FACILITIES PLANNING MANUAL
Part D, Capital Project Design and Construction

Chapter 7, Programming and Design

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CAPITAL OUTLAY HANDBOOK
Part D, Capital Project Design and Construction

Chapter 7, Programming and Design

7.1 OVERVIEW

Design as presented in this Handbook consists of **Programming, Schematic Design, Design, Design Development, and Construction Documents**

The success of the project design hinges on the program, the ability of the architect, the conditions under which the architect must work, and the quality assurance.

During programming, all the information is compiled that will guide the architect's design. If any of that information is incorrect or incomplete, the design will reflect those problems. If the program is too detailed, it will hamper the creativity of the design. A balance must be struck between what is truly needed and what can be allowed to evolve during the design phase.

Often programming and design are done simultaneously so that there is coordination between the program and the design. The general sequence is:

Initial Project Planning, ã Conceptual Design, ã Programming ã
Schematic, Design, ã Detailed Programming, ã Design Development, ã
Equipment Planning, ã Construction Documents.

Periodically during this reiterative, feedback process, there are scope, cost and quality assurance checks consisting of:

1. Area calculations.
2. Cost estimates.
3. Code and regulatory analysis and review.
4. Design presentation and review.
5. Value engineering.
6. Coordination and constructability checking.

The total design process consists of 1) deciding what is required, 2) creating a design that meets those requirements, 3) reviewing the design, 4) incorporating the results of the review, and 5) repeating the process in greater detail, until there is a set of documents that is fully approved and ready for construction. In addition to this

process, there is the parallel state funding process with its submittals and reviews. This adds additional steps to the design process:

1. Revision and resubmission of the capital outlay proposal for any remaining funding appropriations
2. Preliminary Plan submittal

The Initial Project Proposal (IPP), Final Project Proposal (FPP), and subsequent funding submittals are discussed in Part C of the Handbook. They must be coordinated with the design process, incorporated into the architect's contract, and into the design schedule.

7.2 MANAGING PROGRAMMING AND DESIGN

The purpose of planning and programming is to develop a reasonable set of objectives for the design. Initial planning starts with an intention and ends with the parameters for the project: the type of project needed, the scope of the project, and the budget criteria. Programming begins with those parameters and ends with detailed objectives for design which site, programming, and budget should be reasonable and compatible with one another.

Programming must:

1. Distinguish between necessities and preferences so the designer can prioritize the elements of the design, satisfying the necessities first and adding preferences as allowed within scope and budget.
2. Represent the real needs of the users avoiding untimely changes later.
3. Have enough detail while maintaining design creativity, but not allowing the design to go astray.
4. Be based on the correct information avoiding expensive surprises later in the project.

During programming, the users are the most important participants. The project manager is primarily a facilitator, making certain that all the program options are discussed, all the necessary information comes to light, all the players participate in the process, and good decisions are made with room for flexibility.

The design process is a problem solving process which takes all the objectives and parameters and identifies possible solutions until one works particularly well. Then that one is developed in detail.

The project manager should work closely with the users and the architect during design to assure that:

1. The architect has all the necessary information to proceed.
2. The design approaches suggested by the architect are compatible with the campus.
3. The architect is performing according to his/her contract and the usual standard of care.
4. The design solutions all meet the program, planning parameters, and quality control criteria.
5. The users understand and have adequate opportunity for review of design alternatives.
6. All submittals and approvals are complete, timely, and successful.
7. Systems and materials decisions include value engineering according to campus criteria.
8. Construction documents are good quality, properly coordinated, and checked by the district.

Managing Design

Managing design is striking a balance between brain storming, creativity and regulatory requirements. The project manager and architect should communicate regularly to reach consensus in decisions and to ensure that the project does not exceed scope and budget.

Budget Procedures During Programming and Design

The project manager should be aware of the additional factors that influence the budget and scope of a project and are discussed in Part C of the Handbook:

1. Submittal, review, and approval of the FPP.
2. Budget language that controls the scope and cost of an approved project.
3. The need for any subsequent funding applications and reviews.
4. The procedures to obtain other sources of funds for capital outlay including energy loans from the Office of Energy Assessments.
5. Preliminary plan reviews and approval by the State Public Works Board.
6. Construction document review and approval to bid.

7.3 REVIEW OF THE FINAL PROJECT PROPOSAL

The district should be satisfied that the project, given the current level of information, is feasible that is the proposal is within its projected cost and scope, the site is appropriate, and obvious obstacles to completing the project have been addressed.

If the project has a FPP which has been submitted and approved for funding, the district or its project manager should review the proposal and the supplemental budget language. If there is a inconsistency between what is planned locally and what is

described in the budget documents, the Chancellor's Office should be notified immediately.

Some common problems with FPPs are:

1. A proposal is out of date because the project has been shelved waiting for funding
2. The needs expressed in the proposal have changed during the funding process
3. The cost is not realistic for the scope
4. The schedule is not realistic for the scope
5. The proposal does not seem to make sense in the larger campus and community context
6. The proposal is based on incomplete information about the site and existing conditions
7. The proposal is based on incomplete or inaccurate information about codes and regulations
8. The proposal does not include all the necessary systems, e.g. telecommunications
9. The conceptual design, the basis for the scope and cost, is based on erroneous assumptions, e.g., that the state will fund all necessary equipment

The district or its project manager checks the assumptions, scope, cost and schedule prior to starting design. This should make the district aware of community college space and cost guidelines before the district evaluates the proposal.

If the proposal is erroneous, the district may have to request the Chancellor's Office and DOF to authorize a scope or cost change, reengineer the project, or live with the error. Funds may not be available to increase the budget. In many cases, the architect or construction manager will be able to propose design and delivery method strategies to cope with any problems.

7.4 PROGRAMMING

During programming, the detailed objectives for the design are determined and documented. Programming may be done concurrently with the design, a first general phase programming done to prepare for schematic design and a second detailed phase done concurrently with schematics in preparation for design development.

Traditionally, the steps in programming a building are:

1. Site analysis
2. Initial environmental study
3. General programming for schematic design
4. Feasibility review
5. Detailed programming for design development

Under a systems approach, the programming phase may be quite different. The programming may be focused on defining the project in greater detail for design by a manufacturer or specialty contractor. The steps might be:

1. Multiple-site analysis with exploratory demolition in crucial areas
2. Development of total system performance specifications
3. Conceptual/schematic design to define sub-projects, limits of work, and phasing
4. Technical estimate of scope and cost

The information required and tasks performed during programming will vary depending on the type of project and the way programming is coordinated with budget proposals and design phases.

Site Analysis

To analyze existing conditions on the site, there are several studies that may be required. The more technical studies include:

1. Geotechnical report
2. Land survey (including boundaries, topography and utilities)
3. Existing building analysis
4. Surveys of existing hazardous materials
5. Ecosystem studies; e.g., wetland studies

All of these studies are crucial to the feasibility and cost of the project and need to be completed as early as possible. Ordinarily, they would be completed prior to or while writing the FPP.

The geotechnical report describes:

1. Site preparation, compacting or replacement of existing soil
2. Foundation type, size and depth
3. Bearing loads and expected settlement
4. Ground water as it may affect the construction
5. Surface water as it may affect the construction
6. Special construction requirements to minimize settling and cracking

All of these items have a significant effect on construction cost and schedule. The results of a site survey, building survey, and survey for hazardous materials could also have significant effects on cost.

Other information gathered as part of site analysis are:

1. Climate

2. Site features
3. Environmental influences; e.g., noise, odors
4. Historical data
5. Land use plans and controls
6. Views and vistas
7. Circulation (vehicular, pedestrian, service)

Initial Environmental Study

As part of the evaluation of the site, the district must comply with the requirements of the California Environmental Quality Act discussed in Chapter 6.

General Programming

Some of the elements considered during programming are:

1. Educational activities and uses
2. General aesthetics, style, and image
3. Spaces: type, number, area, volume
4. Efficiency ratio
5. Space groupings, adjacencies
6. Circulation, communication, and flow between spaces
7. Service access and function
8. Site activities and uses
9. Relationship to campus
10. Future expansion, adaptability, conversion
11. Historic preservation
12. Campus architecture and scale
13. Personnel, where appropriate

Changes to programming or design necessary because planning was not finished before the project was submitted to the State budget cycle can cause major problems:

1. If the project changes in scope, it may be delayed or stopped at the State level
2. If the project goes over cost, it may be delayed or stopped due to lack of funds
3. If changes are made out of sequence, they may cause errors and cost increases

Feasibility Review

Upon completion of general programming, the project should be reviewed for the following to determine feasibility:

1. The program fits the scope and budget
2. The program fits the site

3. Contradictions within the program, where one set of expectations is incompatible with another set of expectations have been resolved
4. The program is consistent with any new code or regulatory constraints
5. The program does not create additional political problems
6. The program is complete enough to begin design

Detailed Programming

Detailed programming centers around the choice and performance of various construction elements and systems. For example, specialized instructional equipment may require low humidity, or books may need to be protected from direct sunlight.

Some of the elements considered during detailed programming are:

1. Project life span
2. Applicable systems
3. Performance criteria for systems; e.g., structural, mechanical, electrical, security, telecommunications
4. Criteria for alternative systems; e.g., solar orientation, energy conservation, daylighting, natural ventilation, recycling
5. Criteria for life-cycle costing
6. Criteria for materials selection; e.g., materials that are environmentally preferred
7. Space, shafts and raceways for future systems
8. Equipment needs
9. Criteria for operations and maintenance

When the detailed programming is complete, the architect and engineers should have enough information to propose materials and systems for the project.

7.5 SCHEMATIC DESIGN

Schematic design is done by the project architect, engineer or designer and consists of creating and evaluating alternative design approaches to the project until a single design has been selected and approved.

Steps in schematic design:

1. Create and draw alternative designs
2. Evaluate the alternatives in accordance with the program, scope, budget, and quality plan
3. Choose a single design
4. Develop the design enough to assure that it works within the primary criteria
5. Produce a design presentation for review
6. Secure the necessary approvals

Evaluation of Alternatives

It is recommended that the major users participate in the review so they can be satisfied with all the options that have been considered. It is suggested that the criteria for reviewing alternatives be determined in advance to avoid conflicts.

Schematic Design Documents

Usually, schematic design documents submitted by the architect include:

1. Site plan
2. Floor plans
3. Building elevations
4. Building sections
5. Any perspectives, models, or other presentation materials necessary to describe the design

Support data, also submitted by the architect, usually includes:

1. General description - a narrative describing the design concept in response to the program
2. Area calculations - a summary of gross and assignable floor areas as they relate to the scope
3. Construction cost estimate - a systems level estimate as it relates to the budget for the project
4. Code analysis - a brief description of the major code elements
5. Outline specification - a brief description of the major systems the architect had in mind

Design Review and Approval

Design review occurs at the end of schematics and design development. It is recommended that the district maintain design standards or goals to ensure consistency amongst the projects on campus. Design consistency aligned with an educational philosophy will help develop a campus character and image.

There should be some form of district representative and instructional (or other ultimate user) representative sign off at the end of schematic design, giving the approval to proceed with the selected design and to incorporate it into the FPP.

7.5 SCOPE AND COST

The district's project manager and architect should monitor scope and cost throughout the design phases. Both should be familiar with the budget language, cost guidelines, and accepted methods for calculating areas and estimating costs.

Gross Square Footage

Gross square footage (GSF) is the sum of all areas included within the outside face of the environmentally controlled envelope for all stories or areas that have floor surfaces.

It is computed by measuring from the outside faces of the envelope, disregarding architectural and structural projections extending beyond the envelope face. Within the envelope, vertical circulation space (whether floored or not) and vertical mechanical and electrical shafts shall be counted at each floor. Vertical mechanical and electrical shafts located outside the envelope shall be included as if they were inside the envelope.

The following areas are included in GSF:

1. Basements
2. Attics
3. Garages
4. Enclosed porches
5. Penthouses
6. Mechanical equipment floors
7. Areaways
8. Lobbies
9. Mezzanines
10. Inside balconies
11. Unfinished areas
12. Vertical circulation areas (with and without floors)
13. Mechanical and electrical shafts
14. Interior and exterior walls

The following areas are excluded from GSF:

1. Attics without flooring and portions of upper floors eliminated by rooms or lobbies which rise above single-floor height
2. Floored areas with less than 6'6" clear headroom (unless they can be properly designated and used as mechanical or custodial areas)

Open-to-the-weather spaces such as corridors, porches, balconies, courts, light wells, or space under projecting structure overhead, are counted at a ratio of 50% assigned to gross area.

Assignable Square Footage

Assignable square feet (ASF) is the sum of that part of the building designated for program space. ASF is measured from the inside face of walls.

The following areas are included in ASF:

1. Offices
2. Classrooms
3. Laboratories
4. Seminar and conference rooms
5. Libraries
6. File rooms
7. Storage rooms
8. Special purpose rooms (auditoriums, cafeterias, TV studios, locker and shower rooms, maintenance and research garages, phantom corridors for large non-partitioned spaces, private toilets, etc.)

The following areas are excluded from ASF:

1. Free-standing columns or architectural and structural projections
2. Custodians
3. Circulation
4. Mechanical
5. Public toilets
6. Interior and exterior walls

Cost Estimating

There are three basic methods of estimating construction costs:

1. Building type cost per square foot
2. Cost by building systems and components
3. Cost by building trade or CSI division

Building Type Cost per Square Foot

This is a historical method of cost estimating that assumes a certain type of space or building will have a construction costs that are similar to previous spaces or buildings of that type. For example, a chemistry building will have a similar cost to a previously built chemistry building. This method of estimating refers to an established data base of similar spaces to get a cost per square foot and then modifies that cost to allow for location, market conditions, and date of construction. More accurate estimates are obtained using this method when the design of the project is similar to previous projects. The greater the creativity of the design and the more it uses new systems and materials, the less accurate the estimate.

Estimating by cost per square foot is appropriate during the planning and programming phases. It is recommended that the estimate be compared to the "Building Unit Cost Guidelines" in the Instructions for Preparing 1995-96 Capital Outlay Budget Change Proposals, September 1993 provided by the Chancellor's Office.

Cost by Building Systems and Components

This method costs the project by systems or components per square foot. It is considered a better estimate than a building type estimate because it goes into greater detail.

Given a schematic or design of the project, showing the extent and types of systems and components, the estimate method refers to a data base of systems and components cost per square foot (e.g., the cost of a type of roof or wall construction per square foot) and modifies the costs to allow for location, market conditions and date of construction. More accurate estimates are obtained using this method when more is known about the design of the project and greater use is made of common systems and components. When less is known about the systems or more unique systems and components are used, the less accurate the estimate. Estimating by building systems and components may be used during schematic design and design development.

Cost by Building Trade or Construction Specifications Institute Division

The cost by building trade or Construction Specifications Institute (CSI) Division is the same method of estimation as that completed by a contractor to bid the project.

From the construction documents, the estimation refers to: 1) a labor and materials data base, 2) a takeoff of all materials and systems 3) the total materials, labor and overhead required to do the work at that location and 4) an index factor to allow for market conditions at a future date of construction. More accurate estimates are obtained using this method when better and more complete documents describing the

project are available. Estimating by building trade is used during design development and in construction documents.

All of these estimates rely on the skill of the estimator; the quality of the data base; and the accuracy of the information about the design, site, market and schedule of the project.

Contingencies

Contingencies are used with all of the methods of estimating to allow for unknown conditions and changes. Typically, there are two types of contingencies - project contingencies and construction contingencies. The project contingency is an amount to fund unexpected management and consultant costs for the project.

The construction contingency is an amount to fund unanticipated construction costs; e.g., change orders and construction claims that increase the construction cost beyond the estimate. Typically, the State provides a total contingency amount equal to 5% of the total new construction costs and 7% of the reconstruction costs.

Problems with Cost Estimating

The typical mistakes that occur when estimating costs include:

1. Assuming a higher level of accuracy than is possible given the information available
2. Changing the project scope without changing the budget
3. Leaving out some of the cost factors
4. Not keeping the estimate current
5. Estimating from incomplete documents
6. Not realizing that estimates grow as projects progress and more detail is known
7. Not estimating costs to the midpoint of construction or other inflation-related factors
8. Not considering General Terms and Conditions of the contract, construction bonds, and other contractor burdens

Indexing

The Chancellor's Office uses the Engineering News Record's "Building Construction Cost Index" (CCI) index to estimate the effects of inflation on projects. The Chancellor's Office informs the district of the CCI to be used for developing capital outlay proposals. The index is used to factor the current estimated construction cost to a future cost:

Factors Needed to Apply the CCI Index

1. The index associated with the date of the estimate.
2. The date for the mid-point of construction of the proposed project.
3. The index associated with the mid-point of construction.

Once these three factors are obtained, the indexing factor is applied to the project cost by dividing the midpoint of construction date CCI index by the original cost estimate CCI. The resultant percentage is multiplied by the original cost estimate to obtain an cost estimate indexed to the mid point of construction.

If the CCI at the mid-point is not available, the budget and estimate should be escalated at a rate of 3% per year to the estimated mid-point of construction. These calculations should be clearly shown on the estimate.

Every estimate at any phase of the project should clearly show:

1. Any previous estimated construction costs and appropriations and their associated CCIs.
2. The current estimate of construction cost in today's costs.
3. The projected increase in the current estimate at today's costs to the mid-point of construction with the associated CCI and the date chosen for the mid-point of construction.

Factors that Influence Building Costs:

1. Foundations
   A. Weight of structure and loading
   B. Soil bearing capacity
   C. Basement excavation and shoring
   D. Number of stories
   E. Contour of site

2. Vertical Structure
   A. Floor-to-floor height - Ratio of volume to gross floor area
   B. Quantity of retaining walls - Ratio of retaining wall area to gross floor area
   C. Extent of lateral wind and seismic bracing
   D. Weight of structure and loading
   E. Attachment to existing structure
   F. Vibration criteria

3. Floor and roofs
   A. Loads
   B. Spans
   C. Relationship of quantity of slab on grade to suspended slabs
   D. Attachment to existing structure
   E. Vibration criteria

4. Exterior cladding
   A. Shape and height of building - Ratio of finished exterior wall to gross floor area
   B. Quantity of glazing - Window area ratio
   C. Sun shading
   D. Quality of cladding materials
   E. Attachment to existing structure
   F. Parapets

5. Roofing and waterproofing
   A. Quantity of roof - Roof area ratio
   B. Quantity of below-grade waterproofing
   C. Type and R value of insulation
   D. Roofing materials
   E. Skylights and clerestories
   F. Attachment to existing structure

6. Interior partitions
   A. Density of partitions - Interior partition ratio
   B. Ceiling heights
   C. Size and number of lights and doors
   D. Sound insulation
   E. Quality of partitions and doors

7. Floor, wall and ceiling finishes
   A. Percentage of total building finished - Finished area ratio
   B. Quality of finishes and extent of special features

8. Building Fixtures and Service Systems (Group I fixed equipment)
   A. Percentage of building finished
   B. Use or function of building - Extent of equipment included in construction cost or alternatively purchased

9. Vertical transportation
   A. Number and density of elevators - Elevator ratio
   B. Type of elevators

C. Number of escalators
D. Number and type or staircases - Enclosed fire exit or open architectural

10. Plumbing
    A. Number of plumbing fixtures
    B. Length of piping per fixture
    C. Special systems
    D. Number of floor and roof drains

11. Heating, ventilation and air conditioning
    A. Climate
    B. Area of wall exposed to weather - Finished wall ratio
    C. Percentage of building with finished system
    D. Type of system and source of heating and cooling
    E. Number of separately controlled zones
    F. Number of required air changes
    G. Use of existing central plant
    H. Use of thermal storage
    I. Energy management systems

12. Electrical
    A. Load on main breaker
    B. Total connected load
    C. Percentage of building with finished system
    D. Voltage
    E. Extent of signal or communication systems
    F. Switching requirements
    G. Special conduits or ducts for subsidiary systems
    H. Emergency power
    I. Smoke-detection system
    J. Number and type of lights
    K. Telecommunications, cable infrastructure and network electronic systems

13. Fire-protection, sprinkler systems
    A. Flow required over given area (hazard requirement)
    B. Type of heads
    C. Wet or dry system
    D. Access, proximity

14. Site preparation
    A. Site clearing
    B. Demolition

15. Site Infrastructure Development
    A. Grading

B. Landscaping
C. Paving
D. Fire lanes
E. Hazardous materials removal

16. Site Utilities
    A. Utilities
    B. Utilities hook-up fees
    C. Site drainage

17. Off-site infrastructure development
    A. Extending utilities, roads, etc. off of the site

18. Regulatory factors
    A. Local air quality
    B. Accessibility (American Disabilities Act)
    C. Seismic

7.7 CODE REVIEW

The project design must meet the building code (*California Code of Regulations,* Title 24) and all other applicable regulations. To assure that the project is being developed in accordance with code, a code analysis needs to be done early in the design phase and periodically reviewed and updated by the architect.

It is recommended that the district require a formal code analysis as part of the contract with the architect. The district should review the code analysis at schematic design, design development, and construction documents phases. The code analysis serves several purposes:

1. It summarizes the requirements for the project
2. It can be used in conjunction with concurrent plan review to facilitate code approvals
3. It informs an operations and maintenance department of the requisite code elements in the building
4. It can be reviewed by the district as a check on the architect's work

Concurrent Plan Review

In 1994, the Office of Regulation Services of the Division of the State Architect (DSA / ORS) instituted a new procedure for concurrent plan review. The purpose of concurrent plan review is to avoid long delays to the project while waiting for code approvals. The process is new and should be used as appropriate for a particular project. The current procedures for concurrent plan review are as follows:

1. Application and fee: A DSA/ORS number is assigned upon submittal of an application and fee for concurrent plan review. The full plan check fee is required up front
2. A DSA "Plan Review Manager" is then assigned to coordinate the project through a series of code checks
3. The first code checks occur at the completion of preliminary plans. A file is opened and DSA provides a written report of their check to the design professional with copies to the district
4. Up to three additional plan checks occur progressively through the construction documents phase, each followed by a report to the design professional with copies to the district
5. The final plan review for DSA code approval is done on only those areas of the project not previously checked, thus saving time

Deferred Code Approvals and Change Order Approvals

The districts have historically had a great deal of difficulty with code approvals that are required to occur during the construction process. The delays in obtaining these approvals have made the districts vulnerable to delay claims by the contractor. It is recommended that the design of the project be done so as to avoid, to the greatest extent possible, construction materials and methods that may require deferred code approvals. Likewise, code approval for change orders can delay a project and cause additional code check fees. Hence, change orders should be kept to a minimum.

7.8 DESIGN DEVELOPMENT

During design development all of the remaining design decisions are resolved for all significant elements and systems in the design.

Steps in design development:

1. Review and revision of schematic documents per reviews
2. Addition and coordination of all the design systems; e.g., structural, electrical, mechanical
3. Design of all significant details or elements
4. Value engineering with life-cycle costing
5. Updated scope, cost estimate, code analysis

Design Development Documents

1. Site plan
2. Landscape plan
3. Floors plans
4. Elevations and sections
5. Detail drawings
6. Interior details
7. Structural drawings
8. Mechanical drawings
9. Electrical drawings
10. Drawing of any significant special systems
11. Outline specifications

The drawings and specifications should be complete enough to describe the entire design with all its major elements.

Support Data

1. Area calculations
2. Report of design criteria used for the systems
3. Code analysis
4. Energy analysis
5. Estimated project construction cost by systems

The support data includes the design criteria used to design the systems; e.g., structural, mechanical, temperature, air changes, and humidity requirements for the mechanical system. It is suggested that these design criteria be reviewed by operations and maintenance.

7.9 EQUIPMENT PLANNING

In conjunction with the evaluation and choice of building systems, the Group I - Fixed Equipment needs and Group 2 - Movable Equipment needs should be developed and coordinated during the design development phase. While the characteristics of a piece of equipment may suggest its initial classification as Group I or Group 2, it is the designed use of the equipment and its installation characteristic that determines its ultimate classification. Equipment which is mobile, but must be used as part of the function of a specialized room in order for that room to operate, such as equipment for a television studio, may be considered Group I or Group 2 equipment depending on the extent to which the equipment is essential to the basic effective use of the facility. Therefore, districts should justify all equipment needs, whether Group I or Group 2, if it is reasonable to expect questions about the appropriateness of a request.

Group I - Fixed Equipment

'***Group I -Fixed Equipment***' is defined as building fixtures and support systems that become an integral part of the facility during construction. Group I - Fixed Equipment needs are described in the working drawings and specifications for the project and has the following characteristics:

1. It is securely attached to the facility.
2. It functions as part of the building.
3. Removal of the equipment results in visible damage to the building or impairs the designed use of the facility.
4. The equipment is generally interpreted to be real property rather than personal property.
5. Once installed, the piece of equipment loses its identity as a separate unit.

Group 2 - Movable Equipment

'***Group 2 - Movable Equipment***' is the designation given to equipment not identified as Group I - Fixed Equipment. Such equipment usually can be moved from one location to another without significantly changing the effective functioning of facilities at either location. Group 2 equipment also includes library books and other related library materials. Currently, funding may be requested for Group 2 equipment needs in space dedicated to new programs and in net expansion space in existing programs. The need for new equipment should be reduced as much as possible through the use of any existing equipment. It is assumed that all existing Group 2 equipment for an active program will be transferred into remodeled or expanded space before new equipment is requested. Group 2 movable equipment needs that constitute technological upgrades generally will not be honored unless it can be demonstrated that the changes are so significant that they constitute an introduction of a new program. All equipment designs should include these factors when justifying the Group 2 equipment requests in the FPP.

When developing Group 2 needs for new or expanded programs, districts should design their telecommunications and information systems so as to avoid purchases of equipment that will become rapidly outdated. Telecommunication equipment requests should include software, supporting peripherals, file sorters, front-end processors, and any other elements required to make a complete system. Consideration should be given to tying in with a larger campus system such as a fiber optic backbone which links the major buildings. Further, requests for equipment should be accompanied by a short summary of the local plan and total costs for activation of that equipment. The full plan, while not submitted, would list each equipment system; installation cost; warrantee cost; timing and cost for special testing or balancing; process and cost for training staff to operate equipment; cost for initial programming; and any other procedures and costs associated with getting the equipment fully on line.

A detailed list of Group 2 Moveable Equipment needs, net of transferred existing equipment if any, must be submitted and included in a FPP before it will be transmitted to the Department of Finance.

7.10 VALUE ENGINEERING

The term ***'value engineering'*** is the review of engineering systems in the project to verify that the best system has been chosen given the budget and the functional criteria.

Usually, value engineering is what an architect strives to do as a project progresses. Often, however, architects use those systems and materials with which they are familiar and do not take the time for in-depth analysis of alternatives. The district follow the architect's recommendations, require the architect to do some value engineering as part of its contract, or retain other consultants for value engineering. If the project is complex and expensive, such value engineering may save a significant amount of money or steer the district toward better systems. Value engineering is fundamentally a form of quality control. It relates to several other forms of quality control:

1. **Value analysis or management** -- similar to value engineering only applied to the design as a whole as well as to various systems.

2. **Life-cycle costing** -- the analysis of the cost of alternative systems over their entire life span from purchase through operation and maintenance to change-out or demolition.

3. **Constructability review** -- the review of systems and structures for construction access, construction sequence, ease of construction, ease of operation and maintenance, and ease of change-out.

4. **Coordination check** -- the review of systems and structures as they relate to other systems and structures on the project; e.g., running a series of systems in a ceiling without conflicts.

5. **Bid-ability review** -- adequacy of the information in the documents for bidding.

All of these terms refer to the careful design of the project so that it can be constructed with ease, using systems and structures which provide good value over time, and satisfy the parameters of the project.

One last form of review is tied to this analysis:

6. **Independent Cost Review** -- a "third party" construction cost estimate to compare with the project architect's estimate.

All of the analysis of value engineering is done based on the cost estimate. If the estimate is incorrect, so is the analysis. On a complex project with a variety of systems, a thorough check of the estimate or a second estimate is advised.

SARA Systems software is currently available to about half of the districts for estimating. Moreover, SARA provides the Community College Design and Cost Guidelines. In order to obtain a second cost estimate, the districts may call SARA systems at 1 (800) 255-7949 or contract with other reliable cost estimators.

If the time and money is available to the district for all of these forms of quality control, a project would be checked as follows:

1. At the programming phase -- Are there elements of the program that conflict, are unduly expensive, require special operations or maintenance, or simply make no sense in the circumstances of the project?

2. At the schematic design phase -- Is the basic layout and massing of the building appropriate to the expected form of construction; e.g., steel, concrete? Is the layout conducive to the likely systems for the building? Are elements of the design, such as fenestration, cost effective for operations and maintenance?

3. At the design development phase -- What systems will provide the best value? What materials will provide the best value? Are these choices easily incorporated into the construction? Will they conflict with any other materials or systems? What will be their labor and material costs for operation and maintenance?

4. At the construction documents phase -- Are the drawings and specifications free of errors and omissions? Can they be used to construct the project as desired at the appropriate quality level?

Value engineering is normally carried out in four phases:

1. Gathering information such as site analysis and cost estimates
2. Brain storming alternative systems and materials
3. Analyzing the ideas that resulted from the brain storming
4. Making recommendations to the district to incorporate some of the ideas into the design

Often a group of experts can come up with more alternatives and more creative alternatives than a single consultant. The districts can provide value engineering and other checks by:

1. Having knowledgeable in-house technical staff review the project

2. Bringing a consultant construction manager on board during design to review the design
3. Hiring an independent cost estimator
4. Using SARA systems software to provide an independent cost estimate and life-cycle costing
5. Hiring several independent consultants; e.g., architect, mechanical engineer for review
6. Using a general contractor to review the documents for constructability

In all cases, the earlier any problems are discovered the better. Once such a review process is begun, it is suggested that it be continued throughout the design phases.

7.11 REQUEST FOR APPROVAL OF PRELIMINARY PLANS

In accord with *Government Code,* Section 13332.11, the State Public Works Board (PWB) is required to approve all preliminary plans to ensure that projects proceeding to the subsequent phases of working drawings and construction, are consistent with legislatively approved cost and scope and are carried out with all due speed and diligence.

Districts are to submit two copies of the following documents to the Chancellor's Office to request approval of preliminary plans:

1. Letter requesting approval of preliminary plans and release of working drawing funds and, if applicable, explanations of any scope or cost changes made or planned since project was funded by the Legislature
2. Summary of Costs and Anticipated Time Schedule (JCAF 32)
3. Quantities and Unit Costs Supporting the JCAF 32 (Architect's Detailed Cost Estimate)
4. Final "Notice of Determination" stamped by the State Clearing House signifying completion of the CEQA requirements
5. Preliminary plan drawings.and specifications (one copy only)

The Chancellor's Office reviews the submittal and forwards to the Department of Finance copies of the following items in addition to one copy of each of the items listed above:

6. A State Public Works Board agenda item and briefing document describing the project
7. A completed "Request for Approval to Proceed or Encumber Funds" (DF14D) to seek approval of preliminary plans and release of working drawing funds.
8. If scope or costs have changed from that authorized by the Legislature, compelling justification for the scope or cost change. (A Twenty-Day letter or a Department of

Finance budget change request letter may be required depending on budget status of the construction phase.)

9. A cost history for the project.
10. Any other related documents needed to obtain approval of preliminary plans.

The district must submit preliminary plans to the Chancellor's Office for review at least 45 calendar days prior to the scheduled meeting of the PWB. The Chancellor's Office then reviews the submittal, prepares the package and transmits it to the Department of Finance at least 30 calendar days prior to the PWB meeting date. If the preliminary plans contain a significant change in cost or a change in scope from that authorized by the Legislature, at least 24 additional calendar days may be needed to process a formal request to Legislative Committees and the PWB to approve the changes (see Chapter 8, Subsection titled Twenty-Day Letter).

California Environmental Quality Act Completion of Requirements

The environmental document required by the California Environmental Quality Act must be completed before a project is submitted to the PWB for approval of preliminary plans and authorization to begin working drawings (Section 6680 of the *State Administrative Manual*). If an Environmental Impact Report (EIR) is required, the draft EIR should have been completed during schematics with the final EIR completed during design development. (Refer to Chapter 6, Section 6.10 for further discussion of the California Environmental Quality Act.)

Upon PWB approval, the Chancellor's Office shall immediately notify the district.

7.12 CONSTRUCTION DOCUMENTS

The objective of the construction document phase is to produce clear, complete, error-free documents, approved by code that meet the agreed upon program, design, decisions, scope, budget and quality. The construction documents consist of the specifications, drawings, and data for the contractor plus support data to facilitate reviews and approvals.

During the construction documents phase, the design documents are translated by the architect, engineer or designer into working drawings and specifications for the construction of the project. At this point in the project, all of the significant design decisions should have been made and approved, and the client needs to refrain from making any further changes. Design changes during construction can cause delays, increase design fees and increase errors in the production of the documents.

Steps in construction documents phase:

1. Review and revision of preliminary plans per reviews and approvals

2. Determination of any bid alternates
3. Production of construction documents with alternates
4. Code review at 50% document completion
5. Completion of CEQA-required reports, if not already completed
6. Production of a bid estimate and other support data
7. Formal coordination and constructability check of the documents
8. Completion of documents with dates, stamps and signatures
9. Code review at 100% completion and approval

Support data for DSA approval includes: a code analysis, structural calculations, and energy calculations. Support data to get approval to bid from the Chancellor's Office is discussed in the next chapter. There may also be special data to be produced for the bid and construction process such as a commissioning plan, estimates of alternates, an estimated construction schedule, special request for sole source, etc.

Drawings

The construction drawings include:

1. Title Sheet
2. Civil
3. Architectural
4. Structural
5. Mechanical, Plumbing, Fire Protection
6. Electrical
7. Landscape
8. Other drawings as needed to comply with existing building codes

The district is responsible for the technical content of the drawings and insuring that all the drawings are properly dated, stamped and signed by the district's architect and engineer.

The operations and maintenance department should review the drawings for compatibility with the campus infrastructure, utilities, telecommunications, subsurface conditions, or any other hidden conditions. Also, these drawings should be made available to the district's maintenance and operations department for future use after the project is completed.

Specifications

The specifications describe "what" while the drawings show "how many" and "where". In the event of a disagreement between the drawings and specifications, the specifications govern unless stated otherwise in the contract.

There are four types of specifications:

1. Descriptive specifications list the important properties of the product without the use of trade names
2. Proprietary specifications designate the product by brand name
3. Performance specifications outline the ends to be achieved by the product
4. Reference specifications list the standards (e.g. astm) which a product must meet

Specifications may be 'open' or 'closed'. ***'Open specifications'*** are used to allow for competitive bid. Materials or systems referred to by trade name have two or more trade or brand names listed followed by the words 'or equal'. A ***'closed specification'*** limits competitive bidding by establishing such stringent requirements that only a single material or system can meet them. Closed specifications cannot be used on public projects except: 1) in an emergency, 2) when they are part of an existing system, 3) when it has been determined to be in the public's best interest or 4) it is required for a test of the material or product to determine its suitability for future use.

Specifications are written in the CSI format and include the title sheet, index, Division 1 General Requirements, and divisions 2-16 technical requirements.

Division 1 includes a description of the work, allowances, alternatives, change orders, coordination, field engineering, regulatory requirements, abbreviations, special procedures, meetings, schedule, submittals by the contractor, quality control, construction facilities, temporary utilities, materials and equipment, substitutions, guarantees and warranties, unit prices, and contract close-out. All of the items in division 1 are crucial to the success of the construction management and need to be reviewed in detail by the district.

Divisions 2-16 include site work, concrete, masonry, metals, wood and plastics, thermal and moisture protection, doors and windows, finishes, specialties, equipment, furnishings, special construction, conveying systems, mechanical and electrical. These divisions need to be checked for open specifications, technical content and coordination with the drawings, general conditions, and other specification sections. Districts should be especially alert to items furnished by the owner, testing requirements, submittals, job conditions, and warranties as they appear in the technical specifications.

As with other technical requirements of the project, it is recommended that the specifications be dated, stamped and signed by the architect and engineer.

Bidding Alternates

The purpose of bidding alternates is to have some flexibility regarding contract costs when bids come in. Deductive alternates deduct work from the contract and additive alternates add work to the contract. Alternates cannot be used to change the project's

programmatic scope unless there is a compelling reason to do so and prior approval has been obtains from the Chancellor's Office and the Department of Finance.

The districts may incorporate either additive or deductive alternates into the construction documents with prior approval by the Chancellor's Office and DOF. If bid alternates are being considered, they need to be agreed upon at the beginning of the construction documents phase so they can be incorporated into the drawings and specifications. Alternates developed just prior to bidding may cause delays, increase design fees and increase errors.

One alternative a district has is to use district funds to support additive alternates in the project. Prior approval by the Chancellor’s Office and the Department of Finance is still required.

To get Chancellor's Office approval of alternates, the district needs to submit:

1. Current project status report
2. Current cost estimate
3. List of alternates with estimated costs and detailed explanations

It is recommended that this submittal be made at the earliest date the information is available, preferably by 50% completion of construction documents. If the district has concern that the Chancellor's Office may not approve certain alternates, the alternates can be discussed with the Chancellor's Office prior to incorporating them into the construction documents.

Data for the Contractor

The construction documents may contain information and reports in addition to the drawings and specifications. These might include geotechnical reports, abatement reports, structural calculations, campus construction staging areas, special campus parking fees, or anything else pertinent to the contract. This information should be referenced in the specifications and, wherever possible, incorporated directly into the specifications. If it is not of direct relevance to the bid or contract, it needs to be provided to the contractor at a later date as a matter of information. The supporting data is kept to a minimum because it will become a legal part of the contract along with the drawings and specifications.

Regulatory Requirements

A code analysis must be performed on a project to demonstrate that the project meets current building codes, other code requirements, and state regulations. When the project is complete, the code review documents in conjunction with the drawings and specifications are important to the maintenance and operation of the project. They help

to determine the feasibility of retrofits, remodels and additions, where the building can be changed and where it should be left as originally constructed.

Bid Estimate (Estimated Project Construction Cost)

The bid estimate is required to obtain approval to go to bid as discussed in Chapter 8. It should be in CSI format showing materials, labor and overhead. The bid estimate should be broken out in the same categories as the bids are, as required by the bid instructions, so that the cost estimate can be compared with the bids.

Area Calculations

The area calculations from the preliminary plans should be updated to verify that the project is within scope.

7.13 COORDINATION AND CONSTRUCTABILITY

Construction documents can be very extensive and having adequate time to check the detail and coordination of the drawings is critical. The district should perform its own detailed check of the drawings using in-house staff or an independent consultant. Consultants should check the drawings for errors and for code compliance. A code check by a reputable consultant prior to the formal review for approval may speed up the code approval process.

As part of the constructability check, it is recommended that the equipment for the project be reviewed in detail for sequence of procurement, installation, testing and activation procedures. Also, it is important to verify the availability of the equipment within the project time frame and review for potential problems with parts and warrantees.

7.14 CODE APPROVALS

Construction documents must be submitted to DSA for code approval. The district should ensure that code compliance issues are resolved during the concurrent review. Efforts should be given to resolve issues in projects eligible for a single, multi-phased (P, W, C, & E) appropriation to safeguard the opportunity for funding.