a biddable, design package conforming to all the appropriate criteria. Final design will be accomplished by developing and refining the design in its various stages by using the review comments as a communication vehicle between the A-E, the District, and the user.

7.3 Project Review Comments. The A-E shall annotate the action taken on each preliminary and/or concept comments and shall include the annotated comments with the submittal package. If the A-E feels that any comment is inappropriate or in error, he shall call the COR/PM prior to proceeding with the final design to resolve the conflict. If the comment is modified or omitted as a result of this coordination, then a brief record of the conversation shall be included with the annotated comments. Updated listing on deviations from criteria developed for the previous submittal shall be provided. All deviation shall be supported by waivers from authority or by record of correspondence to user by project manager. Review conference actions are not considered supporting authority.

7.4 Changes to Basic Design. Major changes to the basic design will not be permitted at this time unless these changes are the result of review comments, changes in criteria, changes in SOW, or unforeseen problems necessitating the A-E to alter his original design. All the changes will be resolved through the COR/PM before proceeding.

7.5 Civil Design.

7.5.1 Basis for Design. Complete the discussion of civil features that was presented in previous submittals. Update the Basis for Design to include any changes brought about by the design process or review comments.

7.5.2 Computations.

7.5.2.1 Water Distribution and Service Lines. Furnish final flow requirements, line sizes, friction factors, head 1068, water velocities, and line pressures. Provide fire flow test data or other measurements upon which the calculations are based. Show complete calculations demonstrating the ability of the water distribution and service lines to deliver the required pressure and quantity of water.

7.5.2.2 Water and Sewage Treatment. List all criteria used for the design of each treatment process and operation. Furnish all calculations showing the design of the processes and operations including the hydraulic and organic loading. Provide a hydraulic profile of the treatment plant.

7.5.2.3 Sewage Collection. Show the population or fixture unit basis for computing expected flows. Show peak and average expected or measured flows and any factors used in estimated flows. Provide the flows, sizes, slopes, and velocities for each line segment. In addition for lift stations, show required head, volume of wet well, cycle times at peak and average flows, and pump controls.

7.5.2.4 Storm Drainage. Show all the computations used for determining the designs flow and pipe sizes (including all options in pipe materials). List rainfall intensity, return period, concentration times for each drainage area, and the infiltration factors used. Provide an analysis of each new culvert and of existing culverts which are used in the designing. Show adequacy of existing drainage facilities to carry runoff. Include a sketch of the drainage area which shows the grading, principal water courses and the location, size, and invert elevation of existing and proposed new drainage facilities, including surface ditches, storm sewers, and culverts.

7.5.2.5 Roads, Street, Open Storage Areas, Hardstands, and Walks. Show all design calculations including elevation of design wheel loads, material, and type of construction and class of each type of paving. Include all computations for curves, alignment, sight distance, passing distance, and superelevation.

7.5.2.6 Grading. Furnish cross sections and complete calculations for all earthwork.

7.5.3 Drawings. Expand and fully develop drawings used in concepts or early preliminaries as applicable. Add any new sheets necessary to complete the presentation, including the following:

7.5.3.1 Foundation Explorations and Logs. The District will provide information on exploration locations and logs of explorations which be incorporated and coordinated into the final drawing set by the A-E.

7.5.3.2 Siting. Show the dimensions of all new work and the relation of new work to existing facilities. The new work will be located by coordinates or other definite means. only one bench mark shall be used except where a very large area is involved. Indicate the bench mark location, elevation, and description. Provide a north arrow and at least two horizontal control points. Provide complete vertical alignment descriptions. With airfields, this information must be shown for each separate area of pavement. Clearly locate onsite borrow and spoil areas. Indicate possible future construction using short dashed lines.

7.5.3.3 Grading. Provide a north arrow and show the grading and drainage conditions, including scales, direction of drainage, point of discharge, and ditches using notes, symbols, and spot elevations or contours. Provide finished grades for new work and show existing topography. In rigid pavements, grades are to be shown at all joint intersections, or at intersection of joints and centerline, if no regular pattern of intersection exists. Provide sections showing the relationship between existing ground and finished grades, pavements, shoulders, ditches, scales, curbs, gutters, buildings, and other structures.

7.5.3.4 Paving, Railroads, and Fencing. Show the location and dimensions of all roads, streets, walks, pads, open storage areas, runways, aprons, taxiways, overruns, railroads, fences, and gates. Indicate different surfaces and pavement sections with symbols and notes. Furnish all alignment and curve data needed to lay out the work. Provide details showing joints, curbs, gutters, signs, sealants, sidewalks, pavement sections, switches, turnouts, and road crossings. Include all elements of the pavement or track section with depths and compaction requirements. Clearly show joint layout, thickened edges, dowels, tie bars, reinforcement, joint keys, location of tie-down anchors, markings, and striping. For airfield pavements, all joints will be shown on a scaled drawing(s) with elevations shown at all joint intersections. Typical geometric layouts will not be used.

7.5.3.5 Utilities.

7.5.3.5.1 Show all pipes with sizes (such as water, sewer, storm drain, and gaslines) valves, manholes, fire hydrants, service boxes, inlets, culverts, headwalls, and cleanouts. Provide a north arrow on the utilities site plan and show the relation between the utilities and roads, buildings, sidewalks, etc. Provide the sizes, strengths, or classes corresponding to the different material options. Indicate the points of entry to buildings for utility lines.

7.5.3.5.2 Profiles shall be provided for wastewater collection lines, force mains, water supply, and distribution lines where there is a possibility of interference with other utilities. Profiles will also be provided to show adequate cover in areas of varying topography. The profiles shall show minimum cover; new and existing utilities; invert elevations; stationing; surface features such as roads, curbs, sidewalks, etc.; and appurtenances to the utility system

7.5.3.5.3 Furnish details of all features such as valves, manholes, fire hydrants, service boxes, inlets, headwalls, cleanouts, thrust blocks, pipe encasements, frames, grates, covers, steps, etc. For treatment facilities, provide details for treatment units. Show all inplant lines and process piping. In congested areas or in area where data is unclear as to the exact location of utilities, the utilities drawings should contain the following note: "Elevations of utilities are given to the extent of information available. Where elevations are not given at points of existing utilities crossings, such elevations shall be determined by the contractor and reported to the CO. When unknown lines are exposed, their location and elevation shall likewise be reported."

7.5.3.6 Landscaping.

7.5.3.6.1 The plan shall be clearly delineated and dimensioned where necessary to insure the proper location of plants, lawn divider strips, and similar items. The plant list shall have the botanical and common name, quantity, container size or caliper, and spread of the plants specified. Header board, planting, and staking details shall be shown. Lawn areas, where specified, shall be clearly defined. The planting plan shall be a separate drawing and shall not have irrigation details on the same drawing. Where erosion control seeding and special treatment for erosion control is required, the areas shall be well described and delineated. The irrigation plan shall show the layout of the sprinkler system locating the heads, pipe sizes, valves, backflow preventer, and connection to main. State that no landscaping is required if this is the case.

7.6 Architectural Design.

7.6.1 Basis for Design. Complete the discussion of architectural features that was presented in previous submittals. Update the narrative to include any changes brought about by review comments. Update the color boards as directed by the review.

7.6.2 Computations. Update the floor area computations to reflect changes brought about by review comments and/or floor plan changes.

7.6.3 Drawings. Expand and fully develop drawings used in concepts or early preliminaries if applicable. Add any new sheets necessary to complete the presentation, including the following:

7.6.3.1 Provide a detailed typical interior wall section for each type of wall being used. Section to be taken from plans, not elevations.

7.6.3.2 Roof Plan. Indicate mechanical equipment and vents, roof drains, roof slopes, crickets, etc. Cross reference to where flashings and curbs are detailed for roof penetrations.

7.6.3.3 Caulking Joint Shapes. Show all appropriate joint shapes per referenced criteria. Detail and dimension joints and cross reference to drawings where they are required.

7.6.3.4 Fire Ratings. Show only required, not inherent, ratings of 1 hour or more for partitions, ceilings, ceiling-roof, or ceiling-floor assemblies. This may be shown on the reflected ceiling plan when provided in a "REQUIRED FIRE RATING SCHEDULE" listing each room or area to be separated; or in a single line floor plan which indicates only fire partitions and firewalls.

7.5.3.5 Reflected Ceiling Plan. Provide for all buildings with suspended ceilings except industrial type containing minimal office space.

7.5.3.6 Update the color boards as directed by the review comments, and resubmit them. Also, provide one additional color board for each Army and AF project.

7.7 Structural Design.

7.7.1 Basis for Design. Complete the discussion of structural features that was presented in the concept or early preliminary submittal. Update the narrative to include any changes brought about by review comments.

7.7.2 Computations.

7.7.2.1 Present complete structural calculations covering all parts of the structure and miscellaneous facilities. When a computer is utilized to perform design calculations, the analysis will include, but not be limited to, the following information, in addition to information required elsewhere in this manual:

7.7.2.1.1 Describe design methods, including assumptions, theories, and technical formulas, employed in design solutions.

7.7.2.1.2 Present copies of computer input data and output summaries presented in human language, accompanied by diagrams which identify joints, members, areas, etc., according to the notations used in the data listings. Complete listing of all computer output will be provided in a separate binding when it is too voluminous for including in the design analysis. These listings will be augmented with intermediate results where applicable so that sufficient information is available to permit manual checks of final results.

7.7.2.2 Live loads shall be placed to produce maximum stresses and minimum stresses where there is a possibility of stress reversal.

7.7.2.3 If special methods of solution, tables, etc., are employed, references shall be made in the calculations to the sources of such material.

7.7.3 Drawings. Expand and fully develop drawings used in concepts or early preliminaries if applicable. Add any new sheets necessary to complete the presentation.

7.7.3.1 The structure should be carefully studied so that elaborate details are not required and all information necessary for construction is clearly and simply presented on the drawings. Typical sections shall be truly typical and not representative of one particular condition.

7.7.3.2 Wall Elevations. Wall elevations shall be provided for precast or tiltup concrete panels showing typical reinforcing, reinforcing around openings, connections, etc. The intent is to show one complete design on the drawings, even though manufacturers may prefer to detail things differently.

7.7.3.3 Joints. The locations and details of all concrete joints shall be shown on the drawings. Included are control joints in slabs on grade; construction joints in walls, floors, and roofs; and expansion and seismic joints.

7.7.3.4 Structural Data. State the design stresses for all materials, soil bearing values, and other pertinent information from the geotechnical report; classes of concrete and where used; design live loads for various areas of the building including all loads considered in the floor slab; design windload; seismic zone, Z, I, R, C, and S values, whether or not the building has been designed for future horizontal or vertical loads; and any other notes necessary to clarify or complete the information shown on the drawing.

7.8 Mechanical Design.

7.8.1 Basis for Design. Complete the discussion of mechanical features that was presented in the concept or early preliminary submittals. Include any changes brought about by review comments.

7.8.2 Computations.

7.8.2.1 Finalize all computations leading to sizing of distribution systems, selection of powered equipment and its power requirements and controls, and selection of auxiliary equipment.

7.8.2.2 Equipment selection is restricted to regularly cataloged items of domestic manufacturers, in commercial service for more than 1 year, supplied by dealers having service organizations supporting the project location. Completely identify, but not on the drawings, each piece of equipment by manufacturer's name, model, and characteristics. Present a study of floor space in the mechanical room by selecting the largest of three competing makes of each piece of equipment to go into the room. Allow ample room for servicing and replacement of equipment.

7.8.2.3 Provide complete tabulation of cooling loads and psychrometric charts for all the air handling systems with cooling.

7.8.3 Drawings. Expand and fully develop drawings used in concepts or early preliminaries if applicable. Add any new sheets necessary to complete the presentation, including the following:

7.8.3.1 Plumbing.

7.8.3.1.1 Show piping and venting in two-dimensional riser diagrams for complicated plumbing systems, e.g., medical and dental facilities and all multistory buildings.

7.8.3.1.2 Provide a schedule of plumbing fixtures and equipment, showing size data and specification reference.

7.8.3.2 Mechanical.

7.8.3.2.1 Provide double-line drawings for all duct work shown on cross sections and in mechanical rooms. Single-line drawings may be used for air distribution duct layout provided sufficient cross sections are shown for congested areas.

7.8.3.2.2 If required for clarification of duct sizes, show singleline riser diagrams for supply and exhaust systems for multistory buildings. Provide sections where needed to show special relations and indicate the typical location of lights, structural members, etc.

7.8.3.2.3 Locate and detail all fire dampers.

7.8.3.2.4 Provide piping schematics to show all complicated flow processes.

7.9 Electrical Design.

7.9.1 Basis for Design. Complete the discussion of electrical features that were presented in the previous submittals. Include any changes brought about by review comments.

7.9.1.1 Single-Line Diagram. Provide a simplified single-line diagram of the system showing all transformers, motors, conductors, circuit breakers and fuses, etc. All items shall be identified by the same alpha-numeric designation shown on the drawings. The purpose of the single-line diagram is to identify selected points where imaginary faults will be located for the short-circuit study to determine whether protective devices and/or components for such equipment can withstand the available short-circuit stresses. The system equipment may be so simple that calculations may be made using reactances only. This will suffice to indicate that equipment ratings are adequate. If the results are borderline, where equipment ratings are slightly under the required rating, then calculations shall be repeated, using all items such as circuit breaker contacts, small cables, and available reactances and resistances.

7.9.1.2 Deviations from Criteria Summary. Updated listing on deviations from criteria developed for the previous submittal shall be provided. All deviations shall be supported by waivers from authority or by record of correspondence to user by project manager. Review conference actions are not considered supporting authority.

7.9.2 Computations.

7.9.2.1 Provide complete design calculations for all interior and exterior electrical systems.

7.9.2.2 Provide manufacturers' names and model numbers for each major equipment item used in determining dimensional and weight requirements.

7.9.2.3 Calculations for the maintained foot-candle intensities in all areas shall be shown.

7.9.2.4 Provide transformer, generator, switchboard, and feeder computations indicating all demand, diversity, ambient temperature, or derating factors considered in the selection of equipment or conductor sizes. All factors, such as demand and diversity factors, derating factors, etc., shall be supported by engineering or manufacturer data.

7.9.2.5 Provide load summaries for each panel, switchboard, switchgear, motor control center, etc. The summaries shall have a categorization based on type of load (i.e., heating, pumps, lighting, air-conditioning, receptacle, panel, etc.), and include the respective demand factors applied to each. The summaries shall show spare kVA allocated to each piece of distribution equipment, coordinated with spare capacity in service equipment.

7.9.2.6 Compute the voltage drop on all service and feeder circuits and on worst case branch circuits supplied by each panelboard and switchboard.

7.9.2.7 State the rationale for selection of reduced voltage starting equipment.

7.9.2.8 Outside overhead distribution work shall also include calculations including but not limited to pole sizing calculations, conductor tensioning, and sagging calculations and guy wire sizing and placement calculations.

7.9.3 Drawings. Expand and fully develop drawings used in concept or early preliminary submittals if applicable. Add any new sheets necessary to complete the presentation, including the following:

7.9.3.1 Site Plan for Outside Distribution System

7.9.3.1.1 Show location of new and existing poles and routing of new lines on the plot plan.

7.9.3.1.2 Show location of new and existing manholes and pull holes on the plot plan. Locate and show details of major equipment. Show routing and cross section of duct line sections.

7.9.3.1.3 Show location of street, parking, and walkway lighting poles. Provide details of luminaire, pole, and base.

7.9.3.1.4 Provide layout of lighting poles showing dimensions and aiming angles. Provide complete backup calculations

7.9.3.1.5 Where airfield lighting is included in the project, show location, controlling dimensions, extent of the proposed system, routing of supply circuits, location of vaults and control towers, and locations for various types of lighting units.

7.9.3.1.6 Where cathodic protection is necessary, show extent of the facilities to be protected, location and type of anode beds, location of test points, details for sectionalizing an underground piping system, and source and routing of supply for impressed current and cathodic protection system

7.9.3.2 Floor Plan for Interior Distribution System. The floor plans shall show all principal architectural features of the building which will affect the electrical design. Separate floor plans shall be used to avoid congestion. The floor plans shall also show the following:

7.9.3.2.1 Room designation and number.

7.9.3.2.2 All lighting fixtures, fixture types, and number and size of lamps per fixture.

7.9.3.2.3 All switches for control of lighting.

7.9.3.2.4 All lighting circuits and associated wiring.

7.9.3.2.5 All receptacles and associated wiring. Receptacles shall be identified by appropriate NEMA type.

7.9.3.2.6 The location and designation of all panelboards. Drawings shall clearly indicate the type of mounting required (flush or surface).

7.9.3.2.7 Service entrance (weatherhead, conduit, and main disconnect).

7.9.3.2.8 Fixture mounting details where unusual conditions are encountered.

7.9.3.2.9 Location and designation of exit lights and main exit light switch.

7.9.3.2.10 Location of all fire alarm equipment and associated wiring, including alarm bells, manual stations, control panels, power supply switch, and empty service entrance conduit for connection to base fire alarm loop, if applicable.

7.9.3.2.11 Location and proper designation, including associated wiring, of all transformers, motor generator units, rectifiers, primary equipment, and primary and secondary bus and supports. Show the necessary space requirements for each.

7.9.3.2.12 Size, location, designation, and space requirements for all switchgear, switchboards, and similar equipment.

7.9.3.2.13 Location and designation of other signal, communication, or alarm system equipment.

7.9.3.2.14 All unusual grounding requirements and all grounding for transformer vaults, transformer pads, and enclosing fences; d.c. generators and rectifiers; and all a.c. generating equipment. Also include grounding for static grounds in hangars, all fuel handling or storage equipment, and all primary equipment.

7.9.3.2.15 Define the physical limits of each hazardous area and the class, division, and group of equipment and wiring.

7.9.3.2.16 Location, designation, and rating of all motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show all necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.

7.9.3.2.17 The number of conductors in each conduit or cable run when the number of conductors required exceeds two. Circuit designations shall be shown for all home runs and feeders. Circuit and wire sizes shall be shown on the floor plan when not shown on panelboard schedules and/or riser diagrams.

7.9.3.2.18 Elevation views of motor control centers, switchboards, switchgear, unit substations, and other major pieces of equipment.

7.9.3.3 Power Riser Diagrams. A complete power riser diagram shall be shown, including:

7.9.3.3.1 Characteristics of primary supply (voltage, phase, wire, and frequency); size and type of conduit; and size, type, and voltage rating of the primary cable.

7.9.3.3.2 Size, type, and rating of the primary disconnect.

7.9.3.3.3 Main transformer characteristics, including voltage kVA rating, impedance and wiring configuration (i.e., delta-wye, etc.).

7.9.3.3.4 Main secondary feeders and main secondary disconnect.

7.9.3.3.5 Ratings of panelboards, switchboards, and disconnects.

7.9.3.3.6 Characteristics, rating, and proper identification of all motor-generator units, rectifiers, battery chargers, minor transformers, fuses, circuit breakers, and all similar special equipment. Indication of all controls and control wiring required for the proper control of the 60-hertz equipment listed. (All 400-hertz and d.c. wiring, control, feeders, panelboards, and associated equipment shall be shown on a separate riser diagram.

7.9.3.4 Fire Alarm Riser Diagram. A complete, separate riser diagram shall be shown for each fire alarm system. The diagram shall include power supply, control panel, manual and automatic stations, alarm bell, coded transmitter, and zone annunciation. It shall show connection to the base fire alarm loop or provide a spare entrance for future connection to the base fire alarm. In addition, it shall illustrate conduit runs, numbers of conduit, and conduit size.

7.9.3.4 Exit Lighting System Riser Diagram. A separate riser diagram shall be shown for the exit lighting system and shall include power supply exit lights with conduit/conductor size and number.

7.9.3.5 Miscellaneous System Riser Diagram. A separate riser diagram shall be shown for each separate system such as telephone, intercom, paging, CCTV, master clock system, etc. The diagram shall include power supply, control panel or device, conduit runs, other components, and room location of each device.

7.9.3.6 Schedules for panelboards, switchboards, power-switchgear assemblies, and motor control centers shall be provided showing total connected load, total space load, demand factor, diversity factor, maximum demand, main and branch circuit ratings, bracing requirements, interrupting ratings for individual devices, frame size for each circuit, number of poles, and description of each load.

7.9.3.7 Schedule for lighting fixtures shall be developed indicating fixture type, quantity, location, mounting height, and any other information required for installation. Lighting fixtures shall be selected from Corps standard drawings 40-06-04 series where possible. Fixtures required which are not contained in the 40-06-04 series shall be prepared and presented in the contract documents in same format as 40-06-04 series.

Description and pictorial view for each lighting fixture shall be prepared on 8-1/2-inch by 11-inch drawings and included in the contract specifications. Titles of fixture shall follow similar format as Corps 40-06-04 series.

7.9.3.8 Construction details shall be provided for concrete pads, fences, gates, special grounding, the installation of motor-generator units, padmounted transformers, primary and secondary bus supports, and similar items or equipment. The drawings shall clearly indicate all equipment which is furnished and/or installed by others.

7.9.3.9 Schematic diagrams shall be provided to indicate all electrical control, including motor control circuits; switchgear; auto transfer switches; emergency generators; limit controls; street lighting photocell control; etc.