APPENDIX F COST ESTIMATES

> **"When we mean to build, we first survey, then draw the model, and when we see the figure of the house, then must we rate the cost of the erection, which if find outweighs ability, what do we then but draw the model in fewer offices, or at least desist to build at all."**
>
> **William Shakespeare**
> **King Henry IV, Part II**
> **Act I, Scene 3, Line 41**

F-1. INTRODUCTION

When a public agency proposes to construct a building, the taxpayer, the legislature, the agency, the architects and engineers and the contractors have the same goals–to define, communicate and control the project scope, cost, time and quality. Achieving this requires effective communications among all the project participants. A productive exchange of information helps identify potential problems early–even before design begins. The result is a construction project that more effectively meets the agency's needs, while reducing design and construction delays, cost overruns and claims. A well-organized cost estimate, created and modified to a consistent set of rules, is one of the most important tools for communicating information about the project.

F-2. REQUIRED FORMAT

F-2.1. To ensure a consistent approach to the development and presentation of construction cost estimates, the OSE requires that all cost estimates presented to this office shall use a standard format. The required format is defined in the most current edition of ASTM E1557-97 *Standard Classification for Building Elements and Related Sitework - UNIFORMAT II*. The basic document is available as a free download in PDF format from the National Institute of Standards and Technology at the following Web site:

http://www.bfrl.nist.gov/oae/publications/nistirs/6389.pdf

The ASTM standard can be obtained from the American Society of Testing and Materials.

F-2.2. *UniFormat II* is an arrangement of construction information based on physical parts of a facility called systems and assemblies. These systems and assemblies are characterized by their function without identifying the products that compose them. Systems and assemblies render a view of a constructed facility different from a view rendered by a breakdown of building materials, products and activities. *UniFormat II* is intended to complement industry-standard organizations of the technical specifications, such as *Masterformat* or *CSI.* The purpose of *UniFormat* is to achieve consistency in the economic evaluation of projects, enhance reporting of design program information, and promote consistency in filing information for facility management, drawing details and construction market data. Estimates prepared using the *UniFormat* classification system provide the Legislature, the Agency and the A/E with an essential tool to control project scope, cost, time and quality.

F-2.3. *UniFormat II* classifies information into eight categories. Table F-1 presents a more detailed summary of the *UniFormat II* classification system.

A	**Substructure**	**E**	**Equipment and Furnishings**
B	**Shell**	**F**	**Special Construction and Demolition**
C	**Interiors**	**G**	**Building Sitework**
D	**Services**	**Z**	**General**

Table F-1 *Uniformat II* Classification of Building Elements*

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A SUBSTRUCTURE	A10 Foundations	A1010 Standard Foundations A1020 Special Foundations A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation A2020 Basement Walls
B SHELL	B10 Superstructure	B1010 Floor Construction B1020 Roof Construction
	B20 Exterior Closure	B2010 Exterior Walls B2020 Exterior Windows, Exterior Doors
	B30 Roofing	B3010 Roof Coverings B3020 Roof Openings
C INTERIORS	C10 Interior Construction	C1010 Partitions C1020 Interior Doors C1030 Specialties
	C20 Staircases	C2010 Stair Construction C2020 Stair Finishes
	C30 Interior Finishes	C3010 Wall Finishes C3020 Floor Finishes C3030 Ceiling Finishes
D SERVICES	D10 Conveying Systems	D1010 Elevators D1020 Escalators & Moving Walks D1030 Material Handling Systems
	D20 Plumbing	D2010 Plumbing Fixtures D2020 Domestic Water Distribution D2030 Sanitary Waste D2040 Rain Water Drainage D2050 Special Plumbing Systems
	D30 HVAC	D3010 Energy Supply D3020 Heat Generating Systems D3030 Cooling Generating Systems D3040 Distribution Systems D3050 Terminal & Package Units D3060 Controls & Instrumentation D3070 Special HVAC Systems & Equipment D3080 Systems Testing & Balancing
	D40 Fire Protection	D4010 Fire Protection Sprinkler Systems D4020 Stand-Pipe & Hose Systems D4030 Fire Protection Specialties D4090 Other Fire Protection Systems
	D50 Electrical	D5010 Electrical Service & Distribution D5020 Lighting & Branch Wiring D5030 Communication & Security Systems D5040 Special Electrical Systems
E EQUIPMENT & FURNISHINGS	E10 Equipment	E1010 Commercial Equipment E1020 Institutional Equipment E1030 Vehicular Equipment E1090 Other Equipment
	E20 Furnishings	E2010 Fixed Furnishings E2020 Movable Furnishings

F SPECIAL CONSTRUCTION & DEMOLITION	F10 Special Construction	F1010 Special Structures F1020 Integrated Construction F1030 Special Construction Systems F1040 Special Facilities F1050 Special Controls and Instrumentation
	F20 Selective Building Demolition	F2010 Building Elements Demolition F2020 Hazardous Components Abatement
G BUILDING SITEWORK	G10 Site Preparation	G1010 Site Clearing G1020 Site Demolition and Relocations G1030 Site Earthwork G1040 Hazardous Waste Remediation
	G20 Site Improvements	G2010 Roadways G2020 Parking Lots G2030 Pedestrian Paving G2040 Site Development G2050 Landscaping
	G30 Site Mechanical Utilities	G3010 Water Supply G3020 Sanitary Sewer G3030 Storm Sewer G3040 Heating Distribution G3050 Cooling Distribution G3060 Fuel Distribution G3090 Other Site Mechanical Utilities
	G40 Site Electrical Utilities	G4010 Electrical Distribution G4020 Site Lighting G4030 Site Communications & Security G4090 Other Site Electrical Utilities
	G90 Other Site Construction	G9010 Service and Pedestrian Tunnels G9090 Other Site Systems & Equipment
Z GENERAL	Z10 General Requirements Z20 Bidding Requirements, Contract Forms and Conditions, Contingencies Z90 Project Cost Estimate	

* *Uniformat II* provides a fourth level of detail, which should be used for estimates on large or complex projects.

F-3. PRE-DESIGN ESTIMATES

F-3.1. Before any significant state building construction can occur, the agency must first comply with all the project approval requirements of Part I of the *Manual for Planning and Execution of State Permanent Improvements*, and any other oversight entities (such as the Commission on Higher Education). The process always includes evaluation of the agency's estimated budget for the project. This first estimate is the most important cost estimate given during the course of a project's life–it sets the number that everybody remembers.

F-3.2. While project budgets are admittedly difficult to establish during the early stages of a project, a realistic budget can be developed if there is a well-developed project description. Agencies with limited experience in construction may require the services of a design professional to assist in the development of the project's scope and budget. The PIP process allows for a project to be authorized for "A/E services only" specifically to address situations where preliminary programming and budgeting services are needed. Figure F-1 is an example of how the *Uniformat II* structure can be applied to support the development of a project description.

Figure F-1 Sample Project Description Using *Uniformat II*

B SHELL

B10 SUPERSTRUCTURE

B1010 FLOOR CONSTRUCTION

A. Floor System: Two-hour fire-rated, composite steel beam, steel deck, and concrete slab system in 20 feet by 25 feet bay dimensions capable of supporting 75 psf live load.

B1020 ROOF CONSTRUCTION

A. Roof System: Two-hour fire-rated, composite steel beam, steel deck, and concrete slab system in 20 feet by 25 feet bay dimensions capable of supporting 30 psf live load.

B20 EXTERIOR ENCLOSURE

B2010 EXTERIOR WALLS

A. Masonry Cavity Wall Construction:
   1. Modular facing brick installed in running bond with tooled concave joints.
   2. Extruded polystyrene board installed between continuous joint reinforcing.
   3. Bituminous dampproofing applied over concrete masonry units.
   4. Load-bearing concrete masonry units with galvanized continuous joint reinforcing.
   5. Concrete masonry unit lintel units over openings; concrete masonry unit bond beams at top of wall.
B. Loose galvanized steel linters over brick openings with 8 inches minimum bearing on each side of opening.
C. Elastomeric masonry flashing at sills, linters, and other cavity interruptions.
D. Open weepholes in brick masonry at flashing locations on 24 inches centers.

B2020 EXTERIOR WINDOWS

A. Windows: Commercial-grade, aluminum double-hung windows with clear anodized finish and clear insulating glass.

B2030 EXTERIOR ENTRANCE DOORS

A. Doors and Frames: Insulated, exterior flush steel doors set in steel frames.
B. Hardware: Ball bearing butts, closers, locksets, thresholds, and weatherstrip.

F-3.2.1. Project Scope. The gross built area and volume, together with the occupancy type and number of occupants in the building, set the bounds for construction cost. Defining the project scope requires an accurate identification of the agency's functional space requirements.

F-3.2.2. Site. The costs of acquiring and developing the site and accommodating the building to it.

F-3.2.3. Schedule. The Agency must establish an accurate and reasonable project time line, considering the legislative funding schedules and the times required for selection of a design professional, the design of the project and the bidding and construction periods. The schedule will impact the project budget due to inflation factors (escalation) and market conditions.

F-4. GENERAL REQUIREMENTS FOR DESIGN PHASE ESTIMATES

F-4.1. A cost estimate is required with each submittal. All estimates shall be prepared in the required format and shall be summarized. Appropriate back-up data to support the costs shown on the Summary shall be provided. The estimate backup material for each submittal shall be consistent with the level of design required for that

submittal. Accurate quantity take-off, inclusion of all appropriate standard systems, and accurate unit prices for the project's location are fundamental to the development of a good cost estimate.

F-4.2. Properly prepared cost estimates provide a check of the plans and specifications for constructability, coordination, conflicts, discrepancies, and omissions. They are used to establish/verify budget costs, to develop historical data for future estimating, and for verification of the Contractor's proposed Schedule of Values.

F-4.3. The estimate at each submittal is expected to reflect the A/E's or Estimator's best information and experience. Pricing must reflect all requirements of the contract plans and specifications. Estimates may be prepared manually or by utilizing computerized estimating programs. A detailed breakdown of components using Level 3 Elements shall be calculated, quantified, costed and listed on the Summary.

F-4.4. Separate estimates will be prepared for each new non-identical building, structure, or addition costing over $25,000 contract cost. Costs of alteration work to existing buildings will not be included with the building addition costs. When one construction contract contains more than one type of work (i.e., new construction, repair, equipment installation, etc.), the estimate shall be structured such that each type of work is identified separately. In addition to an overall or master summary sheet, each type of work requires a separate summary sheet. Costs from these separate summary sheets must be directly transferable to the master summary sheet.

F-4.5. The A/E's Basic Services require that the work defined as the "Base Bid" represent a project that first, meets all of the agency's program requirements and, second, in the A/E's opinion can be constructed for the funds budgeted by the agency. This process requires continuing dialogue between the A/E and the agency to resolve imbalances between the agency's desires and the agency's budget.

F-5. SCHEMATIC DESIGN PHASE ESTIMATE OF CONSTRUCTION COST

F-5.1. The Schematic Design Construction Cost Estimate shall be developed in the required format using a mixture of Level 2 and Level 3 Elements. Each system shall include a description or listing of the components or items included in that unit cost. To the extent possible, major systems or commodities should be quantified. Where quantification is not reasonable, the assumptions and logic for the estimated cost shall be shown.

F-5.2. The expected degree of accuracy is plus or minus 20 percent, not including contingency. It is expected that the estimator will have made a site visit.

F-6. DESIGN DEVELOPMENT PHASE ESTIMATE OF CONSTRUCTION COST

F-6.1. The Design Development Estimate shall be based on a materials take-off from the preliminary documents. The estimate for this submittal shall reflect cost based on reasonably accurate take-off of material/systems consistent with the level of design. It is expected that the estimate will contain a mixture of Level 3 and Level 4 elements. For those elements of the project where the status of design does not permit a reasonably accurate take-off of quantities or firm pricing of individual items of work, system unit prices may be used. Lump sum costs are not acceptable. Use of empirical costs shall be minimized.

F-6.2. The expected degree of accuracy is plus 15 to minus 5 percent. The estimator shall make a site visit unless the estimator is completely familiar with the construction area and surrounding constraints.

F-7. CONSTRUCTION DOCUMENTS PHASE ESTIMATE OF CONSTRUCTION COST

F-7.1. The A/E shall provide a final estimate based on the working drawings and specifications. Full and accurate description of each system shall be provided in the estimate, which shall be prepared using a preponderance of Level 4 Sub-elements, unless a lesser level of detail is appropriate for a specific project. Quotations must be obtained for all items of substantial quantity or cost. Documentation must be provided for all major items of equipment included in the project. "Estimated Prices" are considered to be quotations that are reasonable expectations of the price a Contractor will be expected to pay. Estimates that do not conform to these formats and information requirements will be returned for revision. Separate estimates must be prepared for each **Bid Alternate** included in the documents and shall be in the proper format.

F-7.2. The expected degree of accuracy is plus 10 percent to minus 5 percent and the estimator shall make a site visit unless the construction area and surrounding constraints are unchanged from those assumed in the Design Development Phase cost estimate.

F-7.3. In preparing its final estimate, the A/E shall apply its best judgment and effort to produce an estimate of the probable actual bid from a competent and knowledgeable contractor who is using the final Bidding Documents

to define the scope of the project, reflecting the A/E's assessment of the current bidding climate and market conditions. This final estimate is NOT to be an estimate of the lowest possible price that could be obtained.

F-7.4. The use of Bid Alternates shall be minimized. The A/E and the agency are expected to cooperate through the design process so that the Base Bid represents a project that achieves the agency's programmatic requirements within the available funds. Bid Alternates, if used, are considered optional enhancements to the project scope.

F-8. CONTINGENCY

F-8.1. The application of contingency for various types of cost estimates covers the entire life cycle of a project from feasibility studies through execution to closeout. The purpose of the contingency guidelines presented in this Appendix is to provide for a standard approach to determining project contingency and improve the understanding of contingency in the project management process. These guidelines have been adopted by the Office of Capital Improvements and the Office of State Engineer and should be incorporated into the PIP planning and operating procedures and practices of all State Agencies.

F-8.2. Contingency Definitions

F-8.2.1. General Contingency

Contingency is an integral part of the total estimated costs of a project. It has been defined by the American Association of Cost Engineers as:

"…specific provision for unforeseeable elements of cost within the defined project scope. [Contingency is] particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."

For the purposes of Agency management of PIP project budgets, contingency covers those costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of the contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected cost.

It is not State practice to set aside contingency for major schedule changes or unknown design factors, unanticipated regulatory standards or changes, incomplete or additions to the project scope definition, force majeure situations, or legislative budget cuts. Project and operations estimates will always contain contingency. Estimators should be aware that contingency is an integral part of the estimate.

F-8.2.2. Buried Contingencies

Some estimators have sought to hide contingency estimates in order to protect the project so that the final Project does not go over budget because the contingency has been removed by outside sources. This is known as buried contingency. All internal and external estimators shall refrain from burying extra contingency allowances within the estimate.

F-8.3. Specifications For Contingency Analysis

Considerable latitude has been reserved for estimators and managers in the following contingency analysis specifications. These guidelines are to be followed by both agency and contractor cost estimators to ensure a consistent and standard approach by the project team.

A written contingency analysis and estimate will be performed on all cost estimates and maintained in the estimate documentation file. This analysis is mandatory.

Estimators may use the ranges provided in this Appendix for estimating small projects; however, larger projects require a more detailed analysis, including a cost estimate basis and a written description for each contingency allowance assigned to the various parts of the estimate.

Justification must be documented in writing when guide ranges for contingency are not followed**.** If extraordinary conditions exist that call for higher contingencies, the rationale and basis will be documented in the estimate. Risk analysis may also be necessary.

F-8.4. Construction Project Contingencies

Table F-2 presents the contingency allowances by type of construction estimate for various standard estimate types. The estimate types in Table F-2 are primarily an indication of the degree of completeness of the design. Contingency is calculated on the basis of remaining costs not incurred. The Independent Estimate, may occur at any time, and the corresponding contingency would be used.

F-8.5. Contingency Factors

The following factors need to be considered to select the contingency for specific items in the estimate while staying within the guideline ranges for each type of estimate.

F-8.5.1. Project Complexity

Unforeseen, uncertain, and unpredictable conditions will exist. Therefore the following percentages are provided for planning and budget estimates. They are listed in order of increasing complexity and should be applied to the estimated value of the specific cost element:

- Land and Land Rights 5% to 10%
- Improvements to Land/Standard Equipment 10% to 15%
- New Buildings and Additions, Utilities, Other Structures 15% to 20%
- Architect/Engineering Services 15% to 25%
- Building Modifications 15% to 25%
- Special Facilities (Standard) 20% to 30%
- Experimental/Special Conditions Up to 50%

Considerations that affect the selection in the ranges given are: state-of-the-art design, required reliability, equipment complexity, construction restraints due to continuity of operation, security, contamination, environmental (weather, terrain, location), scheduling, and other items unique to the project.

F-8.5.2. Design Completeness or Status

Regardless of the complexity factors listed above, the degree of detailed design to support the estimate is the more important factor. This factor is the major reason that the ranges in Table F-2 vary from the high of 20 to 30 percent in the planning estimate to 5 to 15 percent at the completion of design. Again, parts of the estimate may have different degrees of design completion, and the appropriate contingency percent must be used. As can be seen from Figure F-2, as a project progresses, the contingency range and amount of contingency decreases.

F-8.5.3. Market Conditions

Market condition considerations are an addition or a subtraction from the project cost that can be accounted for in contingency. Obviously, the certainty of the estimate's pricing will have a major impact on the contingency. The closer the project is to a firm quoted price for equipment or a portion of construction work, the less the contingency can be, until reaching the minimum post-award levels of 5 to 10 percent for fixed-price construction contracts.

Market conditions include the effects of competition. Simply put, the more bidders who compete for an award, the better the price received. This effect is shown in Figure F-3, which is taken from a study performed by the U.S Army Corps of Engineers. This study showed that 6 to 8 bidders are required before the low bid approximates the "true" cost of the work. When an agency elects to hold <u>mandatory</u> pre-bids, the result is typically a reduction in the number of bidders and probable higher bids.

F-8.5.4. Special Conditions

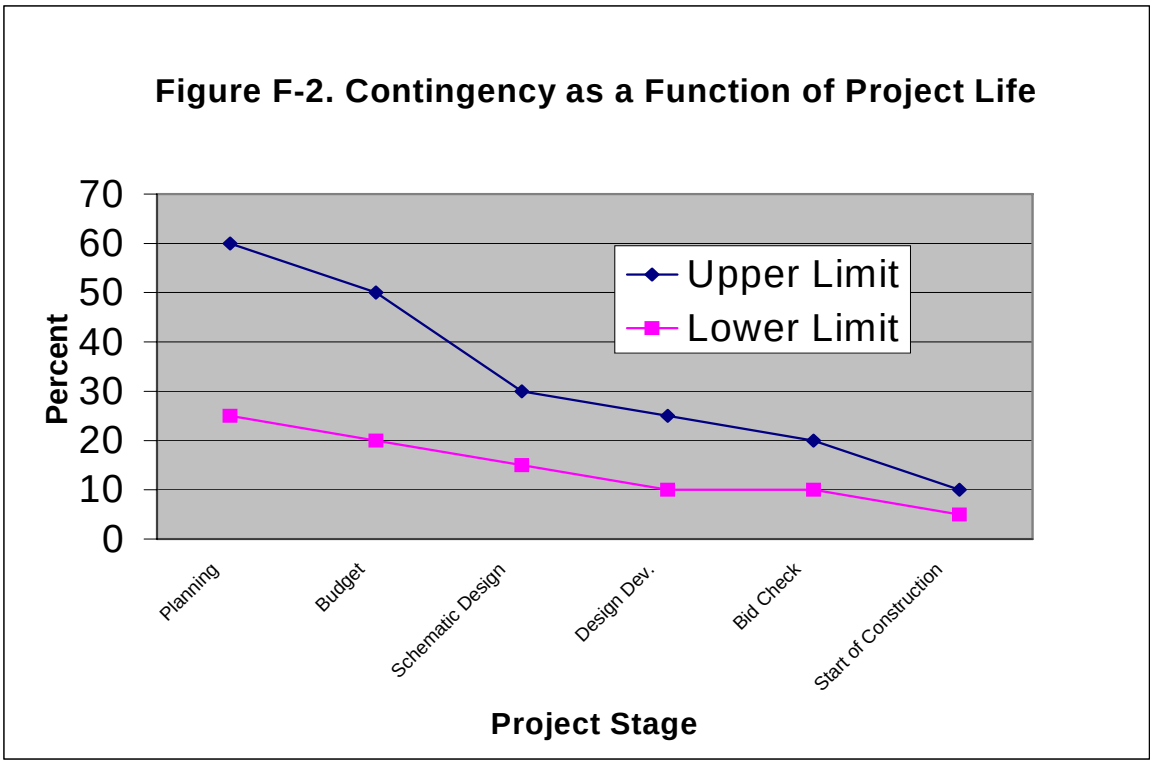
When a project faces unknown conditions with significant cost implications or is incorporating unproved design elements, the estimator can perform an "optimistic-pessimistic" analysis. For each competing outcome, an estimate is made. The difference in these estimates of the optimistic and pessimistic alternative can be used as the contingency.

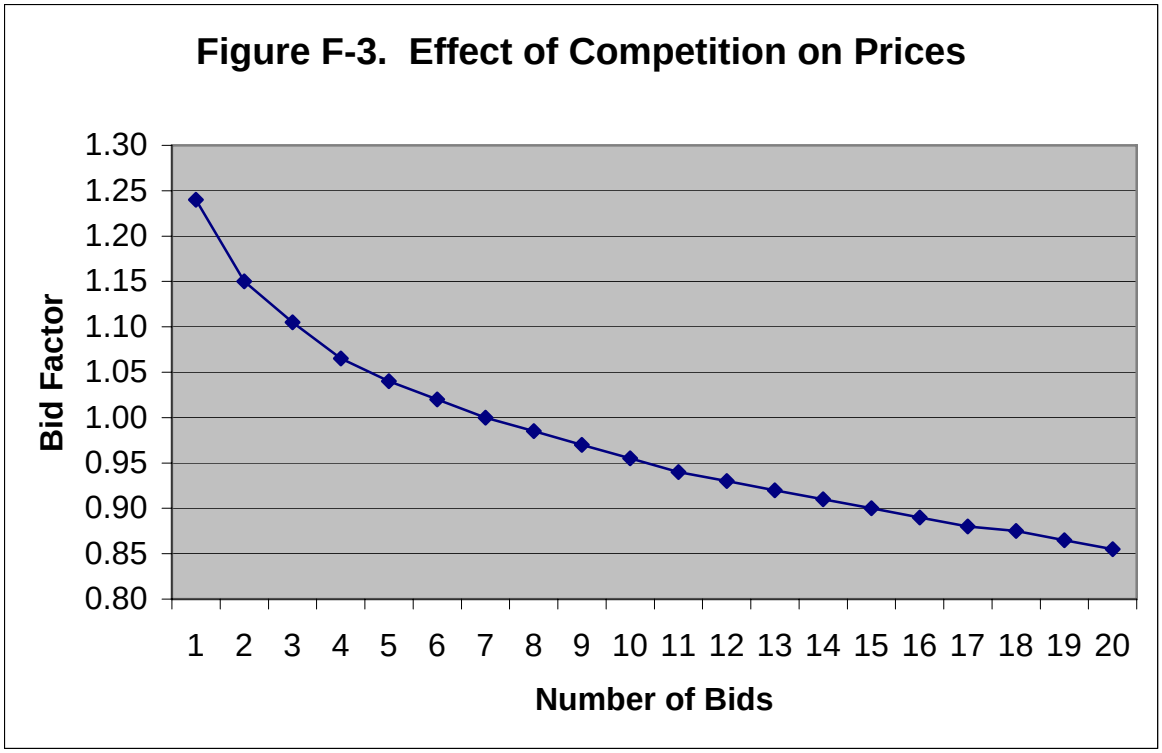
F-8.5.5. Construction Phase Contingency

No amount of field investigation, design quality control or plans review can account for every unknown that may occur during the construction of a project. The agency must assume that unforeseen events and conditions will increase the total cost of construction, which shall be accounted for by the construction phase contingency. OSE requires the construction phase contingency to be between 5 and 10% of the initial construction contract award, unless special circumstances justify a different level.

Table F-2. Contingency Allowance Guide By Type of Estimate

Type of Estimate	Overall Contingency Allowances (% of Remaining Costs Not Incurred)
PLANNING (*Prior to submission of A-1*)	
Standard Project	25% to 40%
Experimental/Complex Project	Up to 60%
BUDGET (*To support APIP approval process*)	
Standard Project	20% to 35%
Experimental/Special Conditions	Up to 50%
SCHEMATIC DESIGN PHASE	15% to 30%
DESIGN DEVELOPMENT PHASE	10% to 25%
CONSTRUCTION DOCUMENTS (BID CHECK)	10% to 20% adjusted to suit market conditions
CONSTRUCTION START	5% to 10%
INDEPENDENT ESTIMATE	To suit status of project and estimator's judgment





F-8.6. Management of Contingency

The responsibility for management of contingency lies with the agency, not the A/E. When presented with any estimate including the A/E's proposed contingency allowances, the agency shall evaluate the entire estimate and the requirements of this Appendix. If the A/E's estimate indicates a mismatch between the current estimate of the construction contract's cost, including appropriate contingencies, and the agency's current budget for the construction contract, the agency is responsible for deciding whether to reduce the total project contingency, obtain additional funds, direct the A/E to reduce the scope of the project, or any combination of these actions. Any effort required of the A/E to comply with the agency's directions is part of the A/E's Basic Services and shall not justify additional compensation.