Facilities Design Guidelines
Introduction

PURPOSE

These Facilities Design Guidelines are intended to assist the Design Professional in performing services required to design a project for the University of California, San Francisco (UCSF). Various UCSF requirements are set forth so the Design Professional will be able to provide required drawings, documents, presentations, etc., in correct format and with acceptable content.

USE

Use the Guidelines, including its Appendices and Standard Details, with the Executive Design Professional Agreement. The UCSF Project Manager will review the Guidelines with the Design Professional. If questions arise while using the Guidelines, contact the Project Manager.

STYLE

These Guidelines are written for the Design Professional with the Design Professional as the understood subject of most sentences. This convention eliminates ambiguity of gender and avoids repetition of the phrase, “The Design Professional shall . . . . ”

TERMS

The Agreement: The Executive Design Professional Agreement between Design Professional and The Regents of the University of California (The Regents).

Design Professional: The term used throughout these Guidelines for the Architect or Engineer executing the Executive Design Professional Agreement.

Capital Projects & Facilities Management (CPFM): UCSF Department with overall responsibility for management of capital improvements for non-hospital projects.

Manager: Manager of the Capital Projects division of CPFM.

Project Manager (PM): The person assigned by Manager to administer the Project for UCSF. The Project Manager is usually a UCSF employee.

University: University of California, San Francisco (UCSF).

REVISIONS

The Manager is responsible for publishing revisions to the Guidelines and issuing those revisions to holders of the Guidelines. Revisions will be issued with a cover letter giving a brief description of the revisions.
INTRODUCTION

TABLE OF CONTENTS

PART 1 — PROCEDURES GUIDE

Introduction
Administrative Requirements
Schematic Design Phase
Design Development Phase
Construction Documents Phase
Bidding Phase
Construction Phase

PART 2 — DESIGN GUIDE

Introduction
General Design Considerations
Instructions for Division 1 — General Requirements

Division 2 — Site Construction
02200 Site Preparation
02210 Subsurface Investigation
02300 Earthwork
02315 Trenching, Backfilling, and Compaction
02500 Underground Utilities
02530 Underground Storm Drainage and Sanitary Sewerage Systems
02660 Underground Water Systems
02700 Bases, Ballasts, Pavements, and Appurtenances
02800 Site Improvements and Amenities
02810 Irrigation Systems
02900 Planting
02950 Site Restoration and Rehabilitation

Division 3 — Concrete
03050 Basic Concrete Materials and Methods

Division 4 — Masonry
04050 Basic Masonry Materials and Methods

Division 5 — Metals
05700 Ornamental Metal

Division 6 — Wood and Plastics
06100 Rough Carpentry
06200 Finish Carpentry
06410 Custom Cabinets
# Table of Contents

<table>
<thead>
<tr>
<th>Division</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>06415</td>
<td>Countertops</td>
</tr>
<tr>
<td>07100</td>
<td>Thermal and Moisture Protection</td>
</tr>
<tr>
<td>07500</td>
<td>Damp proofing and Waterproofing</td>
</tr>
<tr>
<td>07600</td>
<td>Membrane Roofing</td>
</tr>
<tr>
<td>07600</td>
<td>Flashing and Sheet Metal</td>
</tr>
<tr>
<td>08050</td>
<td>Doors and Windows</td>
</tr>
<tr>
<td>08700</td>
<td>Basic Door and Window Materials and Methods</td>
</tr>
<tr>
<td>09100</td>
<td>Finishes</td>
</tr>
<tr>
<td>09220</td>
<td>Metal Support Assemblies</td>
</tr>
<tr>
<td>09250</td>
<td>Portland Cement Plaster</td>
</tr>
<tr>
<td>09300</td>
<td>Gypsum Board</td>
</tr>
<tr>
<td>09650</td>
<td>Tile</td>
</tr>
<tr>
<td>09680</td>
<td>Resilient Flooring</td>
</tr>
<tr>
<td>09720</td>
<td>Carpet</td>
</tr>
<tr>
<td>09900</td>
<td>Wall Coverings</td>
</tr>
<tr>
<td>09900</td>
<td>Paints and Coatings</td>
</tr>
<tr>
<td>10150</td>
<td>Specialties</td>
</tr>
<tr>
<td>10200</td>
<td>Toilet Partitions</td>
</tr>
<tr>
<td>10240</td>
<td>Louvers and Vents</td>
</tr>
<tr>
<td>10260</td>
<td>Grilles and Screens</td>
</tr>
<tr>
<td>10400</td>
<td>Wall and Corner Guards</td>
</tr>
<tr>
<td>10755</td>
<td>Signs and Graphics</td>
</tr>
<tr>
<td>10815</td>
<td>Telephone Enclosures</td>
</tr>
<tr>
<td>11600</td>
<td>Equipment</td>
</tr>
<tr>
<td>11600</td>
<td>Laboratory Equipment</td>
</tr>
<tr>
<td>12500</td>
<td>Furnishings</td>
</tr>
<tr>
<td>12620</td>
<td>Window Treatment</td>
</tr>
<tr>
<td>12690</td>
<td>Furniture</td>
</tr>
<tr>
<td>12690</td>
<td>Floor Mats</td>
</tr>
<tr>
<td>13031</td>
<td>Special Construction</td>
</tr>
<tr>
<td>13032</td>
<td>Cold Rooms</td>
</tr>
<tr>
<td>13033</td>
<td>Warm Rooms</td>
</tr>
<tr>
<td>13034</td>
<td>Darkrooms</td>
</tr>
<tr>
<td>13034</td>
<td>Laboratories</td>
</tr>
<tr>
<td>13080</td>
<td>Noise Abatement {UNDER DEVELOPMENT}</td>
</tr>
<tr>
<td>13090</td>
<td>Radiation and Radio Frequency Shielding</td>
</tr>
<tr>
<td>13185</td>
<td>Animal Facility Areas</td>
</tr>
<tr>
<td>13280</td>
<td>Asbestos Abatement</td>
</tr>
</tbody>
</table>
Table of Contents

13850  Fire Alarm Systems

Division 14 — Conveying Systems
14200  Elevators

Division 15 — Mechanical
15050  General Mechanical Requirements
15080  Mechanical Insulation
15300  Fire Protection Piping
15400  Plumbing
15600  Refrigeration Equipment
15700  Heating, Ventilation, and Air-Conditioning Equipment
15750  Liquid Heat Transfer
15800  Air Distribution
15850  Air Handling
15950  Temperature and Air Volume Controls
15990  Testing, Adjusting, and Balancing

Division 16 — Electrical
16050  General Electrical Requirements
16060  Grounding
16300  Power Distribution
16500  Lighting
16600  Emergency Electrical Systems
16960  Testing Requirements

PART 3 — APPENDICES

Appendix 1 — Area Calculations
Appendix 2 — Construction Documents Review Checklist
Appendix 3 — Errors Commonly Made in the Construction Documents
Appendix 4 — Specifying Construction Products
Appendix 5 — Responsibilities of the Inspector
Appendix 6 — Division 1 — General Requirements
Appendix 7 — Universal Design Guidelines

PART 4 — STANDARD DETAILS

{UNDER DEVELOPMENT}

PART 5 — LIST OF MASTER PLANS AND OTHER UCSF DESIGN GUIDES

INDEX
INTRODUCTION

Part 1 Procedures Guide contains the following sections:

- Administrative Requirements.
- Schematic Design Phase.
- Design Development Phase.
- Construction Documents Phase.
- Bidding Phase.
- Construction Phase.

The Administrative Requirements section discusses topics generally used in the design, bidding, and construction phase sections. Content of the sections corresponds to and expands on articles in the Executive Design Professional Agreement. The text gives “how-to” requirements for conditions in the Agreement.

Part 1 text references various appendices regarding text content. Placing extensive text into appendices avoids long interruptions of text in a section.
ADMINISTRATIVE REQUIREMENTS

1. THE CLIENT

1.1 The Regents and Chancellor. The Agreement is between The Regents of the University of California and the Design Professional. The Regents is the Client in terms of final authority. However, in order to administer the University's capital improvement program, delegations of authority have been given to the Chancellor at UCSF to administer the program within the framework of established University procedures and policies.

1.2 Campus Committees. Campus planning committees serve as advisory committees to the Chancellor in considering the physical development of all UCSF Campus sites. One or more of these Campus planning committees will review the Schematic drawings for major capital projects prepared by the Design Professional. The Chancellor will not approve the Schematic drawings until the Campus planning committees recommend approval. When required, the Chancellor will transmit these drawings to The Regents for final approval.

1.3 Manager. Manager will act for the Chancellor in the administration of the Agreement and will maintain liaison with the Design Professional's staff during the term of the Agreement. Manager will determine when projects meet program requirements and are satisfactory for submittal to the Campus planning committees and the Chancellor.

1.4 Reference Data. Project Manager will provide Design Professional with available reference data concerning the Project, including surveys of existing conditions and applicable as-built documents from previous related projects.

2. CONSTRUCTION BUDGET

2.1 Estimated Project Construction Cost. The Project Budget must be maintained within the funds appropriated, so advise Project Manager on matters of construction cost. The University provides a Construction Budget with the Executed Agreement. As the Project develops, revise the budget by preparing an Estimated Project Construction Cost as described in the Agreement. The Estimated Project Construction Cost becomes effective only when it is submitted to and approved by the Project Manager. It then becomes part of the Project Budget. In the Agreement, the University recognizes The Engineering News Record (ENR) Construction Cost Index as the official indicator of cost change, and the Project Manager will use that ENR Index to evaluate successive cost estimates. Prepare estimates on the basis of current costs in the locality of the Project. The Estimated Project Construction Cost represents the best professional estimate of the expected lowest responsible bid at the ENR Index established in the Agreement.

2.2 “P”, “W”, and “C” Costs. On certain projects involving State funding, Project Manager may require estimates to be identified with “P”, “W”, or “C” costs and may require a Capital Improvement Budget form to be completed. These abbreviations translate to the following terms and phases:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term</th>
<th>Phase(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“P”</td>
<td>Preliminary</td>
<td>Schematic Design and Design Development</td>
</tr>
<tr>
<td>“W”</td>
<td>Working Drawings</td>
<td>Construction Documents</td>
</tr>
<tr>
<td>“C”</td>
<td>Construction</td>
<td>Bidding and Construction</td>
</tr>
</tbody>
</table>
3. AREA CALCULATIONS

As the Project develops, calculate assignable square footage (ASF) for each room or space and for the entire Project, and gross square footage (GSF) for the entire Project. See Appendix 1 for Area Calculations.

4. TIME OF SERVICE

To insure a smooth progression in the administration of the Project and to meet certain deadlines, the Agreement establishes durations for completing services. If these durations cannot be met, give prompt notice in writing of the impending delay to the Project Manager.

5. CODES

5.1 General. Design Professional is responsible for designing the Project in compliance with applicable requirements of federal and state laws, codes, rules, regulations, ordinances, and standards, including, without limitation, those listed below.

5.2 California Code of Regulations (CCR). The CCR contains the following Titles applicable to University construction:

- Title 8, Industrial Relations
- Title 13, Motor Vehicles
- Title 17, Public Health
- Title 19, Public Safety
- Title 20, Public Utilities and Energy
- Title 21, Public Works
- Title 22, Social Security
- Title 23, Waters
- Title 24, Building Standards
  - Part 1, Building Standards Administrative Code
  - Part 2, California Building Code
  - Part 3, California Electrical Code
  - Part 4, California Mechanical Code
  - Part 5, California Plumbing Code
  - Part 6, California Energy Code
  - Part 7, California Elevator Safety Construction Code
  - Part 8, California Historical Building Code
  - Part 9, California Fire Code
  - Part 12, California Reference Standards Code
- Title 25, Housing and Community Development
- Title 26, Toxics

Have copies available of applicable codes and regulations for ready reference.

5.3 Structural Design and Evaluation. Comply with and submit evaluations per Division III-R of CCR, Part 2, Chapter 16A.

5.4 Air Quality. Follow applicable Air Quality Management District Regulations.

5.5 Physically Handicapped. All facilities must be accessible to and usable by the physically handicapped. Comply with Americans with Disabilities Act (ADA), Title II, ADAAG.

5.6 Coastal Commission. Comply with California Coastal Commission Regulations.
5.7 Local Building Codes. The University is not subject to the building codes of local political subdivisions, nor is it required to obtain any related local building permits. However, design and construction of utility connections and fire protection systems, and use of certain off-campus sidewalks and roadways may require interface with the City and County of San Francisco. Coordinate this interface through Project Manager.

5.8 Industry Codes and Standards. Comply with the following Industry Codes and Standards:

- AABC  Associated Air Balance Council
- ABMA  American Boiler Manufacturers Association
- ACRI  Air Conditioning and Refrigeration Institute
- ADC   Air Diffuser Council
- AGA   American Gas Association
- AMCA  Air Moving & Conditioning Association, Inc.
- ANSI  American National Standards Institute
- ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- ASME  American Society of Mechanical Engineers
- ASSE  American Society of Sanitary Engineering
- AWWA  American Water Works Association
- ASTM  American Society for Testing and Materials
- AWWA American Water Works Association
- CBM   Certified Ballast Manufacturers
- CDT   California Department of Transportation
- CGA   Compressed Gas Association
- CISPI  Cast Iron Soil Pipe Institute
- CTI   Cooling Tower Institute
- DHEW Pub. No. NIH 78-23: Guide for the Care and Use of Lab. Animals
- EIA   Electronics Institute of America
- EJMA  Expansion Joint Manufacturers Association
- ETL   Electrical Testing Laboratory
- FCC   Federal Communications Commission
- FM    Factory Mutual Engineering Corporation
- HEI   Heat Exchange Institute
- HI    Hydraulic Institute
- HYDI  Hydronics Institute
- ICEA  Insulated Cable Engineers Association
- IEEE  Institute of Electric and Electronic Engineers
- IES   Illuminating Engineering Society
- ITE   Institute of Transportation Engineers, Transportation and Traffic Engineering Handbook
- MSS   Manufacturing Standardization Society
- NEBB  National Environmental Balancing Bureau
- NEMA  National Electric Manufacturers Association
- NESC  National Electrical Safety Code
- NFPA  National Fire Protection Association Code
- NSF   National Sanitation Foundation
- SMACNA Sheet Metal and Air Conditioning Contractors National Association
- TEMA  Tubular Exchanger Manufacturers Association
- UL    Underwriters’ Laboratories, Inc.

and other applicable Codes and Standards not listed above but required for a particular project.
6. UNIVERSITY REVIEW AND APPROVAL

6.1 General. Each design phase is subject to review and approval by University.

6.2 Program. The Agreement provides documents describing the University-approved program. During the Schematic Design and Design Development Phases, translate the program into a physical solution which is both economically and architecturally appropriate.

6.3 Purpose of Reviews. University’s review of drawings and related documents at the various stages of Project development is intended as a check by University to determine that:

- Work of that phase has been completed.
- Design solution satisfies University programmatic needs.
- Project is within the stipulated scope and budget.
- Project is in conformance with University administrative policies and procedures.
- Project can be supported by building infrastructure.

6.4 In Support of Funds. UCSF may need to submit certain documents to the UC Office of the President to support requests for funds necessary for each subsequent development of the Project. When requested by Project Manager, provide the most nearly completed work available at the time, and assist Project Manager in accordance with the requirements of the Agreement.

7. REGULATORY REVIEWS AND APPROVALS

7.1 By State Agencies. Review of documents by certain State agencies is required to obtain 100% Completion of Construction Documents Phase. Project Manager will make submittals, arrange all meetings with these agencies, and arrange to pay for application fees; however, the Design Professional will assist Project Manager in obtaining approvals from required State agencies. Do not discuss University projects with representatives of these agencies unless a representative of the University is present. The State agencies include:

- Division of the State Architect (DSA) - Handicapped Law Compliance Unit. Make submittal at 100% Construction Documents.
- Office of the State Fire Marshal (OSFM). University makes preliminary reviews at end of Schematics and Design Development Phases, and at 50% Construction Documents. Make submittal to State at 100% Construction Documents.
- Office of Statewide Health Planning and Development (OSHPD) - Facilities Development Section (Hospital projects). Make submittal at 100% Construction Documents. Include documents for OSFM and DSA - Structural Safety Division.
- Division of State Architect (DSA) - Structural Safety Division (Hospital projects). Make submittal at 100% Construction Documents with OSHPD submittal.

Note:—C100% Construction Documents are the completed and coordinated Drawings and Specifications.
—C100% Complete Construction Document Phase is when the 100% Construction Documents have received required reviews and approvals, and appropriate agency stamps are affixed.

- State Public Works Board, State Department of Finance, and State Legislative Analyst (State-funded projects).

7.2 Preliminary University Review. Submit completed Schematics, completed Design Development, 50% Construction Documents, and 90% Construction Documents to Project Manager for review by
appropriate Campus departments.

7.3 Special Preparation by Design Professional. Investigate existing structural systems to assure adequacy for remodeled use, for compliance with OSHPD requirements, and for conformance with State laws governing structural adequacy of existing buildings intended for hospital use.

8. ENERGY ANALYSIS REQUIREMENTS

Comply with the University Energy Conservation design standards noted in Part 2C Design Guide, “General Design Considerations.”

9. MEETINGS

Prepare minutes of all meetings with University, and, within three working days of the meeting, furnish one copy to Project Manager and each person attending the meeting.

10. AGREEMENT CHANGES

The Agreement lists additional services that UCSF will pay for, if the services are authorized in writing. This written authorization for additional services will be conveyed by means of an Agreement Change Authorization (ACA). An ACA will also be used to amend the Agreement if the time of service, scope, or budget should be changed during the term of the Agreement.

11. CONSTRUCTION MANAGER (In Lieu of General Contractor)

11.1 Construction Manager Services. On certain projects, UCSF may use the Construction Management Mode of Contracting. The term “Construction Manager” means the firm or individual(s) retained by UCSF to provide scheduling, cost control, and other construction consulting services for the Project. Services may include studies of the feasibility and the desirability of utilizing multiple construction contracts, phased construction, long-lead time procurement, or other applicable construction strategies. Alternate building systems, methods, and materials may be analyzed in terms of construction feasibility, costs, availability of material and labor, and construction time.

11.2 Authority of Construction Manager. On projects where a Construction Manager is utilized, the Agreement and General Conditions of the Construction Contract will stipulate the authority of the Construction Manager.

12. REMODELING PROJECTS

12.1 Existing Drawings. Review available existing drawings furnished by UCSF of spaces to be remodeled and make field investigations to verify existing conditions. From this information, prepare floor plans, as required, to delineate existing conditions and demolition work. In addition, prepare separate mechanical and electrical floor plans for existing conditions and demolition work. Show new work on separate floor plans. On small remodeling projects, separate existing and demolition drawings may be omitted. Instead, all new, existing, and demolition work may be shown on one drawing, as long as the drawing is understandable and readable.

12.2 University Assistance. Request assistance from University, as required, to verify existing conditions. Assistance may be in the form of: furnishing keys; furnishing a ladder and a person to carry it; cutting holes in floors, walls, or ceilings; or excavating to verify existing underground utilities.
13. DRAWING AND SPECIFICATIONS FORMAT

The following requirements apply to drawings and Specifications prepared during the design phases, and to Record Drawings at the end of the Construction Phase.

13.1 Media. Prepare Drawings with CADD program using DFX or DWG, and Specifications with Microsoft Word or WordPerfect exportable to Microsoft Word, both formatted for an IBM-compatible computer.

13.2 Drawing Submittal Requirements. Submit drawings with the following formats:

- **Media Format.** Use DOS formatted 3 1/2 in. floppy disks or HP-UX formatted HP Re-writable Optical Disks (5-1/4 in. Magneto-Optical disks). A hardcopy file list, pen plotting table, and a plot scale table on 8-1/2 in. x 11 in. paper must accompany the media.

- **File Format.** Use AutoCad, .DXF (Drawing eXchange Format), or .DWG (AutoCad drawing format). If provided in .DXF format, file(s) must be in double precision 16-decimal-place accuracy. If provided in .DWG format, file(s) must be translatable into AutoCad software. Translated drawings must be complete and match hardcopy output.

- **Drawing Format.** Drawing format includes:
  - Drawing sheet: Project Manager will furnish a diskette in .DXF or .DWG media format, containing margins and title blocks; determine sheet size with Project Manager.
  - Title block: The Project title and drawing file numbers, obtained from the Project Manager at the beginning of the Project, shall appear on all Construction Documents and on all schematic and design development drawings. Sheet numbers are established by Design Professional. The date on the Drawings shall be the day the tracings are submitted to University for printing of bid sets.
  - Scales: Make Drawings to the following scales:
    - Plans and elevations: 1/8 in., 1/4 in., or 1/2 in. = 1 ft.
    - Site plans and surveys: 1 in. = 20 ft. or larger.
    - Details: 1/4 in. = 1 ft. or larger. Make details large enough to be easily read.
  - Survey drawings: Include all survey information by modification made on existing UCSF AutoCad Campus Site Plan, obtainable from Project Manager.
  - Site plans: Include Campus grid lines at 100-ft. intervals on all site plan drawings for Parnassus Campus buildings. Reference by coordinates. Wherever possible, establish new facility locations in terms of grid coordinates.
  - Drawing orientation: Orient identically all plan views of a project with north to bottom of sheet. For projects on Parnassus Campus, indicate the Campus grid north with north arrow.
  - Design Professional identification: Diskette will include space for Design Professional block immediately to the left of University title block. Include firm name, address, telephone number, and required signatures and registration numbers. Drawings prepared by a consultant to Design Professional shall include the same information on both firms.
  - Legend: Provide an adequate identifying legend and list of abbreviations for all symbols and abbreviations used.
  - Key plan: UCSF diskette will include a Campus key plan showing location of building site.
  - Setup/Scale: Produce plans using units in feet.
  - Layering: Use long format version of the American Institute of Architects cad layering guidelines (CAD Layer Guidelines, AIA, 1990) for plan drawings or other categorical layering system as approved by UCSF prior to required submittals. In general, do not use Layer 0 for drawing entities or placing blocks. Layer 0 may be used for creating blocks.
  - Menus: Set to the standard ACAD.MNU prior to final “as-built” submission. Replace third party and proprietary menus at that time.
13.3 **Drawing Execution.** Execute drawings as follows:

- **Accuracy.** Make drawings accurate to the stated dimensions with not greater than 1/4 in. variation permitted. Not-to-scale (NTS) designations are not permitted on plan drawings. Make drawings to scale.

- **Entity Construction.** Draw all entities with functionally efficient graphic entities. Lines shall be continuous until logically terminated at an intersection or endpoint. Remove colinear (overlapping) entities.

- **Standard Symbols.** Blocks may be scaled or rotated. Do not mirror symbols which are intended to remain blocks (e.g., plumbing fixtures).

- **Polylines, Donuts, and Solids.** Permitted: Solids, polylines, polyline widths, and fitted polylines. Not permitted: Donuts and splined or curved polylines.


- **External References.** Final “as-built” submittals shall be bound. Reference file layer names must be renamed or merged to conform with the base sheet layering system. Layer names using “sheet-of-origin” references will not be permitted.

- **Paperspace.** Transfer all entities related to the plans, with the exception of title block information, to model space prior to final submittal. Non-plan view drawings (e.g., detail and schedule drawings) need not be transferred to model space.
SCHEMATIC DESIGN PHASE

1. GENERAL

This section sets forth Schematic Design Phase requirements for construction of a new building or alteration of or additions to an existing building. Drawings and other material produced during this Phase will be used in presentations to Campus design review committees and, if required, to The Regents. Simplicity and clarity should be governing factors in the development of the Drawings and any general narrative related to the design.

2. ARCHITECTURAL REQUIREMENTS

2.1 Existing and Proposed Floor Plans. Meet with Project Manager, representatives of the Capital Projects & Facilities Management Department, and the Campus Planning office to review the following requirements for existing and proposed floor plans if the total project budget is over $250,000 and a Project Planning Guide (PPG) is required:

- **Existing Floor Plans.** Prepare floor plans of the existing Project site which clearly show the functional use, room numbers, and assignable square footage (ASF) of each room. The room numbers and ASF must be consistent with the Campus Space Inventory published the previous December.
- **Proposed Floor Plans.** Prepare floor plans of the proposed Project space which clearly show the functional use and ASF of each room. Proposed space should be described in accordance with the definitions in the [Office of the President Facilities Data System Manual, June 1996](note definition of Basic Gross Area on page 4.6, and Use-Related Definitions on pages 4.9 and 4.10).
- **Existing and Proposed Floor Plans.** Make the existing and proposed floor plans at the same scale, clearly legible, and on standard 8-1/2 x 11 in. pages.

2.2 Site Utilization Plan. (Scale: 1" = 40'-0" or larger) Include the following:

- Overall dimensions of proposed building.
- Location and outline of existing structures on site within a radius of at least 300 ft. measured from the exterior walls of the proposed building. Indicate easements, rights-of-way, and roads.
- Outdoor facilities, service drives, streets, parking areas, landscaping, paved areas, covered walks, stairs, pools, retaining walls, handicapped access, etc., with building floor elevations and elevations of major adjoining outdoor features noted.
- Section(s) of site, if necessary, to explain changes in level in the proposed building as related to the site and adjoining buildings.
- Major underground utilities.

2.3 Floor Plans. (Scale: not less than 1/8" = 1'-0") Include the following:

- Location, sizes, and space numbers of all programmed spaces and other required gross area spaces, including corridors, stairs, toilets, janitors’ closets, mechanical spaces, and storage rooms.
- Overall dimensions of each major area of the building.

2.4 Elevations and Sections. (Scale: not less than 1/8" = 1'-0") Include the following:

- Principal elevations of the building. Indicate grades and other exterior features. Provide floor-to-floor dimensions.
- Sections as necessary to explain the structure and any other unusual design features.
2.5 **Presentation Drawings.** Include the following:

- As directed by Project Manager, a color-rendered perspective of a size large enough to convey the overall design. A normal (eye-level) view of the structure is preferred, but, in some instances, a “bird's-eye” view will be needed to convey the full scope of the Project. Show landscape features of the site development in a realistic manner without obscuring the structure. Mount and mat the perspective using a 30 x 40 in. board.
- One mounted copy of all floor plans, elevations, and other drawings on heavy 30 x 40 in. boards for ease of presentation and for later exhibition by University.
- A board with samples of the actual exterior materials proposed for new buildings.
- When directed, photographs (35mm slides) of the presentation drawings and samples for those projects requiring presentation to The Regents. Return presentation drawings to UCSF after slides are prepared. Provide a narrative description setting forth the design concept and important features of the Project to aid in the presentation to The Regents.

3. **STRUCTURAL REQUIREMENTS**

3.1 **Structural System.** Provide a detailed written description of the recommended structural system, and the basis for recommending this system over other approaches.

3.2 **Framing.** Provide a conceptual structural framing plan of a typical floor, indicating the dimensioned grid system, columns, shear walls, and related items.

4. **MECHANICAL AND ELECTRICAL REQUIREMENTS**

4.1 **Life Cycle Analysis.** When directed by Project Manager, provide life cycle analysis of heating, ventilating, and air-conditioning system. This analysis should include capital costs, operating costs, maintenance costs, and anticipated level of performance with comparisons made between proposed and other possible systems.

4.2 **Capacity.** Determine capacity of existing systems to accommodate loads of new mechanical and electrical work. *Field-verify points of connection and capacity.* Testing of the area to be retrofitted is the responsibility of the project, while testing of the infrastructure (e.g., electrical risers) is the responsibility of the utilities department.

4.3 **Review Scope.** At completion of Schematic Design Phase, meet with Project Manager to review the scope of mechanical work for the Project.

5. **AREA TABULATION**

Tabulate assignable (ASF) and overall gross square foot (GSF) areas. Develop a space-by-space comparison of schematic plan assignable areas with program assignable areas. Prepare tabulations by floors and include totals for the building. See Appendix 1, Area Calculations.

6. **COST ESTIMATE**

6.1 **Method.** Develop Estimated Project Construction Cost based on the completed schematic drawings and general description of the structure. The method of estimating should be appropriate to the type and scale of the Project using the Construction Specifications Institute (CSI) format for breaking down the costs into construction systems and assemblies. Indicate ENR Index expected at bid opening date.

6.2 **Comparison to Budget.** Compare Estimated Project Construction Cost with the Construction Budget. Any unusual cost items should be brought to the attention of Project Manager at this time.
7. OUTLINE SPECIFICATIONS

Prepare Outline Specifications that contain a general description of the Project's site, structure, and type of construction. Include brief statements regarding plumbing, heating, ventilation, air-conditioning, electrical portions of the facility, and any unusual features of design. Use the standard CSI Division and Section format in outline fashion.

8. REVIEW AND EVALUATION OF PROGRAM (REP)

8.1 Preliminary Evaluation. Upon starting the Schematic Design Phase, provide a preliminary evaluation in writing of the Project Program utilizing the following checklist. Include the Estimated Project Construction Cost (Article 6 above) and Project construction budget requirements in the evaluation. Review evaluation findings with Project Manager. If required, present alternative approaches to design and contracting mode.

8.2 Checklist.

Architectural.
— Determine the codes applicable to Project and what impact these codes will have on the design.
— Obtain a complete inventory of chemicals, radioisotopes, and other biohazard materials, if Project is a laboratory.
— Determine how many and what type of fume hoods will be required (e.g., biosafety hood, radioisotope hood). Also, determine location of fan units.
— Determine access to mechanical and electrical spaces. Access shall not be through laboratory, office, or any other occupied space.
— If cold room is in Project scope, determine design requirements. Also, determine space requirements and location of cold room equipment.
— Provide for toilet facilities as related to Project requirements, and for remaining occupants on the building floor.
— Provide janitors' closets for housekeeping requirements, including maintenance shop carts.
— Provide for adequately sized mechanical and electrical rooms.

Mechanical.
— Estimate cooling and heating loads for Project. Calculate cfm/sq. ft. of Project area.
— Determine design criteria for Project area (e.g., air-conditioned or not).
— Determine design parameters (e.g., maximum summer inside and outside temperatures, minimum inside and outside temperatures, special humidity and filtration requirements).
— Determine major HVAC and refrigeration equipment types. Estimate approximate sizes in cfm and refrigeration capacity, electrical KW, and voltage. Give approximate locations of equipment within and outside the Project area.
— Estimate demand on HVAC piping utilities (in gpm or approximate pipe size), the sources for this demand (new or existing), and capacity and effects on present demands of Users for the following systems:
  • Heating hot water.
  • Chilled water.
  • Condenser water.
  • Drainage.
  • Steam.
  • Steam Condensate.
— Determine type of temperature controls to be used, and intended control scheme (e.g., variable air volume).
— Determine whether design will incorporate the reuse or tie-in to any existing mechanical equipment (e.g., pumps, fans). Determine the condition and age of this equipment, and
capacity and effects on present demands of Users.

Plumbing.
— Determine requirements for sanitary and acid waste. Determine condition and capability of existing sanitary and acid waste system for handling added load.
— Estimate demand (in gpm or pipe size) and sources for the following utilities:
  • Distilled water.
  • Domestic hot and cold water.
  • Medical gases, including vacuum, compressed air, oxygen, etc.
  • Sprinkler lines.
  • Waste lines.
— Determine quantity and locations of emergency deluge shower and eyewash fountain units. Determine approximate demand (in gpm or pipe size) and source for domestic cold water for this requirement.

Electrical.
— Measure the existing load (in Amperes and KVA) on all circuits in the area to be renovated using a recording chart ammeter for 72 hours during the occupied workweek.
— Estimate the total new load (in Amperes and KVA) on all circuits in the area to be renovated.
— Estimate the emergency electrical power requirements (e.g., fume hoods), and determine the source for this power.
— Estimate the emergency lighting requirements, and determine the source for this power.

Fire Protection.
— Determine type, condition, and capacity of existing fire alarm system. Identify interface for new to existing system, if required.
— Determine code requirement for sprinkler system. Estimate demand (in gpm or pipe size) and source for new sprinkler system.
— Determine size, capacity, and condition of existing sprinkler system. Coordinate design of new system with Fire Sprinkler Master Plan.
— Locate existing main and floor shutoff valves, flow switches, risers, laterals, drains, etc.
DESIGN DEVELOPMENT PHASE

1. GENERAL

The following are minimum requirements for all projects involving construction of new buildings or renovations of, or additions to, existing buildings. For renovations, coordinate with Project Manager for specific requirements of the Project.

2. ARCHITECTURAL REQUIREMENTS

2.1 Plot Plan. (Scale 1" = 40'-0" or larger) Include following:

- Overall dimensions of proposed buildings, including any alternatives. Indicate reference to a benchmark and baseline.
- Location and extent of existing structures on site within a radius of at least 300 ft. measured from the exterior walls of the proposed building. Identify structures and streets by proper names.
- Existing and proposed contours.
- Method of general drainage of the site as affected by the proposed building.
- All exterior elements, including outdoor facilities, streets, service drives, parking areas, handicapped access, paved areas, covered walks, landscape development, stairs, pools, retaining walls, fire hydrants, etc.
- Various floor and grade elevations, including those for stairways, walls, terraces, etc.
- Section(s) through site, if necessary, to explain changes in level in the proposed building as related to the site.
- Underground Campus utilities.
- Small scale Campus map indicating Project location.

2.2 Floor Plans. (Scale: not less than 1/8" = 1'-0") Include following:

- Locations, sizes, and space numbers of all programmed spaces and other required gross areas, including corridors (width), stairs, toilets, janitors' closets, mechanical spaces, storage rooms, etc. For additions or alterations to existing buildings, show the existing floor plan, indicating the existing space usages.
- Locations of doors and windows. Indicate door swings.
- Overall dimensions of each major area of the buildings.
- Fire ratings of fire separations, exit enclosures, fire doors and similar elements, as required by applicable codes.
- Locations and swing of all fire and exit doors. Indicate area fire separations.
- Location of all plumbing fixtures, including lavatories, floor drains, toilets, urinals, service sinks, drinking fountains, fire hose cabinets, fire extinguishers, and sprinkler systems.
- All principal built-in features, including fixed auditorium seats, kitchen equipment, display cases, counters, shelves, lockers, etc.
- Locations of all movable items of furniture and equipment listed in the space description sheets. Differentiate movable furniture and equipment from built-in furniture and equipment.

2.3 Elevations and Sections. (Scale: not less than 1/8" = 1'-0") Include following:

- Locations of windows, doors, window vents, stairs, platforms, retaining walls, etc., for all elevations of building. Indicate grades, paved areas, etc.
- Floor heights and windowsill heights.
- Longitudinal and transverse sections of each major area, indicating floor elevations, finish exterior
grades, ceiling heights, pipe tunnels, unexcavated areas, basement and areaways, rooflines, and parapets.

- Small scale plan or diagram (if necessary) to show section lines for each elevation and section.
- Larger scale (1/4 in.) for special design features with notes related to materials and design.

2.4 Interior Details. (Scale: not less than 1/4” = 1'-0") Include following:

- Detail plans, sections, and elevations.
- A thorough study of the following space types to illustrate the details clearly and for review by the Project Manager:
  - Classrooms and lecture halls.
  - Kitchens and related service areas.
  - Laboratories and any other programmed spaces.
  - Toilet and locker rooms.
- An interior finish schedule which indicates, in general terms, all floor, wall, and ceiling finishes along with any special items of interest.

3. STRUCTURAL REQUIREMENTS

Provide a structural plan for each level of the structure at the same scale as used for the architectural plans. Indicate the dimensioned grid system, columns, load-bearing walls, shear walls, footings, and related items. Structural peer review requirements to be determined.

4. MECHANICAL REQUIREMENTS

4.1 Existing Capacity. Show verified capacity at points of connection.

4.2 Plot Plan. (Scale: same as Architectural Plot Plan) Include following:

- Routing of outside utility lines from point of connection to existing utilities to the building, when required.
- Existing utilities, including those underground.

4.3 Floor Plans. (Scale: not less than 1/4” = 1'-0”) Include following:

- Plumbing.
  - Locations of main wastes, vents, and all service mains, including water, air, gas, vacuum, etc.
  - Locations and required piping connections of equipment, including pumps, tanks, generators, etc.
- Heating, ventilation, air-conditioning, and steam systems.
  - Service mains, including steam, return, hot water, chilled water, condensate water, etc.
  - Air-moving equipment and single-line duct runs to all outlets, including supply and exhaust fan systems, fume hoods, etc.
  - Locations and required piping connections of equipment, including pumps, tanks, converters, etc.

4.4 Large Scale Drawings of Equipment Rooms. (Scale: not less than 1/4” = 1'-0”) Indicate layout of equipment to assure adequate space allowance. Include elevations of built-up fan units to assure proper air flow and access to component part of the units.

4.5 Analysis of Mechanical Systems. Submit an analysis of the principles of operation of the heating, ventilating, and air-conditioning system and its controls. The analysis is to consist of schematic
5. ELECTRICAL

5.1 Plot Plan. (Scale: same as Architectural Plot Plan) Include following:

- Routing of outside utility lines from point of connection to existing utilities to the building, when required.
- Existing utilities, including those underground.

5.2 Floor Plans. (Scale: not less than 1/4" = 1'-0") Include following:

- Power and signal layouts on one set of drawings, and lighting layouts on a different set of drawings. Use standard symbol conventions.
- Single-line electrical distribution diagrams showing primary service to substations and secondary service to distribution switchboards, motor control centers, and panel boards for power and lighting. Include the point of connection to external utilities (e.g., high voltage, telephone, all signal systems).
- Each load center unit substation, motor control center, distribution and switchboard, telephone equipment room, and closet. Indicate type and locations of lighting fixtures in typical offices, laboratories, corridors, examination rooms, etc. Use a schedule for details.

5.3 Large Scale Drawings of Equipment Rooms. (Scale: not less than 1/4" = 1'-0") Include layout of equipment to assure adequate space allowance, and elevations of built-up fan units to assure proper air flow and access to component parts of the units.

6. AREA TABULATION/ROOM NUMBERS

Tabulate ASF and GSF areas. Show space-by-space comparison of Schematic Design Phase assignable area with program assignable areas. Tabulate by floors and include building totals. Coordinate room number assignments with Project Manager, following University's standardized system. See Appendix 1, Area Calculations.

7. OUTLINE SPECIFICATIONS

Outline Specifications comprise:

- A general description of the construction, including structural system, wall system, roofing, waterproofing, exterior and interior finishes, etc.
- A general description of the plumbing, air-conditioning, heating and ventilation systems, including controls, ducts, filtration and piping. Include appropriate code references to be followed in design.
- A general description of electrical services, including voltage, number of feeders, and whether feeders are overhead or underground. Provide a specific description of items to be served by emergency power, and describe design consideration for special areas.
- All fire safety items on the Drawings. Include the flame spread rating of all applicable materials and finishes, and a description of all mechanical and electrical devices required by State Fire Marshal for the intended occupancy of the building.
8. COST ESTIMATE (ESTIMATED PROJECT CONSTRUCTION COST)

At completion of the Design Development Phase, provide a Cost Estimate based on:

- The completed Design Development drawings, outline specifications, and the Project ENR level at Bid Opening Date.
- A format in sufficient detail so all materials and construction are considered. Prepare as an abbreviated form of Contractor's estimate, giving quantities of materials and unit costs.
- Costs per GSF for major divisions of the work, broken down into CSI divisions. Provide subtotal for each division.

9. CONSTRUCTION PHASING SCHEDULE

As appropriate, provide a construction phasing schedule in bar-chart format and outline (narrative) form.

10. SOILS AND MATERIALS TESTING

Make initial recommendation for soils and materials testing requirements. Verify these requirements at conclusion of the Construction Documents Phase.
CONSTRUCTION DOCUMENTS PHASE

1. GENERAL

1.1 Submittals. Submittals in the Construction Document Phase include Drawings and Specifications prepared by the Design Professional and standard Construction Documents furnished by the University. The University will review the Construction Document submittals at 50% completion, 100% completion, and after corrections are made to the 100% completion.

1.2 Reviews. Project Manager will review the 50% and 100% completion submittals for content to check for completeness and conformance with program. Capital Projects & Facilities Management personnel, consultants, and outside agencies may also participate in the review.

2. 50% COMPLETION SUBMITTAL

The following items make up the 50% completion submittal.

2.1 Civil Engineering Drawings:

- Site plan.
- Grading and drainage plan.
- Utilities plan.
- Site demolition plan.
- Site sections and details.

2.2 Architectural Drawings. Architectural drawings include, but are not limited to, the following items as applicable to the Project:

- Plot plan.
- Floor plans.
- Roof plan.
- Elevations and sections.
- Necessary details and wall sections.
- Schedule of finishes (e.g., doors, windows).
- Locations and identifying data on items of fixed equipment (e.g., kitchen equipment, laboratory furniture, cabinets, shelving). Detail anchorage of all fixed items.

2.3 Structural Drawings, if applicable. Structural drawings include, but are not limited to, the following items as applicable to the Project:

- Plans of foundations, floors, roofs, and any intermediate levels showing a complete design with sizes, sections, and relative locations of various members.
- Schedules of beams, girders, and columns.
- Details of all connections, assemblies, and expansion joints.
- Details of structural framing system necessary for support of major nonstructural elements and major fixed building equipment.
- Structural drawings accompanied by computations, stress diagrams, and other pertinent data, complete to the extent that calculations for individual structural members can be readily interpreted. Preface the computations by a statement outlining the basis for the structural design and indicating the manner in which the proposed building will resist vertical loads and horizontal forces. The computations shall be sufficiently complete to establish that the structure will resist the loads and forces prescribed by CCR requirements. Give assumed safe bearing pressures.
on soils and ultimate strengths of concrete in computations and noted them on drawings. Where unusual conditions occur, submit additional data pertinent to the work.

2.4 **Plumbing Drawings.** Show the complete plumbing systems in detail, showing the methods for fastening piping and fixtures to structures to resist seismic forces and include, where applicable. Include:

- Size and elevation of street sewer, house sewers, house drains, street water main, and water service into the building.
- Location and size of soil, waste and vent stacks with connections to house drains, fixtures, and equipment.
- Size and location of hot, cold, and circulation water mains, branches, and risers from the service entrance and tanks.
- Riser diagram or other acceptable method to show all plumbing stacks with vents, water risers, and fixture connections for multistory buildings.
- Fire extinguishing equipment such as sprinklers and wet and dry standpipes.
- Plumbing fixtures and equipment which require water and drain connections, including pumps and storage tanks.

2.5 **Heating, Ventilation, and Air-Conditioning Drawings.** Show the complete heating, ventilating, and air-conditioning systems in detail, showing methods for fastening equipment to the structure to resist seismic forces and include, where applicable:

- Heating and steam mains, including branches, with pipe sizes.
- Air-conditioning systems with equipment, water, and refrigerant piping and duct work.
- Exhaust and supply ventilation systems, showing duct sizes with steam or water connections and piping.
- Locations of the existing and new DDC control panels along with a general sequence of operations are to be included on the mechanical prints.
- Coordinate 120-volt requirements with electrical engineer.

2.6 **Electrical Lighting and Power Drawings.** Show the complete electrical systems and detailed methods for fastening equipment to the structure to resist seismic forces. The drawings include, but are not limited to, the following items:

- Electrical service entrance with service switches, service feeds to the public service feeders, and characteristics of the light and power currents.
- Transformers and their connections, if located in the building or on the site.
- Drawings showing main switchboard, power panels, light panels, and equipment.
- Feeder and conduit sizes with schedule of feeder breakers or switches.
- Light outlets, receptacles, switches, power outlets, circuits, and isolated electrical system.
- Telephone and data layout.
- Fire alarm system.
- Emergency electrical system.

2.7 **Draft Specifications.** Prepare the Specifications as set forth in Article 5 below. Incorporate and expand on the Outline Specifications from the Design Development Phase.

2.8 **Energy Code Certification.** Submit appropriate California Energy Commission form certifying the design meets code compliance.

2.9 **Cost Estimate.** Provide an updated Estimated Project Construction Cost.
3. 100% COMPLETION SUBMITTAL

The following items make up the 100% completion submittal. The University will review this submittal to ensure compliance with these Guidelines. The University will use Appendix 2, Review Checklist, and Appendix 3, Errors Commonly Made.

3.1 Completed Drawings. Completed and signed drawings, including incorporation of comments made on 50% completion submittal.

3.2 Completed Specifications. Completed Specifications, including incorporation of comments made on 50% completion submittal.

3.3 Construction Documents. Completed and coordinated Construction Documents listed in Paragraph 4.1 that University will reproduce for bidding purposes.

3.4 Cost Estimate. A final Estimated Project Construction Cost based on the 100% completion submittal. Base this estimate on current prices and arrange in the form of a contractor's estimate showing quantities of materials and unit prices. Include an itemized breakdown of all the work activities on the Project, contractor's markup and profit, and permit fees which are administered by UCSF. UCSF will provide calculation for permit fees.

3.5 Area Tabulation. See the Agreement for requirements.

3.6 Soils and Materials Testing. Include final Special Inspection and testing requirements in the Specifications.

4. REQUIREMENTS FOR CONSTRUCTION DOCUMENTS

4.1 Makeup. Construction Documents for bidding consist of standard documents provided by University in addition to the Drawings and Specifications developed by the Design Professional. Most construction contracts are based on a single lump sum amount. If other modes of contracting are used, University will provide construction documents modified to suit the particular mode used.

Standard documents provided by the University include:

- Cover Page
- Certification (sign and stamp this page)
- Table of Contents
- Advertisement for Bids
- Project Directory
- Instructions to Bidders
- Supplementary Instructions to Bidders
- Information Available to Bidders
- Bid Form
- Bid Bond
- Agreement
- General Conditions
- Supplementary Conditions
- Exhibits
- Specifications Table of Contents (complete as required)
- Division 1 - General Requirements (complete as required)
- List of Drawings (complete as required)
4.2 Design Professional Responsibilities.

- Provide Construction Documents that are properly coordinated, checked, and correct.
- Develop the Drawings and Specifications based on University requirements. See Articles 5 and 6 below.
- Provide Specifications in the form of a typed master.
- Complete List of Drawings following University format. Project Manager will furnish instructions and sample from University's Facilities Manual.
- Clearly show on the Drawings and describe in the Specifications construction phasing requirements. Coordinate with Project Manager text requirements in other construction documents. Phasing will require review and approval by Project Manager who will coordinate the requirements with other University departments.
- Allow for required reviews and approvals by Project Manager, Capital Projects & Facilities Management, EH&S, OSFM, OSHPD, DSA, and University's General Counsel before issuing documents to bidders.
- Provide Addenda during the Bidding Phase, if required, in the form of a typed copy using format provided by Project Manager. Provide Drawings and Specifications as required, each identified by date and addendum number. Number Drawings sequentially.

4.3 University Responsibilities. University will administer and coordinate:

- Reproduction of all documents, including Addenda.
- Completion and placement of the Advertisement for Bids.

5. REQUIREMENTS FOR SPECIFICATIONS

5.1 Formats. Prepare Specifications as recommended by the CSI Manual of Practice formats. The University's requirements for specifying items are given in Appendix 4, Specifying Construction Products.

5.2 Specifications Fundamentals. In addition to the format recommended by CSI, the following items are set forth for emphasis:

- Do not repeat requirements in the Specifications addressed in the General Conditions.
- Prepare Drawings and Specifications complete, detailed, and accurate enough so all bidders may prepare estimates on exactly the same work, and so construction may proceed with no misunderstanding of the work to be done. This requirement is fundamental.
- Avoid duplication and conflict between the various Drawings and Specification sections.
- Avoid the use of unusual materials or those not available on the local market. If materials are not well known, include the name and address of either the manufacturer or local supplier.
- If possible, specify products, things, or materials by brand or trade name. However, this method requires at least two trade names plus the words “or equal” except in certain specifically defined instances. See Appendix 4 for complete requirements.
- Do not specify items on Drawings unless authorized by Project Manager. If items are specified on the Drawings (e.g., because of local custom), specifications on the Drawings must meet the above requirements. Avoid conflicts between items specified in the Specifications and items specified on the Drawings.

5.3 Division 1. Use Appendix 6, Division 1 C General Requirements for editing and inclusion in Division 1. Special requirements for Division 1 Sections are discussed in Part 2, Instructions for Division 1C
General Requirements.

5.4 **Specification Page Format.** Use the following CSI page format:

- Sheet size: 8-1/2 x 11 in.
- Margins: Top 1 in., left 1-1/4 in., right and bottom 3/4 in.
- Headers and footers: Make Division and Section numbering and titles consistent with CSI format. Identify each Specifications page by Project title in upper left corner. Place Section number and page number in footer. Place the words “End of Section” immediately below the end of text on the last page of each section.
- Text arrangement: Select spacing, indentation, and general arrangement of text, but maintain uniformity throughout the Specifications. CSI format is recommended.
- Preset format: Project Manager will furnish a diskette with preset margins, headers, footers, and titles.
BIDDING PHASE

1. GENERAL

After the Design Professional receives agency approvals, the Documents are ready for bidding. The Contracts Administration Department, working with the Project Manager, will advertise, issue Documents, issue Addenda, receive bids, open bids, and award the Contract.

2. REVISIONS TO BID DOCUMENTS

The Instructions to Bidders states that during the bidding period revisions to the Bidding Documents will be made by Addenda. Project Manager will work with Contracts Administration so Addenda are issued no fewer than three days prior to bid opening.

3. BIDDER CALLS

The Project Directory and Supplementary Instructions to Bidders instruct bidders to direct inquiries regarding the Specifications and Drawings to the University's Representative, and inquiries regarding bidding to the Project Manager. Designate one person to take all calls from bidders. Log in caller, date, time, question, and response. Forward log information to Project Manager for possible inclusion in Addenda.

If bidders call requesting clarification or interpretation of the Bidding Requirements, refer all such calls to the Project Manager.

When questions arise too close to the bid opening for an addendum to be issued, and the subject matter does not justify deferral of bid opening to issue an addendum, inform bidder the Documents stand as issued.

4. PRE-BID CONFERENCE AND SITE VISIT

Participate in University's mandatory Pre-Bid Conference and site visit. Compile a list of questions generated by the bidders that requires interpretation and clarification of the Bidding Documents. Do not answer these questions at the Pre-Bid Conference, but furnish the answers to the Project Manager. Project Manager will issue answers to the questions in the form of an Addendum.

5. ACTION ON HIGH BIDS

The Agreement outlines actions University may take in the event the lowest responsible bid received exceeds the Construction Budget by more than 10%.
CONSTRUCTION PHASE

1. GENERAL

1.1 Services. The presence of professional personnel on University's staff does not relieve Design Professional from performing services required by the Agreement. Review of Contractor documents (such as shop drawings and submittals) during the Construction Phase shall remain the responsibility of the Design Professional.

1.2 Construction Notification. In conjunction with Project Manager, consult with Users of existing occupied spaces adjacent to construction site, and inform them of work that may be required in their space, anticipated length of construction, required utility shutdowns, and amount of noise or other disruption that construction activities may create.

2. CONSTRUCTION MEETINGS

2.1 Pre-construction Meeting. Conduct preconstruction meeting to discuss project scheduling, and to review administrative procedures and Contract requirements.

2.2 Regular Construction Meetings. Conduct these meetings at the job site. Prepare minutes for these meetings and distribute minutes within three working days of the meeting.

3. INTERPRETATIONS

3.1 Preparation. Issue decisions or interpretations (clarification) regarding the Contract Documents or disputes arising out the Documents on an impartial basis. Prepare and forward clarifications to Contractor, Project Inspector, and Project Manager in the form of typewritten text accompanied, if necessary, by drawings. Identify each clarification and its drawings by date and consecutive clarification number.

4. REVISIONS

4.1 Cost Proposals:

- Cost Proposals describe Contractor-proposed revisions to the Contract Documents. When requested, the Contractor prepares and transmits Cost Proposals showing changes in the Contract Price and Contract Time.
- Review Contractor's quotation and forward to Project Manager with recommendations of acceptable cost and time change, if any.

4.2 Field Orders. Prepare Field Orders to provide an immediate written order covering an urgently needed change in the Contract. Field Orders contain a “not-to-exceed” added cost, or a "not-less-than" deductive cost, and a Contract Time change. This procedure allows for the subsequent establishment of the exact change in cost and time.

4.3 Change Orders:

- Prepare Change Orders incorporating revisions to the Contract Documents from approved Cost Proposals, Field Orders, or otherwise, using standard Change Order forms provided by University.
- Sign Change Orders and transmit them to Project Manager for execution by University and Contractor. Make all required drawings or other attachments part of a Change Order by the Change Order text and attaching them to the Change Order.
NOTE: The above procedures may be simplified (e.g., telephoned communications, informal description of proposed changes) with approval of Project Manager on small projects or where immediate Change Order execution is desirable.

4.4 Change Order Text:

- **Signatures.** Since a Change Order is a modification of the Contract, it is normally signed by both University and Contractor. Although the Design Professional prepares Change Orders, the Design Professional's signature is not required for a Change Order to be valid.
- **Description of Change.** Clearly and completely describe the change(s) effected and any resultant change in Contract Price and Contract Time.
- **Reference to Other Documents.** For coordination purposes, an item in a Change Order may be headed by a reference to a related Cost Proposal and Field Order number. However, fully describe the change in the "Description of Change" portion of the Change Order. In no case shall the description of the change be in terms like, ". . . in accordance with Design Professional's letter of (date)" or ". . . as discussed at job site meeting." A preferred description is, “Provide all labor and materials for work described by Field Order No. __, dated ___.”

5. INSPECTION

5.1 Source. The University provides inspectors to inspect the Work.

5.2 Direction. Inspector is employed at the construction site working under the Design Professional's general direction, to observe progress of the Work and to report to the Design Professional any nonconformance with the Contract Documents.

5.3 Duties. See Appendix 5 for specific duties of the Inspector.

6. MATERIALS TESTING

6.1 Laboratory Recommendations. During the Bidding Phase, Project Manager will contract with soil and material testing laboratories based on recommendations submitted by Design Professional during the Construction Documents Phase.

6.2 Coordination. Provide coordination between the activities of Contractor and the soil and material testing laboratories.

7. PROGRESS PAYMENTS

Review and approve Contractor's Application for Payment, and distribute copies of Certificate of Payment to Project Manager, Contractor, Inspector, and Capital Projects & Facilities Management, Contracts Administration Unit.

8. COLOR SCHEDULE

Provide a revised and updated color schedule, and samples of textures and finishes of all materials.

9. PROJECT CLOSEOUT PROCEDURES

9.1 List. Provide Contractor with a listing of items that are to be turned over to the University before the Project is completed. Contractor is responsible for submitting these items to the Project Manager. Submit all items by transmittal, giving the name and number of the Project, Contractor's name, number of items, Specifications reference, and description.
9.2 **Manuals.** Turn over all manuals (e.g., operation, maintenance, training) to the Project Manager. Assemble manuals into three-ring binders and provide five copies. Mark each binder with the name and number of the Project and Specifications Sections included. Tab each division with the appropriate section. Include the name, address, and telephone number of the Contractor, subcontractor, and supplier/vendor in each binder. Do not include guarantees or warranty data in the manuals.

9.3 **Site Meeting.** Conduct a “Familiarization” site meeting with Contractor and University personnel when the Project is approximately 65% to 75% complete and systems operational, and prior to installation of ceilings.

Project Manager will invite appropriate UCSF departments to the meeting. Make a list of concerns and distribute it to all attendees. Prepare and distribute your response to the concerns to all persons invited to the meeting.

9.4 **Extra Stock.** Contractor will deliver all extra stock, tools, keys, and other items designated by the Project Manager. Contractor will itemize these items on a transmittal giving the Project name and number, Contractor's name, reference to Specifications Section, and description of items. The description is to include the names of manufacturer and supplier, order number, kind/type, color, and color number for items considered as maintenance replacements. Inspector will inventory the items at the time of delivery and sign the Contractor’s transmittal. Contractor will forward the transmittal to the Project Manager.

9.5 **Final Inspection.** Contractor will request a final inspection of the Project a minimum of ten working days prior to the inspection date. Provide one complete punch list to the Contractor.

Notify University Departments a minimum of seven days in advance of the scheduled date of final inspection. Have all persons indicate their attendance by signing an attendance sheet. Provide copies of the attendance sheet to the Project Manager. Distribute punch lists by facsimile within five working days after the final inspection to the Project Manager and Contractor.

9.6 **Training.** Contractor will submit all relevant operation and maintenance manuals at least fourteen days prior to the start of any training for equipment or systems. Require Contractor to include a schedule for the training in the Contractor’s Contract schedule. Provide schedule to the Project Manager at least fourteen working days prior to start of training. Project Manager will coordinate schedule with the University departments as needed.

9.7 **Guarantees.** The Contractor will submit two sets of certificates, guarantees/warranties, and tests in separate three-ring binders to the Design Professional. Each item is to be referenced with the name and number of the Project, Specifications Section, names of the Contractor, subcontractor, and vendor, including telephone numbers. Each Section will be tabbed with the Specifications Section number on the tab. Provide these binders to the Project Manager.

10. **FINAL APPROVAL AND INSPECTION**

10.1 **Submittal Review.** Review Contractor’s As-Built prints, guarantees, and operating manuals for compliance with the Contract Documents.

10.2 **Guarantees.** Assemble and deliver to Project Manager written guarantees required of Contractor.

10.3 **Final Inspection.** Conduct the final inspection of the Project and advise University as to the acceptability of work performed by Contractor.
10.4 Acceptance of the Work. Notify University, in writing, when the Work is acceptable and complete.

11. RECORD DOCUMENTS

The Record Documents are the Final Drawings and Specifications, including revisions made by the Design Professional in the course of construction and changes in the Work during construction based on As-Built Drawings and Specifications furnished by the Contractor and by directives. Properly annotate and cross-reference revisions and changes. Prominently note “Record Document” on each sheet. Provide the following documents to Project Manager at completion of the Project:

11.1 Record Drawings.
   - Provide reproducible Record Drawings.
   - Furnish on Mylar, or other similar material approved by Project Manager.

11.2 Approved Shop Drawings. Provide sepias of Contractor’s shop drawings.

11.3 Approved Submittals, Approved Catalog Data, and Operating and Maintenance Manuals. Provide two copies of each item submitted by Contractor. Submit checklist derived from review of receivables required by the project specifications. The data package shall be organized in accordance with the checklist provided, such that the data provided can be easily inventoried and filed for future reference.

11.4 Diskettes. Furnish one set of 3.5 in., double-sided, double-density diskettes, or compact diskettes incorporating all Drawings and Specifications for the Project.
INTRODUCTION

Part 2 Design Guide contains the following sections:

- General Design Considerations.
- Instructions for Division 1 — General Requirements.
- Design Guides for Divisions 2 — 16 Sections.

**General Design Considerations:** This section sets forth design objectives and special considerations for UCSF projects. University policies are quoted in part. Complete policies are available from Project Manager.

**Instructions for Division 1 — General Requirements:** These instructions inform the Design Professional how to prepare the University's Standard Division 1 Specifications Sections. The listed section numbers and titles generally follow section numbers and titles in the CSI Masterformat, 1995 Edition.

**Design Guides for Divisions 2 — 16 Sections:** Design guides are furnished by corresponding CSI Section numbers and titles in the CSI Masterformat, 1995 Edition. Each Guide addresses design requirements for the corresponding Specifications Section and may inform the Design Professional of specific content to place in that Specifications Section. Guides are divided into General, Products, and Execution parts—the same part division as CSI section format. However, some parts may be combined, or not included.

**GENERAL**

- Section text references special design guides prepared by various UCSF departments (e.g., Environmental Health and Safety). These referenced guides are available from Project Manager.
- Section text attempts to avoid repetition of requirements contained in the various codes enumerated in Part 1.
GENERAL DESIGN CONSIDERATIONS

1. DESIGN OBJECTIVES

1.1 General. For any project, the Design Professional is constantly faced with decisions regarding the selection of materials and methods to design an economical, aesthetically pleasing, and well-functioning end product. These design objectives are applicable on an industry-wide basis. However, on UCSF projects, the Design Professional must devote special attention to three design objectives:

- Functional Requirements.
- Overall Economy.
- Technical Guidelines.

See the following text for a discussion of these objectives.

1.2 Functional Requirements. UCSF facilities include a broad variety of building types (academic, administrative, medical, laboratory, housing, service, etc.), each with its own unique function. The success of the University's fourfold mission of teaching, research, patient care, and public service relies on the ability of its facilities to satisfy the User's functional requirements. The Project Manager will review specific requirements described in the Project Program early in the Schematic Design Phase. Carefully study these functional requirements to achieve a design that ensures the proper operation of the building, its systems, and surrounding amenities. Fully discuss these requirements with Project Manager to clarify any questions.

1.3 Overall Economy. UCSF constantly seeks ways of reducing its construction costs. At the same time, the increased use of more sophisticated building systems may increase the construction and maintenance costs. Further, the lowest construction cost does not necessarily provide the lowest overall cost when the life cycle of the Project is considered. Therefore, life cycle costing should be an important design objective. Examples of elements where lowest construction cost may not necessarily provide the lowest life-cycle cost are:

- Wall and floor finishes.
- Ceiling accessibility.
- Window treatment.
- Partition systems.
- Heating and ventilating systems.
- Energy conservation details and systems.
- Locks and panic hardware.

1.4 Technical Guidelines. Design Guides for Divisions 2 through 16 provide UCSF guidelines for design, materials, and methods. Design Professional is encouraged to propose alternate approaches that meet or exceed these guidelines, if justified by operational factors. Alternate approaches must be supported by justification documentation. Alternates must be reviewed and approved by Project Manager. Among the operational factors to be considered in designing building systems are:

- Functionality and cost.
- Reliability and long life.
- Minimized maintenance requirements.
- Simplicity and adequacy of control systems.
- Accessibility of mechanical and electrical components.
- Stocking and availability of replacement parts.
2. SPECIAL CONSIDERATIONS

2.1 General. In addition to the Design Objectives set forth above, the Design Professional must also devote attention to the following Special Considerations:

- Seismic Safety.
- Fire Protection.
- Access for the Physically Disabled.
- Environmental Quality.
- Exterior Design.
- Interior Design.
- Energy Conservation.
- Noise Suppression of Exterior Equipment.

See the following text for a discussion of these considerations.

2.2 Seismic Safety. The University's Seismic Safety Policy states, in part:

POLICY

It is University policy, to the maximum extent feasible by present earthquake engineering practice, to acquire, build, maintain, and rehabilitate buildings and other facilities which provide an acceptable level of earthquake safety, as defined in this Policy, for students, employees, and the public who occupy those buildings and other facilities at all locations where University operations and activities occur. . . . Feasibility is to be determined by weighing the practicability and cost of protective measures against the gravity and probability of injury resulting from a seismic occurrence.

. . .

New Buildings and Other Facilities; Hospitals. The design and construction of new buildings and other facilities on University premises shall, as a minimum, comply with the current seismic provisions of CCR Title 24, California Building Standards Code, or local seismic requirements, whichever requirements are more stringent. In addition, provisions shall be made for adequate anchorage for seismic resistance of nonstructural building elements, including but not limited to glass, fixtures, furnishings and other contents, equipment, material storage facilities, and utilities (gas, high-temperature water, steam, fire-protection water, etc.) with respect to potential hazards to persons in the event of seismic disturbances.

. . .

The design and construction of new facilities or alterations for hospitals, skilled nursing facilities, and intermediate-care facilities as defined in Section 15001 of the California Health and Safety Code, on University premises or under University operation shall comply with CCR Title 24, California Building Standards Code.

The complete Seismic Safety Policy is available from the Project Manager.

2.3 Fire Protection. Fire Protection is a program element in the University's Environmental Health and Safety Policy. This Policy states, in part:
POLICY

It is the policy of the University of California to maintain a reasonably safe environment for its students, academic appointees, staff, and visitors.

University operations shall be conducted in compliance with applicable regulations and, when appropriate, with accepted health and safety standards.

Fire Protection. Program activities shall be sustained which serve to protect life and property from fire. Facilities shall be maintained and operated in compliance with applicable regulations and accepted standards of fire safety and protection.

Plastics. Obtain approval of the State Fire Marshal for any plastic materials.

2.4 Access for the Physically Disabled. Design renovation to enable programs occurring in renovated facilities to be accessible to the physically disabled. Prior to commencing design of a renovation project, Project Manager will advise Design Professional if the facility’s programs are already accessible. If programs are not accessible, Project Manager will advise Design Professional what additional elements pertaining to accessibility to include. However, Design Professional is the person responsible for ensuring that all code requirements are adequately met.

2.5 Environmental Quality. If an Environmental Impact Report (EIR) is required, University will prepare the document and provide a copy to Design Professional. Take into account the Project’s environmental concerns throughout the design process.

2.6 Exterior Design.

Loading Docks. Provide adequate staging area for handling incoming or outgoing materials. Provide adequately sized doors to allow movement of materials and equipment into building. Consider space for dumpster and pickup vehicles.

Sun Control. Appropriate sun control design is essential on west-facing elevations to control heat gain and heavy glare of afternoon sun.

Windows. Detail windows, louvers, and vents with flush installation on exterior face of buildings to eliminate ledges where birds may roost or nest.

Curb Cuts. Provide curb cuts and parking for the disabled.

Wall Surfaces. Design exterior wall surfaces for minimum maintenance. Review proposed finishes with Project Manager during Schematic Design Phase.

2.7 Interior Design.

Vertical Expansion. Design for vertical expansion in floor-to-floor height partitions to avoid cracking of finish materials due to structural system movement or deflection.

Equipment Access. Provide adequate access to equipment, valves, etc., located above suspended
gypsum board or plaster ceilings.

**Patching.** Provide adequate patching to maintain fire-resistive requirements of existing floor, wall, and ceiling finishes.

**Gypsum Board.** Existing buildings are frequently remodeled. Therefore, use gypsum board, except in showers, animal care facilities, or where washing down of walls and ceilings may be required. Review finishes in these areas with the Project Manager and User during the Schematic Design Phase.

**Finishes.** Review all finishes used in public corridors and spaces with Project Manager and Fire Marshal during the Schematic Design Phase.

2.8 **Energy Conservation.** The University’s policy on energy and water conservation and management states:

Conservation of resources requires more than a temporary response to emergency situations. Conservation must become an integral part of our lives.

The University will comply with California Energy Commission energy efficiency standards for buildings. We will also cooperate with the California Department of Water Resources, and each campus, laboratory, and field station is expected to cooperate with local water districts in efforts to conserve water and to meet reduced water use goals of the local districts.

University Conservation Standards and Guidelines are set forth in Facilities Manual, Volume 6, Chapter 5, Energy and Water Conservation and Management (copy available from Project Manager).

2.9 **Noise Suppression of Exterior Equipment.** See Section 13080 NOISE ABATEMENT.
INSTRUCTIONS FOR DIVISION 1 — GENERAL REQUIREMENTS

GENERAL

1. Standard Division 1 Sections. The University's Office of the President has prepared Standard Division 1 Specifications Sections for the Construction Documents. Some Sections are complete, others require completion. UCSF will provide these Division 1 - General Requirements Sections on diskette, in addition to the hard copies included as Appendix 6 in these Guidelines. Use these Standard Division 1 Specifications Sections for the Long Form and Short Form Construction Documents.

2. Completed Sections. Use the following Sections as issued, without changes:

- 01012 - Information and Procedures Instructions (RFI). Note: May be included in Section 01010.
- 01051 - Project Coordination.
- 01080 - Regulatory Requirements.
- 01200 - Project Meetings.
- 01340 - Shop Drawings, Product Data, and Samples.
- 01510 - Temporary Utilities.
- 01520 - Fire Safety.
- 01600 - Material and Equipment.
- 01640 - Product Options and Substitutions.
- 01700 - Project Closeout.
- 01740 - Guarantees, Warranties, Bonds, Service and Maintenance Contracts.

3. Sections Requiring Completion. Use the following Sections after adding the information described below. Review all changes with the Project Manager. Note: Sections 01011 through 01019 may be included in Section 01010.

- 01010 - Summary of Work. Complete the work required by Construction Documents article. Provide a description of the Project and special completion requirements, if applicable.
- 01011 - General Requirements. Complete the paragraphs for Shoring, and Laying Out of the Work, if applicable.
- 01013 - Multiple Construction Contracts. Insert appropriate text, if used.
- 01014 - Contractor's Use of the Project Site. Insert appropriate text, if used.
- 01015 - Contract Definition. Insert appropriate text, if used.
01016 - Work by Separate Contractors. Insert appropriate text, if used.

01017 - Owner Furnished Items. Insert appropriate text, if used.

01018 - Project Phasing. Insert appropriate text, if used.

01019 - Work Sequence. Insert appropriate text, if used.

01020 - Allowances. Provide descriptions of Allowances, if Allowances are used.

01060 - Hospital Project Procedures. Enter Section numbers in Paragraphs 1.3, 1.4, 1.5, 1.6, 1.7, and 1.10, if Project is located within a Campus Hospital structure. List items in Paragraph 4.2.

01070 - Cutting and Patching. Insert appropriate text.

01090 - Abbreviations, Symbols, and Definitions. In Paragraph 1.1, list abbreviations of organizations referenced in the Construction Documents.

01100 - Alternates. Provide descriptions of Alternates, if Alternates are used.

01150 - Measurement and Payment. Insert appropriate text, if used.

01155 - Unit Prices. Provide descriptions of Unit Prices, and insert work numbers, if Unit Prices are used.

01220 - Progress Meetings. Insert appropriate text, if used.

01300 - Submittals. Insert appropriate text, if used.

01310 - Contract Schedules. Indicate type of schedule required of Contractor. Modify important milestone events, if required.

01400 - Quality Control. Include paragraph for Geotechnical Engineer, if applicable.

01420 - Inspection of Work. Insert text as appropriate.

01500 - Construction Facilities and Temporary Controls. Obtain from Project Manager the additional information shown at the bottom of EH&S safety instructions. Insert into text.

01560 - Environmental Mitigation. Enter descriptions developed by Project Manager, if used.

01710 - Cleanup and Disposal. Insert appropriate text, if used.

01720 - Contractor's As-Built Documents. Insert appropriate text, if used.

4. Table of Contents. The Specifications Table of Contents includes all the above Division 1 Sections in numerical order. If a Section is not used, indicate “Not Used.” If a new Section is used, add it to the listing in the correct numerical order.
DIVISION 2 — SITE CONSTRUCTION

02200 SITE PREPARATION

GENERAL

1. Pedestrian Control. Require temporary fences, barriers, trench covers, flagmen, or other devices to ensure safe conditions for pedestrian control.

2. Salvage. Coordinate with Project Manager items to be salvaged. Specify Contractor care to prevent damage to reusable material or to the adjacent area from which it is removed.

3. Existing Subsurface Utilities. Where known to exist, show utilities on Drawings. Coordinate extent of removal of abandoned lines with Project Manager. Instruct Contractor to consider locations as approximate, and to protect the utilities shown or other utilities discovered during construction. Also, instruct Contractor to take reasonable steps to ascertain the exact location, nature, and extent of utilities shown or discovered during construction. Provide for notification if utilities are found. Utilities in use are to be left in place, or disposed of in the manner prescribed by Project Manager.

4. Protection of Existing Facilities and Surrounding Landscapes.

   Damage Protection: Require damage protection from Contractor's operations for trees, plants, utilities, and existing improvements that are to remain. Should damage occur, Contractor is to replace item to duplicate the item's condition prior to the damage. If Contractor damages trees designated for protection, the University will require compensation.

   Design Consideration for Existing Trees:
   • Make every effort to protect existing trees.
   • Avoid fills and excavations within the drip line. Establish finish grades above the root system. Do not change the finish grade near the tree trunk.

   Prohibited Actions: Do not allow:
   • Poisoning by disposal of petroleum, paint products, dirty water, soil sterilization, or any other application of deleterious material on or around root system location.
   • Use of plants, trees, or shrubs for anchorage of ropes or lines, for power attachment, for signage support, or any other temporary or permanent purpose.
   • Unnecessary compaction by trucks or other equipment.
   • Excessive watering.
   • Heat from trash burning.
   • Damage resulting from contact by trucks, grading equipment, equipment storage, movement of vehicles, and gravel or earth fill storage, both below grade and to trunks, limbs, or branches.
   • Damage to root system by flood erosion, excess wetting and drying from dewatering, or other activity.

5. Disposal.

   Ownership: All debris should become property of Contractor upon removal and be disposed of in a legal manner. Do not allow use of University's refuse containers for debris disposal.

   Time: Dispose of debris during the day of removal and do not allow debris to build up until final cleanup period.
6. **Herbicides.** Review use and application of controversial products, such as sprayed herbicides, with Project Manager. In no case will any product be allowed to contaminate any person or landscaping beyond perimeter of site.

7. **Tree-Trimming.** An Arborist (Consultant to University) may be required to direct removal of branches from trees and large shrubs to allow clearance for new construction. The Arborist may also be required to direct repair of trees and shrubs damaged by construction to prevent further deterioration.
02210   SUBSURFACE INVESTIGATION

GENERAL

1. Soil and Subsurface Conditions.

   **Geotechnical Data:** Whenever site construction design requires the use of soil or subsurface investigation reports, logs of test borings, or similar geotechnical data, UCSF will provide the geotechnical data with the Information Available to Bidders as references for Contractor. Both the Information Available to Bidders and General Conditions Paragraph 3.17, Concealed or Unknown Conditions, state the geotechnical data is not a part of the Contract. However, General Conditions Paragraph 3.17 requires the University to assume responsibility for conditions that require changes to design details.

   **Contractor Investigation:** If Contractor is required to perform subsurface investigation as a Project activity, specify requirements in this Section.
02300 EARTHWORK

GENERAL AND EXECUTION

1. General. Require the following:
   - Wherever possible, maintain benchmarks, monuments, signs, and other reference points. Provide for replacement and resetting those disturbed, displaced, or destroyed.
   - If a soils report has been prepared for the project, implement the design recommendations of the Soils Engineer. Coordinate any proposed modifications of design recommendations with the Soils Engineer.

2. Environmental Requirements. Include the following requirements:
   - Avoid disturbing areas of high-erosion susceptibility or with steep slopes. If this avoidance is not practical, require the Contractor to provide temporary erosion control measures during construction, and include permanent erosion control measures in the Construction Documents.
   - University will normally plan project so earthwork can be performed during periods annually known to have favorable weather. Unfortunately, unfavorable weather may occur despite the best of planning.
   - Require Contractor to:
     - Prepare for unfavorable weather conditions that may interrupt filling and grading operations.
     - Grade and compact surface areas to minimize collection of water.
     - Provide adequate temporary drainage to prevent erosion.
     - Resume normal operations after weather interruption and after compaction specified in last layer is reestablished and verified.

3. Submittals. Require:
   - Samples of all proposed imported materials in sufficient amounts to establish material is satisfactory for use.
   - Written approval of imported material.

4. Backfill. Soils Engineer will witness proper placement of all fill. Allow jetting only where permitted and approved by the Soils Engineer.

5. Field Quality Control. Soils Engineer will witness all excavation, filling, and compaction.
02315  TRENCHING, BACKFILLING, AND COMPACTION

GENERAL

1. Existing Utilities.

   Existing Buried Utilities: For projects involving excavation work, Project Manager will provide, at Design Professional's request, available information on existing buried utilities so relocation or removal work may be correctly shown on drawings and service disruptions minimized. Verify utility locations by digging pilot holes. The cost of these pilot holes will be paid for by the project.

   Unknown Locations: Where presence of subsurface facilities is suspected, but exact locations are unknown, consult Project Manager concerning advisability of exploratory excavation to locate the utilities.

   Damage: Specify that Contractor is responsible for repairing utilities damaged by Contractor if utilities are shown on the Drawings, or if presence of utilities is brought to Contractor's attention in advance of excavation.

2. Disruption. Include measures to minimize disruption to vehicular and pedestrian traffic. Require bridges or other means to allow access to street crossings, driveways, fire hydrants and valves, etc. In developed areas, limit the length of open trench.

3. New Utility Location. Provide detectable tape or other measures to allow future location of new non-ferrous utilities.

4. Trench Surfacing. In paved areas, include measures to assure neat cuts and to limit future damage to existing pavement. Require installation of temporary surfacing within one day after backfill. Require maintenance until permanent surfacing is placed.
02500 UNDERGROUND UTILITIES

GENERAL

1. Existing Conditions.

   General Information: UCSF Campus contains numerous underground utilities distributing steam, electricity, telecommunications, water, gas, sprinkler water, computer data, cable video, sewage, etc. Use the following procedures to ensure existing utilities are not damaged or disturbed:

   • Information on existing underground utilities is available from Capital Projects & Facilities Management. Contact the Project Manager and review Capital Projects & Facilities Management's drawings to determine if any underground utilities exist in the Project area. If necessary, obtain prints of Facilities Management's drawings, costs to be paid by the Project.
   • Coordinate work potentially affecting utilities with local authorities and surveyors or services, (e.g., PG&E, Pac Bell, SF Water Department, CP FM Utilities).
   • Contact Project Manager to arrange for underground utility locator services, cost to be paid by the Project. Project Manager will provide documentation produced by underground utility locators.
   • All identified utilities require verification of location prior to start of excavation work. Indicate on Drawings general locations. Require Contractor to: determine actual locations utilizing hand excavation, underground utility locator services, or other accurate methodology. Mark field conditions with stakes and spray paint.
   • Report to Project Manager for visual inspection any utilities identified during construction not recorded on Capital Projects & Facilities Management's utility drawings. Contractor to mark these utilities on as-built drawings, along with any new utilities added during construction.
   • Provide direction to Contractor to follow the above procedures for any underground excavation on the Campus. Contractor to bear full responsibility for repair and replacement of any damaged utilities if these procedures are not followed.

2. Utility Layout and Distribution. Receive Project Manager's approval early in design process for routing of all utilities. Make all efforts to avoid routing any utility in such a way as to require trenching or any disturbance within the root zone of trees. Consolidate and restrict utilities, to every extent possible, to those areas with existing utility lines.

3. Utility Tunnel Design. Determine utility tunnel access during planning phase. Give consideration to adequate access for personnel (e.g., walking and working space, space for constructing utilities in the tunnels, space for future installation of pipes, computer cables).

4. Utility Tunnel Penetrations. Take the following steps for tunnel penetrations:

   • Make watertight.
   • Design for expansion and contraction, and differential settlement, maintaining watertight seal.
   • Address fire boundaries.
   • Review with and obtain approval of Project Manager.
   • Must be core-drilled.

5. Connections. Coordinate requirements for connections with the Project Manager. Include any special requirements or limitations on downtimes in the Construction Documents.
02530 UNDERGROUND STORM DRAINAGE AND SANITARY SEWERAGE SYSTEMS

GENERAL DESIGN

1. Hydrology. Use the rational method of design, and base on a 10-year storm. Factors include:
   - Runoff coefficients ("c"):
     - Residential - High Density 0.60
     - Residential - Low Density 0.40
     - Academic 0.75
     - Open Space 0.25
   - Calculations: Submit design calculations and flow maps of all tributary areas with the Drawings.

2. Sewage Flow. Coordinate design flow with project Mechanical Engineer for flow rate (usually based on fixture units).

3. Hydraulics.

   Minimum velocity: 2.5 FPS at full flow.

   Manning n: 0.013 for all pipe sizes.

   Head Loss: At changes of direction, install a drop in flow line equal to the velocity head times the ratio of angular change (A°) to 90°:

   \[ \frac{V^2}{2} \times \frac{A^\circ}{90^\circ} = \text{Head Loss} \]

   Match crowns wherever practicable.

   Pipe Size: Design to flow 90% full without surcharge.


   Mains:
   - Acceptable materials: Vitrified clay pipe (ASTM - C700), or polyvinyl chloride pipe (ASTM - D3034 or F679).
   - Location of storm conduit: Typically, 12 ft. south or east of street centerline.
   - Minimum size of conduit: 15 in., except 12 in. minimum I.D. required for inlet runs.
   - Laterals: Cast iron soil pipe (ASTM - A74), VCP, or PVC.
   - Sanitary sewer laterals: 4 in. minimum I.D. for single-family residences; 6 in. minimum I.D. otherwise. 2% minimum slope.
   - Curved conduit: Curved sewer conduit not allowed for sizes less than 36 in. I.D. or larger, unless approved in writing by Project Manager.

   Manhole Locations:
   - All changes of pipe size, type of pipe, direction.
   - Intersections of lines, including inlet runs.
   - Where building acid waste systems will be diluted by building storm and sanitary waste systems.
Part 2  Design Guide

Manhole Spacing:

- For pipe 33 in. in diameter and smaller: A nominal spacing of 300 ft., with a maximum spacing of 320 ft.
- For pipe larger than 33 in. in diameter: Spacing designed individually for the specific project.
- Backflow preventers: Provide backflow preventers on laterals connecting to buildings with basements.

Inlet Locations:

- First inlet from high point: Nominal distance of 1000 ft. from high point, provided the depth of flow in the gutter does not exceed 0.4 ft.
- Subsequent spacing: Nominal spacing of 600 ft., or as necessary, to limit flow spread to 8 to 10 ft.
- All low points.
- Points where depth of flow in gutter exceeds 0.4 ft.
- Street intersections (wherever possible, do not locate within curb return).

Storm Inlet Runs: 12 in. minimum diameter with a minimum slope of 2%. Inlet runs to be intercepted at a storm manhole, not at another inlet.

Outlets: Where crossing City of San Francisco sidewalks, fit drain line with a City of San Francisco-approved double vent assembly installed on the sidewalk.

Grates and Frames:

- For catch basins: Suitable for use with bicycle traffic, and high heels in pedestrian traffic areas.
- Match-mark in pairs before delivery to job site. Grates to fit into frames without rocking.

Manhole Covers: For 24 in. clear opening with the word “STORM” or “SEWER,” respectively, in letters not less than 2 in. high cast into cover.

Ladders and Accessories: Equip each manhole on UCSF property with a hot-dipped galvanized steel ladder anchored to the manhole wall with stainless steel bolts and hardware.
02660 UNDERGROUND WATER SYSTEMS

GENERAL AND PRODUCTS

1. Connections to Existing Mains. Keep newly installed facilities isolated from the system until bacteriologically acceptable. If isolation is provided by a closed valve, conduct pressure testing for leakage in new facilities before bacteriological acceptance.

2. Water Services. Include:
   - Location: Typically, show water services located in middle of lot. Do not locate in driveways or less than 5 ft. from sewer laterals.
   - Minimum service: 1 in., show size on drawings.
   - Minimum meter size: 3/4 in., show size on drawings.
   - Water meter box: Size according to service size for services 2 in. or less. Provide box to each domestic water meter assembly, size according to meter size, with reading lid marked, “WATER METER,” and with extension as required.
   - Domestic water meter: Indicate size on drawings, with registers reading in cu. ft.

3. Air Reliefs. Provide air relief assemblies on drawings at high points in lines.

4. Blow-Offs. Show standard blow-off assemblies on drawings at low points in lines. If a fire hydrant is installed near a low point, a blow-off is not needed.

5. Fire Hydrants.
   - Location:
     - At intervals of approximately 300 ft.
     - Stagger on opposite sides of street.
     - Determine exactly by specific needs for each area.
     - Not more than 7 ft. from curb or edge of street.
     - For most applications, 24 in. off curb.

   Factors That Influence Hydrant Location:
   - Normal direction of response of first due fire company.
   - Proximity of target hazards.
   - Ease of use in conjunction with sprinkler systems and “on site” systems.
   - Locations of driveways, parking stalls, and other utilities.
   - Minimum clearance:
     - 5 ft. from electroliers, driveways, and utility poles.
     - 3 ft. at shrubbery.

   Fire Hydrant Valve: Locate 10 ft. from hydrant barrel.

   Fire Hydrant Connections and Coupling: 2-1/2 in. size and fully compatible with City and County of San Francisco fire equipment without adaptations. Needs local fire chief’s written approval (and inspection if required) prior to Final Payment.

   Manufacturers: Use only those manufacturers providing hydrants to city and county fire departments called upon to service UCSF. Selection subject to approval of local fire department for specific
jurisdiction.

6. Fire Sprinkler Service Lines.

Requirements: Comply with requirements of UCSF Master Plan for Fire Sprinklers. A copy of this Master Plan is available from Project Manager.

Location: Indicate location of supply main on Drawings. Include the following in scope of work:

- Construction of underground fire sprinkler service line, including tapping of existing water mains and connections at sprinkler riser in building.
- Construction of fire protection water system components, including all required fittings and thrust blocks.
- Testing for pressure and leakage: No measurable leaks permitted.
- Flushing of completed installation.
- Prohibition of water service taps on fire sprinkler service lines.

System Control Gate Valves: Either outside post indicator gate or gear-operated butterfly type requiring at least four turns for closure:

- Post indicator valve: Designed for use with indicator post, with flanged ends.
- Indicator post: Designed for use with indicator valve.

Fire Department Connection: Horizontal type with dual clappered inlets, red plastic plugs, and a sign with raised letters reading, “AUTO SPR.” Provide swing type check valve with rubber gaskets.

7. Water Mains.

Type: Ductile iron pipe for domestic water systems. Schedule 80 Polyvinyl Chloride (PVC) for irrigation water only.

Location: Typically, 6 ft. north or east of street centerline.

Depth: 3 ft. minimum cover in fully improved areas; 4 ft. in unimproved areas.

Pressure Rating: 150 psi.

8. Valves.

Line Valves: Install at all intersections and at uniform intervals not to exceed 800 ft. Provide the same number of valves at intersections as the number of legs. Bolt valves to tees or cross with stainless steel bolts.

Gate Valves:

- Install at ends of lines to be extended in future if water services are located between last valve and end of line.
- All iron, bronze-mounted, double disc, parallel seats, nonrising stem, 2 in. square operating nut turned counterclockwise to open, O-ring packing, and flanged or mechanical joint ends (as applicable).

Tapping Valves: Gate valve with nonrising stem, O-ring seals, and 2 in. square operating nut.
Check Valves:

- Check valves: Swing check type, mounted horizontally, with rubber or composition discs.
- Detector check valves: Iron body, flanged ends, galvanized finish, and compatible with 3/4 in. bypass.

Backflow Preventers: Provide backflow preventers for irrigation lines and fire lines. Backflow preventers should be a type and model approved by the California Department of Health Services and the water supply company. Install backflow preventer assembly with 12 in. minimum clearance above grade.

Water Valve Boxes: Provide for each buried valve. Material: Precast concrete with steel or cast iron traffic cover marked, “WATER”.
02700 BASES, BALLASTS, PAVEMENTS, AND APPURTENANCES

GENERAL

1. Roadways, Parking, and Service Areas.

**Design Traffic Index:** UCSF will provide for each project. Minimum values:

- Residential streets: 5, or local city standard, whichever is greater.
- Collector streets: 6, or local city standard, whichever is greater.
- Arterial streets: 7, or local city standard, whichever is greater.

**Pavement Surface:** Asphalt concrete. For small areas where no unusual subgrade conditions exist or exceptionally heavy traffic load is not anticipated, and for minor repair work, 2 in. of CDT asphalt concrete on 8 in. of Class II aggregate base may be used. Consider Portland cement concrete pavement on steep grades.

**Proposed Traffic Counts:** Project Manager will clear with city Traffic Department. Obtain written approval for proposed work from city Traffic Department.

**Parking Dimensions:** Ratio of compact spaces to total parking spaces: 30% to 50%, depending on specific project requirements and city Traffic Engineer requirements, where applicable.

**Service Area Dimensions:**

- Minimum depth: 54 ft. (subject to layout).
- Minimum drive: 20 ft. curb to curb (subject to use).

**Trash and Dumpster Container Area Dimensions:**

- Dumpster container pad: 6 x 10 ft. for each container.
- Approach slab: 10 x 10 ft. immediately in front of the container pad. Reinforce to support 15,000 lb. front axle loading, stopping repeatedly at the same location.
- Driveways and gates to trash container areas: 10 ft. minimum width for a straight approach. If truck approach is on a curve, add 2 ft. to outside of curve for 12 ft. minimum.

**Trash and Dumpster Operating Requirements:**

- Containers on casters require room to turn in the enclosure.
- Vertical clearance of the dumpster truck is 14 ft. Vertical clearance for emptying container into truck is 22 ft.
- Turning radius of dumpster truck is 42 ft.

**Grades:**

- Longitudinal slope: 0.3% minimum for all streets. Hold this grade around outside of horizontal curves and around curb returns.
- Streets: 2% cross slope.
- Intersections: 1% positive drainage slope. Profile of the through street shall be continuous through intersection.
Surface: Provide rough texture for nonskid surface on approach ramps, driveways, and paved work areas in excess of 4% slope.

Fire Department Access: In general, fire roads must be 10 ft. wide minimum, with 36 ft. minimum outside turning radius, 15% maximum grade, and with 14 ft. minimum vertical clearance. Provide adequate turnarounds at dead ends.

2. Walks and Paths.

Paths Not Subject to Motor Vehicle Traffic: 1-1/2 in. asphalt concrete over 4 in. aggregate base material (or cement-treated base), or asphalt concrete on compacted subgrade, depending on existing conditions.

Exterior Walks, Terraces, etc.: Minimum 2% cross slope.

Walks: Rounded with a minimum 5 ft. radius at intersections.


4. Header Boards. Requirements include:

- Not desirable unless required for stability or safety.
- Required wherever asphalt is set adjacent to, or through, lawn area.
- Where not used, roll or tamp edge of asphalt straight, uniform, and with an even edge.

5. Concrete Construction. Add carbon black to concrete for curbs, gutters, and sidewalks to match existing work.
02800 SITE IMPROVEMENTS AND AMENITIES

GENERAL AND PRODUCTS

1. Walks, Road, and Parking Appurtenances. Provide vehicle control devices to prevent vehicles from entering Campus from unauthorized locations, while permitting uninterrupted pedestrian and bicycle traffic. UCSF Parking Operations will review vehicle control design.

Place steel bollards wherever vehicles can reach or damage safety equipment (e.g., fire hydrants, stand pipes, mechanical equipment, transformers, tanks). Also place to protect buildings wherever a curb cannot be made to suffice (e.g., door jambs at roll up doors, loading docks, roof columns).

2. Site Furnishings.

   Trash Receptacles: 22-1/2 in. diameter x 3'-0" high, cast stone, Natural or Sand Buff color, Light Sand Blast finish, with spun aluminum lid with anchor chain and spring fastener. Lid color—anodized blue to match UCSF logo.

   Outdoor Bicycle Racks: Galvanized metal modular, single- or double-sided.

   Ash Urns: 14 in. diameter x 22 in. high, cast stone, Natural or Sand Buff color, Light Sand Blast finish, with natural aluminum tray partially filled with sand.

   Benches:
   - Direct-bury type steel frame, painted UCSF blue.
   - Set in concrete footings.
   - 3 x 3 in. oak slats, with back rests, but without arm rests.

3. Site and Street Shelters.

   Kiosks and Bus Stop Shelters: Design to match existing units.

4. Signs.

   General Design and Materials:
   - Conform to UCSF Signage Standards Manual (available from Project Manager), and International Safety Standard Symbols for Signs (e.g., “CAUTION RADIATION,” “HIGH VOLTAGE”).
   - Traffic and other regulatory signs: Metal on metal poles designed in accordance with CDT Sign Specifications Manual.
   - Metal signposts: 2 in. I.D. standard wall steel galvanized pipe with one end finished to receive mounting cap and fittings.
   - Concrete for signposts: Class B, conforming to CDT Standard Specifications.
   - Metal sign panels: .080-gauge treated aluminum.
02810  IRRIGATION SYSTEMS

GENERAL

1. Layout.

Sprinkler Systems: Use automatic sprinkler systems with uniform brand for all system components of the same function.

Slopes: Water slopes greater than 30 degrees by stream spray, rotor, or other low precipitation head if the controller cannot cycle at two minutes several times per night.

Valves: Size remote control valves for a minimum pressure drop of 2 psi for the given GPM of the lateral. Install with at least one union.

Watering: Do not service plant materials of differing watering requirements by the same valve. In no case shall turf be on the same valve as any other plant material unless approved by Project Manager.

Irrigation: Irrigation solely dependent upon quick coupling valves shall have valves spaced no more than 90 ft. apart.

Coverage: Complete coverage of irrigation areas is required.

Cross Connections: Do not make cross connections between old and new irrigation systems without approval and without verification of capacity and central control station.

Connections to Existing Water Mains, Other Than at Valve Outlets: Make with compression tees and gate valves.

2. Sprinkler Heads.

Connection: Connect sprinkler heads 2 ft. or less from lateral connection by threaded fittings only to the lateral.

Precipitation Rate: Do not valve together sprinkler heads of differing precipitation rates.

Location: Shrub heads located along pathways or traffic areas: Use type that retracts to ground level when watering is completed.

PRODUCTS

1. Pipe and Pipe Fittings.

Mains and Pipe Sustaining Static Pressure: PVC No. 1220, 315 psi, or Schedule 40, whichever has greater pressure rating.

Laterals: PVC No. 1200, 200 psi or greater pressure rating. Size for maximum 10% pressure drop from nearest to farthest head of any valved lateral. Size for maximum velocity of 5 ft. per second in any section.

Fittings and Risers: PVC, unless approved by Project Manager. Galvanized fittings may be used in...
case of potential mechanical stress, as in above-ground atmospheric breakers, hose bibbs, quick couplers, and some valves. In such cases, make connections so male PVC threads insert into female galvanized threads, not vice versa.

**Mains and Pressure Pipe:** Schedule 80 PVC fittings.

**Shock Absorber Type Joints:** Do not use Marlex, rubber flex riser, or other innovations.

2. **Valves.** Remote control valves require a flow control handle adjustable by valve key.

3. **Sprinkler Heads and Controllers.**

   **Turf Spray Heads:** Pop-up type with 2 in. minimum pop-up height.

   **Controllers:** Capable of watering starts of at least once every hour, and capable of watering a minimum of two minutes per station.

4. **Quick couplers.** Use 3/4 or 1 in. size. Do not place inside turf areas.

5. **Backflow Prevention Devices.** Use atmospheric vacuum breakers. Where feasible, install 12 in. minimum above height sprinkler head.

6. **Service Saddles.** Double strap, all bronze.

7. **Wire.**

   **Size:** No. 14 U.F., unless larger conductor is necessary for the given application.

   **Color:** Use white wire exclusively for the common wire. For all other wire, use continuous color for each valve.
02900  PLANTING

GENERAL

1. Design. Include following items in design:

- Design planting at entrances to roadways, parking lots, and pedestrian areas to provide clear visibility for persons leaving and entering the area.
- Plant materials and turf seed to match those types that have shown successful growth and low maintenance in the nearby micro-climate.
- Select plants compatible with natural limitations of climate, weather, and soil conditions of the coastal areas of the San Francisco Bay Area.
- UCSF will not accept exotics or plants with peculiar horticultural or excessive maintenance requirements.
- Give full consideration to appropriateness of plants in given man-made environments (e.g., provide adequate space for street trees).
- Where possible, keep street trees at medians, along roads, etc., at a minimum of 6 ft. from the curb to facilitate street sweeping and minimize curb damage.
- Select and site large shrubs and trees around buildings in a way compatible with accepted standards of solar access and energy-efficient design.
- Do not block or cover building security lighting with plants.
- Provide for a Soils and Plant laboratory, approved by Project Manager, to perform a soil analysis at planting sites. Incorporate recommendations from this analysis into scope of project as needed.
- Incorporate water and energy conservation as the primary design consideration.
- Incorporate low-maintenance or self-maintenance materials as the secondary design consideration. Consider small-size lawn areas or assembling areas to form a large, easily machine-mowed area. Imitation materials (e.g., carpet center dividers) are unacceptable.

2. Undesirable Plants. Avoid the following plant types:

- Plants that grow invasive surface root systems near underground utilities, building foundations, and lawn areas.
- Plants unduly prone to disease (e.g., Dutch Elm).
- Plants incompatible with water requirements of existing plant life (e.g., oak in lawn, willow with native plants, mixing drought-tolerant with water-loving species).
- Plants known to be particularly active with fruit, pollen, or leaf fall (e.g., olives, acacia, loquat, cottonwood, fruit trees).
- Plants known to develop particularly brittle structures (e.g., eucalyptus).

PRODUCTS

1. Planting Materials.

   Backfill:

   - Use excavated material, finely divided, loose, and free of clods, with all stones larger than 1 in. removed.
   - Add soil amendment in the proportion of 1 part amendment to 3 parts of thoroughly mixed soil.
   - Site topsoil usable if additional soil is required.
Soil Amendment and Mulch: Composted, with nitrogen-stabilized and water-holding materials with long residual life.

Commercial Fertilizer to Mix with Backfill Soil: Ammonium phosphate 16-20-0 applied at 2 lb. actual nitrogen per 1000 sq. ft., or 912.5 lb. of ammonium phosphate applied to each 1000 sq. ft. area.

EXECUTION

1. Field Quality Control.

CPFM Personnel: During construction, certain activities require the participation of Capital Projects & Facilities Management personnel who later will have charge of landscape maintenance.

Testing: Perform testing of sprinkler main with water pressure of 125 psi for 2 hours.

Preliminary Inspection: Request a preliminary inspection upon completion of all planting and cleanup work. Completion of all corrective work, and reinspection and approval establishes beginning of maintenance period.


Start: Maintenance period starts immediately upon Design Professional's approval, as noted in Preliminary Inspection above, and continues for 60 calendar days. On minor projects, where the cost of Contractor planting maintenance may be disproportionately high compared to construction cost, maintenance period can be reduced to 45 or 30 days, with concurrence of Project Manager.

Tasks: Keep plants in healthy growing condition.

Final Inspection: Hold Final Inspection at conclusion of maintenance period.

3. Guarantee Period. Guarantee all plants for one year and respond within two weeks to written requests by University for replacements. If Contractor fails to respond within this time, University may proceed with replacement work and bill the Contractor.
02950 SITE RESTORATION AND REHABILITATION

GENERAL

1. Asphalt Concrete Surface Restoration.

   *Base Course for Permanent Asphalt Concrete Surface Restoration:* Class II Aggregate Base equal to existing pavement structural section but not less than 8 in. in depth.

   *Wearing Surface for Permanent Restoration on Improved Streets:* Type B Asphalt Concrete equal to the existing pavement but not less than 2 in. in depth.
03050 BASIC CONCRETE MATERIALS AND METHODS

GENERAL

1. **Finishes.** Provide nonslip surface for exterior ramps and stairs. Review with Project Manager.

2. **Concrete Cover.** Due to high salt conditions in fog and wind at UCSF, design adequate concrete coverage over reinforcing steel for exposed concrete work. University has experienced considerable concrete spalling from reinforcement with insufficient cover.

3. **Sealers and Hardeners.** Consider use of sealer or hardener or both for interior cement-finished floors to prevent cement from dusting and to facilitate cleaning. Review locations and types with Project Manager.
DIVISION 4 — MASONRY

04050 BASIC MASONRY MATERIALS AND METHODS

NO GUIDELINES PROVIDED
DIVISION 5 — METALS

05700  ORNAMENTAL METAL

GENERAL

1. Exterior Railings. Review locations with Project Manager.

2. Expansion Joints. Make exterior building expansion joints waterproof and noncorrodible.

PRODUCTS

1. Exterior Ornamental Metal. Use stainless steel, copper, or aluminum for exposed ornamental metal on exterior of buildings. Aluminum material and finishes must be able to endure high salt conditions prevalent in fog and wind conditions at UCSF.

2. Exterior Railings. Use stainless steel or aluminum, and design to requirements for ornamental metal. Railings that are hot-dipped galvanized after fabrication may also be used.

3. Finishes.

   * **Aluminum Clear Finishes:** Conform to Aluminum Association Designation 622A41 (clear), Architectural Class One.

   * **Aluminum Color Anodized Finishes:** Conform to Aluminum Association Designation 622A42 (color), Architectural Class One.
DIVISION 6 — WOOD AND PLASTICS

06100 ROUGH CARPENTRY

GENERAL

1. **Blocking.** Specify adequate blocking in all new partitions designed to support, reinforce, or secure shelving, doorstops, wall-mounted coat racks, toilet accessories, etc.

2. **Lumber.** Avoid use of “green” lumber.

06200 FINISH CARPENTRY

GENERAL

1. **Grade.** All finish carpentry work to conform to Custom Grade as defined by the Woodwork Institute of California (WIC) Manual of Millwork.

2. **Design Requirements.** Adhere to the following requirements:
   - Avoid use of particleboard in wet areas.
   - Avoid use of “green” lumber.
   - Specify only “heavy duty” brackets and supports for wood shelving.
   - Use 3/4 in. minimum thickness shelving. Add seismic lips in labs.
06410 CUSTOM CABINETS

GENERAL

1. Design Requirements.

Casework:

- Minimum design for casework is Woodwork Institute of California (WIC) Custom Grade. Use casework of modular design (4'-0" maximum lengths) for ease of access to building sites and possible reuse in future remodeling work. Consider designs by laboratory equipment manufacturers if budget will permit.
- Cabinets in janitor rooms may be WIC Economy Grade with paint finish.
- Do not use particleboard or pressed board for laboratory work.
- Design drawers for heavy loading; use metal guides only with a minimum load carrying capacity of 100 lb.
- Provide adequate backing in stud walls for attachment of casework and detail same on drawings. Size backing and wall supports and design for UBC Seismic Zone 4 and shelf loading for 50 lb. per sq. ft.
- Verify with Project Manager requirements for locks for casework doors and drawers. Also, verify keying requirements for required locks.
- Verify with Project Manager if User requires glazed doors for casework.
- Where plastic laminate is used for casework cabinet units, verify with Project Manager if chemical resistant type is required. If wood is used for casework bodies, verify with Project Manager if finish must be chemical resistant.
- Where shelving is to be used for storage of liquids and chemicals, require a 3/4 in. minimum raised lip at all exposed edges. Anchor open shelving to its supports.

06415 COUNTERTOPS

GENERAL

1. Grade. Minimum design for countertops is Woodwork Institute of California Custom Grade.

2. Design Requirements.

Loading: Verify span design of countertops and shelving with Project Manager to confirm loading requirements (e.g., heavy equipment items). Study countertops under fume hoods for excessive loading where radioactive shielding may be required. Study may be accomplished with the use of lead bricks.

Faucets: Locate sink faucets so outlet is well over sink to prevent water splashing onto countertop. Do not use plywood or particleboard at sinks.

Plastic Laminate: Do not use plastic laminate countertops around sinks in laboratory spaces using acids or other corrosive agents or radioactive isotopes. Consider lab tops fabricated of stone, epoxy, stainless steel, composition stone, or molded resin. Fabricate sinks of a material equal to, or better than, countertop material. Verify requirements for size and depth of sinks with Project Manager.
DIVISION 7 — THERMAL AND MOISTURE PROTECTION

07100 DAMPPROOFING AND WATERPROOFING

GENERAL

1. **Below Grade Walls.** University has experienced problems with waterproofing below grade walls. Obtain adequate information from soils investigations for waterproofing requirements, and clearly indicate extent and details of waterproofing and foundation drains.

2. **Parking Structures.** In the design of parking structures, provide waterproof traffic toppings over areas used for storage, offices, etc. Consider need for waterproofing of all slabs to prevent alkali from dripping on cars.

3. **Air-Intake Plenums.** Provide sloped, drained, and waterproofed floors in all air-intake plenums. Fit drains with trap primers and connect only to building sanitary waste piping.
07500  MEMBRANE ROOFING

GENERAL

1. Mechanical Equipment.

   **Roof Level:** Design roof-level installation of mechanical equipment, pipes, and conduit to permit future reroofing.

   **Mounting:** Preferred method of mounting air-handling units, fans, etc. on roofs is on housekeeping pads (concrete pads on concrete roofs; built-up wood platforms on wood roofs) at least 6 in. above finished roofing surface. Flash and counterflash over entire pad surface.

   **Installation:** Install ductwork and piping on built-up angle iron or channel supports anchored to sleepers (concrete or fire-treated wood on concrete roofs; fire-treated wood on wood roofs) that are anchored to roof structure.

   **Supports:** Design ductwork and piping supports so ductwork and piping are at least 18 in. above roof surface. Route piping and electrical conduits to minimize tripping hazard.

   **Loads:** Design supports and anchorage for UBC Seismic Zone 4, or 30 lb. per sq. ft. wind loading, whichever is greater. Submit details and calculations to Project Manager.

2. Built-Up Systems. University has experienced best results using cold-applied bituminous roofing systems. To deviate from this type of roofing, obtain approval from Project Manager. Where patching is required, match existing roofing system; roofing contractor to be pre-qualified to maintain warranty.

3. Details. Provide large scale details on Drawings showing:

   • Termination bar flashing (e.g., at skylight curbs).
   • Flashing and counterflashing.
   • Parapet wall base.
   • Concrete, steel, or wood curb flashing and roofing.
   • Terminations at prefabricated equipment curbs (e.g., at mushroom type exhaust fans).
   • Pitch pockets and support anchorage.
   • Stack flashings where applicable to the Project.
   • Roof penetrations.

4. Walking Pads. Provide rooftop bituminous walking pads around new rooftop equipment.

07600  FLASHING AND SHEET METAL

GENERAL

1. Material. Exterior sheet metal work: Stainless steel or copper. Materials and finishes must endure high salt conditions prevalent in fog and wind at University.

2. Aluminum Finishes. Refer to Section 05700.
DIVISION 8 — DOORS AND WINDOWS

08050  BASIC DOOR AND WINDOW MATERIALS AND METHODS

GENERAL AND PRODUCTS

1. Doors.

   **General:**

   - Classroom, office, and exit doors: 36 in. minimum width.
   - Single-leaf entrance doors: Preferred unless for a functional or aesthetic reason to provide double doors.
   - Full glass doors: Use either a horizontal push bar, panic hardware, an intermediate mullion, or design so door is not mistaken for being open when closed.
   - Double doors: Equip with an astragal to prevent entry (e.g., with a coat hanger inserted between the leaves to release the panic bar).

   **Exterior Doors and Frames:**

   - Provide protection of exterior doors from wind and rain by recessing or exterior shielding.
   - Verify security provisions. Review security requirements with Project Manager and Campus Police.
   - Materials: Stainless steel or aluminum. Aluminum material and finishes must endure high salt condition at UCSF. Specify thickness of metal and finishes.
   - Aluminum finishes: Refer to Section 05700.

   **Toilet Room Doors:** Do not undercut nor provide door grilles and louvers as means of supplying makeup air. Ducted, heated supply air will be provided to toilet rooms.

2. Windows.

   **Exterior Windows and Frames:**

   - Stainless steel or heavy anodized aluminum, conforming to requirements for exterior doors and frames.
   - Attachment hardware: Type 304 stainless steel.

   **Exterior Glazing:** Use double-glazing.

3. Glass.

   **General:**

   - Use safety glass for glass doors, both swinging and sliding types.
   - Glass panels over 14 in. wide: Use either a horizontal mullion or guard rail, or design to prevent the space being mistaken for an opening.
   - Full glass panels at offices, corridors, etc.: Use a horizontal mullion or guard rail to prevent contact by furniture.
08700 HARDWARE

GENERAL AND PRODUCTS

1. General.

Security: Verify security requirements with Project Manager. User, Campus Police Department, and Capital Projects & Facilities Management Lock Shop will provide security requirements.

Backing: Provide for adequate backing in stud partitions for all finish hardware items.

Fire Safety: Clearly locate firemen's lockboxes on Construction Drawings.

2. Locksets or Latchsets. Review with Project Manager whether doors are to have locksets or latchsets. Review type of locksets or latchsets with Project Manager.

To Match Existing:

- Parnassus Campus buildings: Except Langley Porter Psychiatric Institute, specify Schlage “L” series locks with lever trim, or Schlage “D” series cylindrical with lever trim. Cylinders will be restricted Schlage Quad Section. 0-Bit cylinders and key blanks will be drop shipped from factory to Capital Projects & Facilities Management Lock Shop.
- Langley Porter Psychiatric Institute: Specify Best cylinders with Schlage Lever Design Hardware. Many patient areas have special requirements. Verify with Project Manager.
- San Francisco General Hospital: Specify Russwin hardware with Medeco cylinders.

Exterior Locksets: Stainless steel for all working parts.

3. Keys and Locks. Each building is six level mastered. Type of Schlage quad keyway is to be determined by Campus geographical area. Contact Capital Projects & Facilities Management Lock Shop for sectional keyway.

New Buildings: Provide University with six level master keying system, one cut key and four blanks per lock. All keys to be stamped “DO NOT DUPLICATE.”

Lock Cylinders: Compatible with UCSF’s existing keying system.

Remodeling Projects: All pinning will be provided by Capital Projects & Facilities Management Lock Shop. Contractor will supply 0-Bit cylinders and two key blanks per lock. Cylinders will be restricted Schlage Quad Section. 0-Bit cylinders and key blanks will be drop shipped from factory to Capital Projects & Facilities Management Lock Shop.

Construction Keying: As required by Project Manager and Campus Police. Specify Contractor to provide construction locks and keys for security of construction site. UC Lock Shop will provide construction cylinders and keys.

4. Kickplates. Verify if kickplates are required on doors, or if 3'-0" high armor plates are required to protect door faces from damage. Verify if door edge protection is required to protect door from damage.
5. **Exterior Doors.**

   **Hinges:** Furnish exterior doors with hinges made with nonremovable pins.

   **Weatherstripping and Seals:** Provide with weatherstripping. Design exterior doorsills to prevent infiltration of windblown and standing water from building exterior.

   **Exterior Hardware:** Provide stainless steel for all finish hardware mounted on the exterior.

6. **Toilet Rooms.** At patient care areas, provide toilet rooms with breakaway door hardware and frames in order to allow emergency access into toilet room should a person collapse behind the door.

7. **Door Closers.**

   **Public Use:** Use closers capable of being adjusted to 8.5 lb. on exterior doors, 5 lb. on interior doors, and 13 lb. on fire doors.

   **Mounting:** Mount closers on wood doors with through bolts.

8. **Floor Checks.** Design floor-check installations to permit adjustment without removal of door, and to be sufficiently sturdy to effectively close door against normal outward building or room air pressure.

9. **Panic Devices.**

   **Emergency Exits:** UL-approved and mechanically designed to prevent entry along the door edge.

   **Locking Device:** Equip with an auxiliary bolt against end pressure or knife shoving when door is in closed position.

   **Double Doors:** Both doors activate using concealed vertical rod device.
DIVISION 9 — FINISHES

09100 METAL SUPPORT ASSEMBLIES

GENERAL

1. Metal Studs.

   Typical: Roll-formed, nonbearing steel members, with outer flanges knurled to accept screws; 20-gauge minimum, punched to accommodate bridging or services; and formed from galvanized steel that corresponds to ASTM A446, Grade A, with minimum yield point of 33,000 psi.

   C-Studs at Openings, All Corridors, Laboratory Walls, Hospital Walls, and All Walls with Wall-Mounted Shelving: 20-gauge minimum, punched webs, with minimum 1-5/8 in. flange with flange-stiffening lips; formed from steel that corresponds to ASTM A607, Grade 50, with minimum yield point of 50,000 psi; and galvanized or painted with rust-inhibitive paint.

2. Fasteners. Refer to “Anchors and Fasteners” article in Section 01011.

3. Backing in Stud Partition or Furring. Securely weld or screw unpunched, 16-gauge minimum, backing stud sections to at least three studs or furring supports. Attach objects to backing stud webs.
09220 PORTLAND CEMENT PLASTER

GENERAL

1. Exterior. If cement plaster or stucco is used as an exterior finish, specify exterior plaster and expansion joints fabricated of zinc.

09250 GYPSUM BOARD

GENERAL

1. Water-Resistant. Use water-resistant type gypsum board finish in toilets, janitor rooms, and other wet areas.

2. Expansion Joints. Consider use of expansion joints in gypsum board with large areas or long wall lengths.

3. Remodeling. Where 5/8 in. gypsum board is used, specify Type “X” in all cases to provide the ultimate flexibility in future construction.

09300 TILE

GENERAL

1. Shower Rooms. Use ceramic tile on metal lath and setting bed finish for walls, ceilings, and floors in shower rooms and stalls. Exception: One-piece molded receptors are permitted for single shower stalls.
09650 RESILIENT FLOORING

GENERAL

1. General Design. Consider:
   - Proper underlayment surfaces and backing for installation of flooring.
   - PVC flooring with heat-welded joints in wet laboratory areas not subject to heavy chemical usage.
   - Waterproof nonskid trowelled-on chemical-resistant floors for wet laboratory and animal care areas with heavy chemical and water usage.
   - Sheet vinyl flooring with chemically welded joints on low budget projects.

2. Base. For base use:
   - 4 in. minimum room base height, except where another height is required to match existing base.
   - Rubber or vinyl topset on vinyl composition tile and flat type on carpet.
   - Integrally coved type for PVC flooring or sheet vinyl.

3. Waxes. If floor waxes are used, specify nonslip type. Confirm use of wax with Project Manager.

09680 CARPET

GENERAL


2. Fire Safety. Refer to Section 01520, Fire Safety. The radiant test information is available to Contractor's vendors from manufacturers. Therefore, require the vendor to supply the required data.

09720 WALL COVERINGS

GENERAL

1. With Radioisotopes or Mercury. Use sheet vinyl with welded seams in areas where radioisotopes or mercury will be used.
09900  PAINTS AND COATINGS

GENERAL

1. Protection.

   Cleaning:  Do not permit cleaning of painting tools and equipment within occupied buildings or near outside air intakes.  Do not dispose of paints/varnishes in sanitary sewer or University drains.  These materials may be considered hazardous waste.

   Occupants:  Inform Project Manager and building occupants adjacent to construction site of conditions that might be expected during painting operations.  Prohibit job site spraying of lacquer and varnishes in occupied buildings.

   Odors:  Make provisions to shut off air supply at intakes where odors originate.

2. Preparation.  Thoroughly prepare surface, particularly for wet or exterior surfaces where mildew is a common problem.

3. Application.  A factory finish is required on all interior heating, ventilating, and air-conditioning grilles, diffusers, and registers.  Do not permit job site painting of these items.

MATERIALS

1. Review.  Review paint materials for use in public corridors, entries, vestibules, lobbies, and toilet rooms with Project Manager for appropriateness of color.

2. Paint.

   Type:  Latex or acrylic types complying with current requirements of California Air Resources Board.  If these materials are not suitable to meet User requirements for any space, request Project Manager to indicate specific needs.  Notify Project Manager if other than latex paints/varnishes are to be used.  Provide Material Safety Data Sheets (MSDS).

   Mixing:  Use factory-mixed paints.  Do not permit job site mixing.

3. Mildew.  Paints, stains, etc., shall be mildew resistant.
DIVISION 10 — SPECIALTIES

10150 TOILET PARTITIONS

GENERAL

1. **Typical.** Use plastic laminate, stainless steel, marble, etc. Review materials with Project Manager.

2. **Adjacent to Urinals.** Use stainless steel or plastic laminate finish type. Do not use baked enamel finished screens or toilet partitions at these locations. Review type with Project Manager.

10200 LOUVERS AND VENTS

GENERAL

1. **Exterior.** Aluminum materials and finishes to endure high salt conditions prevalent in fog and wind at University.

   - **Details:** Detail louvers and vents to eliminate ledges or overhangs where birds could roost or nest.
   - **Air Intake Louvers:** Side-draining type and certified by manufacturer, with zero water carryover.
   - **Bird Screens for Louvers:** Stainless steel and mounted so readily removable.
   - **Materials:** Stainless steel, copper, heavy anodized aluminum, or factory-baked enamel paint finished aluminum.
   - **Mounting Hardware:** Stainless steel.

2. **Aluminum Finishes.** Refer to Section 05700.

10240 GRILLES AND SCREENS

GENERAL

1. **Exterior.** Use stainless steel or aluminum, conforming to requirements of louvers and vents.

10260 WALL AND CORNER GUARDS

GENERAL

1. **Wall Guards.** Consult with Project Manager as to need for chair rails, wall bumper guards, wall corner guards, and protective wall covering to protect wall finish from damage by furniture and rolling carts. Protect all corridor wall corners with 16-gauge minimum stainless steel with stainless steel screws.
10400 SIGNS AND GRAPHICS

GENERAL

1. **Standards Manual.** The UCSF “Signage Standard Manual and Ordering Catalog,” is a part of these Guidelines. The current version is available from Project Manager. UCSF furnishes and installs all signs and room numbers. Verify sign requirements with Project Manager, and provide space and backing in partitions as needed. UCSF will review all sign installations for form, color, and location.

2. **Emergency Evacuation Route Diagrams.** Provide on all new projects. Review text, method of mounting, and location with Project Manager and State Fire Marshal.

10755 TELEPHONE ENCLOSURES

GENERAL

1. **UCSF-Furnished.** UCSF furnishes telephone enclosures. Include backing in stud partitions for support of telephone enclosures. Review type of enclosure with Project Manager.

10815 TOILET ROOM ACCESSORIES

GENERAL

1. **Location.** Provide indications on Drawings for adequate backing in stud partitions for toilet room accessories.

2. **Types.** Review types with Project Manager:

   **Paper Towel Dispensers:** Surface-mounted, to dispense single-fold towels.

   **Toilet Paper Holders:** Surface-mounted, to dispense two rolls of standard toilet tissue, utilizing theft-proof roller.

   **Seat Cover Dispensers:** Surface-mounted or recessed.

   **Soap Dispensers:** Wall-mounted or lavatory-mounted, to dispense liquid soap. Do not use soap dispensers that utilize soap-holding tank under countertop or lavatory. Plastic wall-mounted dispensers are available through soap supplier.

   **Mirror Frames:** Stainless steel, with integral shelf for public toilets. Review types with Project Manager.

   **Grab Bars:** Stainless steel or polished chrome finish.
DIVISION 11 — EQUIPMENT

11600  LABORATORY EQUIPMENT

GENERAL

1. Fume Hoods.

   Manufacturer: May be manufactured by a laboratory equipment firm or may be shop-fabricated. Consult Project Manager to assure the hood design is appropriate for the intended service and code requirements.

   Design Requirements: Face opening length: Normally on even feet, with 4 ft. minimum, but can be any length.

   Utility Services:

   • Required on either or both ends. Where utility chase is on hood and against wall (avoid this, if possible), use internal access plate.
   • Where water is used, furnish cup sink. Show whether service is from above or below.
   • Determine if a removable end panel is required (solely for appearance) on either or both ends. Determine if front access panel is required for light fixture access (impaired overhead clearance).
   • Equip cold water service with an approved vacuum-breaker located outside the hood air stream.

   Hood Material: Stainless steel or painted steel exterior surfaces. Review with Project Manager.

   Base Cabinet: Verify whether base cabinet must be listed by the State Fire Marshal and must be accessible to disabled.

   Removal or Dismantling of Existing Hoods: As recommended by Industrial Hygiene Section of EH&S:

   • Project Manager and EH&S will determine history of use of the specific fume hood.
   • Users and EH&S will perform decontamination before hood is relocated or put into storage.

   Special-Purpose Hoods: Hoods for Perchloric acid, laminar flow, biosafety, radioactivity, chemical carcinogen, etc., may require special consideration (e.g., filtering, air incineration, placement). Review in Design Development Phase with Project Manager.


2. Emergency Eyewash and Safety Shower Equipment.


3. Flammable Liquid Storage Cabinets.

   Design Guide for Flammable Liquid Storage Cabinets: The EH&S Design Guide, Flammable Liquid Storage Cabinets, is a part of these Facilities Guidelines. The current version is available from
4. Autoclaves and Sterilizers.

General: In buildings with central steam system, use steam-driven autoclaves and sterilizers. Normally, autoclaves and sterilizers require 50 to 80 psig steam service, depending on the manufacturer. Design steam supply feed in accordance with existing building distribution layouts to the room containing the equipment, with a drip trap installed in the ceiling of the space below.

Ethylene Oxide Sterilizers: Only diluted ethylene oxide (12% by volume) is used at UCSF, and it is treated as nonflammable gas. However, ethylene oxide is classified as a hazardous material. EH&S will review and approve all installations and designs during Design Development Phase.
DIVISION 12 — FURNISHINGS

12500  WINDOW TREATMENT

GENERAL

1. **Coordination.** Verify need for any window treatment and coordinate with Project Manager. Provide adequate backing for draperies, blinds, etc.

2. **Sun-Control Film.** If sun-control film is used, obtain approval of type from Project Manager. Many buildings are in use at night, and some sun-control films have an interior “mirror effect” that is unacceptable. Also, consider adverse effects the film may have on existing neighborhood buildings from reflection of sunlight.

3. **Fire Safety.** All window treatment must comply with Section 01520, Fire Safety.

12620  FURNITURE

GENERAL

1. **Who Furnishes.** UCSF usually furnishes all furniture. Review furniture requirements with Project Manager.

2. **Flammability.** Furniture must comply with Department of Consumer Affairs’ “Technical Bulletin No. 133: Flammability Test Procedure” when used in the following locations:
   - Rooms or spaces that patients (both inpatients and outpatients) may enter for any reason related to their treatment.
   - Auditoriums, lecture halls, lounges, and other assembly rooms.
   - Dormitories.
   - Lobbies and foyers, with specific approval from State Fire Marshal.

12690  FLOOR MATS

GENERAL

1. **Exterior Entrances.** Use floor mats at all exterior entrances.
DIVISION 13 — SPECIAL CONSTRUCTION

13031 COLD ROOMS

GENERAL AND PRODUCTS

1. Normal Construction. Normally specify cold rooms as units constructed of polyurethane foam-insulated modular panels, with a cam locking system that secures panel edges against gaskets for a vapor-proof assembly. Require UL label on all cold rooms or cold boxes.

2. Panel Skins.

   **Material:** Panel skin material commonly used includes galvanized steel, embossed or otherwise patterned aluminum, and Type 302 or 304 stainless steel (usually No. 2B finish).

   **Stainless Steel:** Where stainless steel is required on interior surfaces, consider using aluminum or galvanized steel for exterior panels. Where stainless steel is required for exterior panels, consider using aluminum or galvanized steel for those panels not exposed to view.

3. Doors.

   **Viewports:** Use doors with viewports with multiple glazing as required to prevent condensation. Review viewport requirements with Project Manager.

   **Locks:** Provide safety release lock on interior of box. Consider use of foot-operated door opener with alarm.

4. Floors. Ramp to door may be required due to thickness of insulating floor panels. Nonskid surface is desirable as floors are generally slippery.

5. Temperature. Rooms are used mainly as low-temperature work and storage space, with temperatures held between 2°C and 5°C, and with no need for special humidity control.

6. Frozen Storage Space. Frozen storage space at -20°C is sometimes requested; however, point out to Users (through Project Manager) during Schematic Design Phase that:
   - Such space can generally be provided more economically through use of commercial type reach-in units.
   - The cubic footage required is more efficiently achieved with reach-in units, since no space is wasted by doors and aisles.
   - Use of several reach-in units in place of a single walk-in cold box provides redundancy. Loss of refrigeration to a unit, or shutdown for maintenance, is less serious.

7. Alarms. Provide local visible and audible alarms, or audible alarms indicating departure from temperature set point. Supervisory transmitters to signal Power Plant are no longer available. (Upon completion of the new Central Fire Alarm System, supervisory signals will again be possible.) Require manufacturer's documentation for alarm systems.

8. Moisture. To prevent entry of vapor pressure-driven moisture into insulated panels, make penetrations of cold room panels for piping or conduits only through a nonmetallic sleeve with an exterior flange embedded in sealant and held in place by a flange located on the box interior wall.
9. Exterior Skin Penetrations. Take the following precautions:

- Do not penetrate the exterior skin of cold rooms. Pay particular attention to screws securing such things as conduits, water or refrigeration lines, thermometers, etc.
- Where such penetrations are thought to be necessary, specific approval of the University Representative is required. Give such approval only where necessity exists, and then only with effective sealing at points of penetration.
- To minimize penetration problems, specify or detail methods of supporting such items as conduits, piping, and controls on exterior skin.
- Design evaporative coil support through cold room roof, with proper vapor seal at exterior skin penetration. For attachments, use Type 316 stainless steel bolts and vibration-proof nuts installed with nylon shoulder washers to inhibit electrolytic corrosion. All-nylon bolts are brittle at low temperatures, and could shear during earthquake stresses.

10. Condensing Units.

   Equipment:

   - Use building chilled water if available, or use remote DX unit.
   - Do not use once-through water-cooled equipment.
   - Protect domestic water systems with approved, reduced, pressure type back-flow preventers. Use UL-listed condensing units.
   - Use condensing units with semi-hermetic compressors.

   Location: Avoid locating condensing units on cold room or cold box roofs. Locate at floor level with sufficient access space provided around them for easy servicing. Show access space on the Drawings. Carefully review any ceiling-mounted units for ease of maintenance.


   Equipment and Location:

   - Provide refrigeration system with a continuously running evaporator fan and a liquid line solenoid valve controlled by a room thermostat. Use UL-listed refrigeration system.
   - Control compressor cycling by a low-pressure control to provide a pump-down cycle. Require a manual reset for the high-pressure control.
   - Specify remote bulb units for room thermostat and any alarm thermostats. Show locations of thermostats on the Drawings.
   - Mount thermostats and liquid line solenoid valve outside the room.
   - Consider head clearance under evaporative fan coil unit. Consider excessive air movement from fan, evaporator corrosion, and thermal gradients in large rooms.

12. Piping.

   Refrigeration Piping: Type L copper ACR tubing with wrought copper, silver-soldered fittings. Charge with 5 psig nitrogen during all soldering operations to reduce slag and flux contamination of the interior of the tubing.

   Sinks Located in Cold Rooms:

   - Allow no lines inside room to remain filled with water.
   - Locate water shutoff valves below ceiling for normal maintenance of faucets.
Part 2  Design Guide

- Include a typical wall penetration detail on Drawings.
- Design line downstream of the valve to enter room below counter level and then grade up to a gooseneck serving the sink. Immediately outside the wall, use a tee with a 1/8 in. copper drain line with drain cock. Extend line to a funnel or cupsink drain so when valve is shut, piping inside the room will drain completely.
- Use fused joint, fire-retardant polypropylene sink drains for acid waste sinks. Use Schedule 40 PVC with solvent-welded fittings for nonacid waste sinks.
- Use standpipe for discharge of condenser water or evaporator condensate. Run lines separately to drain and P-trap outside of cold room or cold box. Evaporator condensate lines have tendency to clog; therefore, avoid horizontal runs to drain.
- Rooms without a sink: Run evaporator drain line directly as possible to outside the room, and provide trap at this point. To avoid condensation on evaporator drain line outside room, use Schedule 40 PVC piping with solvent-welded fittings.
- Air and vacuum piping: Enter room at the outlets, with no extended piping inside. Use no natural gas outlets. Verify possible use of airfuge in cold room; preplan accordingly.
- All sink gooseneck faucets: Except for distilled or deionized water faucets, provide with an approved vacuum-breaker on the faucet.


PENETRATIONS: To minimize penetrations, design electrical circuits to enter room via a minimum number of conduits, preferably one.

CONDUIT: Use PVC for conduit through wall or roof and for all conduit and boxes inside room.

SEAL-OFF FITTING: Place immediately outside the room, and drill a 1/8 in. diameter hole in the bottom of all boxes located in the room.

14. Ground Fault Protection. Receptacle outlets: Provide one feed-through ground fault circuit interrupter receptacle in each circuit, protecting the other receptacles on its load side.

15. Lighting. For lighting provide:

- A maintained level of 70 foot-candles at counter height.
- An emergency light inside the cold room.
- Fluorescent fixtures enclosed and gasketed, ABS plastic, acrylic lenses, low-temperature ballasts, and cool-white rapid-start lamps secured with nylon bolts through ceiling, effectively sealed at warm side.
- A vapor-tight light switch, under rubber membrane, located inside room. Delete the vapor-tight incandescent fixture normally supplied with the room.

16. Casework. Wood tends to rot, common wood finishes do not do well, plastic laminate tops delaminate, and “Chemsurf” cracks. Use stainless steel or epoxy-coated wire construction shelving units, anchored to wall panels for stability. Epoxy or stainless steel tops are suitable for workbenches.

17. Seismic Support. Consider need for backing within panels for seismic support.
13032  WARM ROOMS

GENERAL AND PRODUCTS

1. **Normal Construction.** Normally specify warm rooms as units constructed of polyurethane foam-insulated modular panels, metal surface panels, with a cam locking system that secures panel edges against gaskets. Require UL label on all warm rooms.

2. **Panel Skins.**

   **Material:** Panel skins commonly used include galvanized steel, factory-painted steel, embossed or otherwise patterned aluminum, and Type 302 or 304 stainless steel (usually No. 2B finish.)

   **Stainless Steel:** Where stainless steel is required for interior surfaces, consider using aluminum or galvanized steel for exterior panels. Where stainless steel is required for exterior panels, consider using aluminum or galvanized steel for those panels not exposed to view.

3. **Doors.**

   **Viewports:** Use double-glazed viewports. Review requirements with Project Manager.

   **Locks:** Provide safety release lock on interior of box. Consider use of foot-operated door opener with alarm.

4. **Floors.** Floor panels are not required, eliminating need for ramp to door. Consider insulation of ceiling space below floor to eliminate floor sweating.

5. **Temperature.**

   **Common:** Rooms are used as work space and storage incubators. Temperature is most commonly held at 37°C, without need for humidity control.

   **Fan:** Use a recirculating fan to maintain uniform temperature throughout room.

   **Exhaust:** Some manufacturers’ control systems utilize continuous exhaust with makeup air taken from surrounding space. If so, achieve energy conservation by limiting exhaust under thermostatic control to exhaust necessary to control excess temperature. This limiting will also reduce overheating of the space in which warm room is located. Design for three control steps upon temperature rise: first, deactivation of heaters at set point; then, exhaust fan operation slightly above set point; and finally, alarm operation should the temperature increase continue. Specify manufacturer’s documentation for controls system, including wiring diagrams, parts lists, etc.

   **Excess Temperature:** Because of possible loss of stored cultures, excessive temperature is generally a critical consideration. Since rooms are of insulated construction, such excesses can be caused by relatively small heat inputs such as circulating fan, lights, occupants, and small equipments, even though room heaters may have been de-energized by room thermostat. For this reason, the room control system must be capable of introducing outside air automatically upon sensing temperature above the set point.

6. **Walk-In Storage.** If walk-in rooms are requested purely for storage purposes, explore the possibility of using multiple reach-in units since they can provide the required cubic footage without loss of space for walk-in aisles and doors. The redundancy provided by several units may also offer advantages.
7. **Alarms.** Provide local visible or audible alarms indicating departure from temperature set point. Determine types of alarms required with Project Manager during Design Development.

8. **Recirculating System.**

   *Use:* For rooms used for incubation of cultures in uncovered petri dishes, specify a recirculating system which minimizes airflow to avoid excessive drying of media in the dishes.

   *Consider Air Volume Requirements:* Certain rooms are designed with ducts taking air from the fan-coil unit at ceiling down to discharge opening near floor, thus requiring lower air quantities than other rooms which have both intake and discharge openings at the ceiling-mounted fan-coil units.

9. **Ground Fault.**

   *Use:* Piping mechanical or electrical services into warm rooms poses no particular problems. Do not provide gas outlets except where some specific requirement is programmed by User.

   *Receptacles:* To provide ground fault protection for receptacle outlets, provide one feed-through ground fault circuit interrupter receptacle in each circuit, protecting the other receptacles on its load side.

10. **Lighting.**

    *Level:* Provide to maintain a level of 70 foot-candles at counter height.

    *Fixtures:* Enclose and gasket with acrylic lenses and cool-white rapid-start lamps.

    *Light Switch:* Locate inside room. Delete the vapor-tight incandescent fixture normally supplied with the room.
13033 DARKROOMS

GENERAL

1. **Ceilings.** Construct of plaster or gypsum board. To avoid light leakage problems, do not use lightweight suspended acoustical ceiling systems, unless ceiling plenum is light tight.

2. **Doors.** Consider use of stock manufactured revolving door units. This type of door ensures darkness but may present problems in providing an acceptable means of exiting the room and in meeting handicapped requirements. Consider a vestibule if revolving door does not meet requirements. Determine if another available existing darkroom meets access requirements, and verify if ORS reviewers will accept the use of this existing darkroom in lieu of designing new darkrooms to comply with access requirements.

3. **Ventilation.** Ventilate room to remove chemical odors.

4. **Processors.** Where darkroom functions to process x-ray films (e.g., autoradiographs), consider using through-wall automatic processors with in-feed only inside darkroom. Processor may be installed outside darkroom with allowances to service the unit because service and maintenance breakdowns are frequent with automatic processors. Keep heat load and odors from processor outside the darkroom.

5. **Plumbing.** Photographic developer and fixer not to be discharged into the sanitary sewer; these materials may be considered hazardous waste. Provide storage space for the collection of these waste chemicals and secondary containment for the storage of both replenishment and waste chemicals.
GENERAL

1. **EH&S Design Guides.** EH&S Design Guides are a part of these Facilities Guidelines. Current versions of the following Guides are available from Project Manager:

- *Requirements for Laboratories Containing Radioactive Materials.*
- *Biosafety Level 2 Laboratories.*
- *Building Code Requirements for Laboratories.*
- *Compressed Gas Cylinders.*
- *Ceiling Access Procedures.*
- *Fume Hoods.*
- *Emergency Eyewash and Safety Showers.*
- *Flammable Liquid Storage Cabinets.*

2. **Fume Hoods.**

   **Location:**
   - Do not locate fume hoods, biosafety cabinets, and similar equipment where face velocity will be adversely affected by personnel traffic in aisles in front of hood, nearby doors, operable windows, etc.
   - Since a hood is a likely location for a fire, a violent chemical reaction, or a chemical spill, locate hood so an incident or an emergency at the hood does not impair rapid exit of room occupants.
   - Locate room air supply diffusers and air-conditioners so airflow across hood sash is not disturbed.

   **Air Change:** Design a sufficient size room in which a fume hood is located so the air change rate required for proper fume hood operation falls within a reasonable range as set forth in EH&S Design Guide, Fume Hoods. See Section 11600, Laboratory Equipment.

   **Air Pressure:** Design laboratories to have negative air pressure relative to adjacent spaces.

3. **Lighting.**

   **Shelving:**
   - Review task lighting levels that may be reduced by overhanging wall cabinets or shelving. Consider use of additional lighting fixtures mounted under cabinets or shelving to provide proper lighting at work level.
   - Provide an air gap between lighting fixtures and shelving where fixtures are mounted on the underside of shelving in order to prevent heat from fixture ballast from affecting reagents.

   **Darkening Controls:** Some laboratories require darkening or darkening control. Review requirements with Project Manager.

4. **Compressed Gas Cylinders.**

   **Restraints:**
   - Provide high and low restraints of chains, metal straps, or other approved materials securely attached to building structure to secure gas cylinders used in laboratories.
• If a gas cylinder storage room is required, provide a properly designed metal rack system with chains and snap hooks to separate gas cylinders and provide anchorage.

**Design Guide:** Refer to EH&S Design Guide, *Compressed Gas Cylinders*.

5. **Chemical and Flammable Storage.** Coordinate chemical and flammable storage cabinets with Project Manager. Refer to Section 11600 for additional information regarding flammable liquid storage cabinets.

6. **Exhaust.**

   **Location:** Locate stainless steel canopies above autoclave and sterilizer doors to capture vented steam, reduce heat load into occupied space, and prevent staining and deterioration of room finishes.

   **Requirements:** Verify need for the following local exhaust ventilation requirements with Project Manager:
   - Heat.
   - Steam.
   - Toxic vapors.
   - Fumes.
   - Combustion products.
   - Dusts.
   - Odors.

   **Ventilation:** Verify requirements for the following special exhaust ventilation with Project Manager:
   - Slot back.
   - Down draft.
   - Paint spray.
   - Welding/soldering.
   - Grinding.
   - Buffing.

7. **Refrigeration.**

   **Flammable Storage:** Regulations require special design for refrigerators and freezers utilized for storage of flammable liquids. Label refrigerators and freezers not utilized for storage of flammable liquids, “FOR NONFLAMMABLE USE ONLY.”

   **Support:**
   - Equip refrigerators and freezers with lockable wheels to facilitate moving equipment for service.
   - Anchor all refrigerators or freezers over 5 ft. tall to building structure with demountable assembly.
   - Design anchoring assembly of all hospital installations for OSHPD approval. Design to meet UBC Seismic requirements for all other installations.
   - A California-registered engineer shall prepare calculations demonstrating compliance. Submit calculations to Project Manager for review.

8. **Valves and Circuit Breakers.** Clearly label all accessible valves and circuit breakers for laboratory utilities.
13080 NOISE ABATEMENT

GENERAL

1. Purpose and Scope

The mechanical units located on the rooftops of the many buildings at the UCSF Parnassus Campus produce a volume of noise that is of concern to nearby residents as well as UCSF. The goal is to keep the noise observed at the property lines low enough to meet the city noise ordinance. This goal will be met as long as:
- mitigation and retrofitting succeeds in meeting the noise ordinance at all points on the property line at some point in time, and
- thereafter, any new or replacement mechanical units are not allowed to produce any increase in the existing noise levels at the property lines.

2. Assumed Noise Budget

A noise budget has been developed that allocates noise levels to groups of mechanical units identified by building was developed. The budget, which is based on sound levels measured along the east property line, is contained in the following table. If each group of mechanical units generates no more A-weighted sound power than shown in the table, the level at the east property line will not exceed the city noise limits.

<table>
<thead>
<tr>
<th>Building Rooftop Group</th>
<th>Power Level from Entire Group (dB re 1pW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Plant</td>
<td>94</td>
</tr>
<tr>
<td>Health Sciences - East</td>
<td>97</td>
</tr>
<tr>
<td>Long Hospital</td>
<td>92</td>
</tr>
<tr>
<td>Medical Sciences 2</td>
<td>94</td>
</tr>
<tr>
<td>Langley-Porter Psychiatric Institute</td>
<td>86</td>
</tr>
<tr>
<td>Moffitt Hospital</td>
<td>90</td>
</tr>
<tr>
<td>Medical Research 1 and 2</td>
<td>87</td>
</tr>
<tr>
<td>Health Sciences - West</td>
<td>91</td>
</tr>
<tr>
<td>Surge</td>
<td>79</td>
</tr>
<tr>
<td>Medical Sciences 1</td>
<td>91</td>
</tr>
<tr>
<td>All the rest</td>
<td>91</td>
</tr>
</tbody>
</table>
3. Noise Sources in Mechanical Units

In order to understand the guidelines for avoiding or reducing noise from mechanical units, it is helpful to understand some of the mechanisms involved. The following paragraphs examine some of the sources of noise in mechanical units and their relevant characteristics.

**Total Air Flow**

- proportional to the total airflow - every doubling of total airflow increases sound levels. For mechanical units that principally move air (or gases), the sound level produced is by 3 dB. As a consequence, large air handling units generally produce more noise than smaller ones.

**Efficiency of Flow**

- Noise is the one of the larger by-products of inefficiency. In a mechanical unit, this means that steps taken to reduce blockage to flow will simultaneously reduce noise levels at the source. The first step in assessing the cause of excess mechanical system noise is to discover sources of needless flow restriction.

**Operating Point**

- A related point to flow efficiency is operating point. Once the path of airflow has been optimized to the greatest extent possible, the remaining flow conditions (air volume, static pressure, flow velocity, moisture content, filters and coils, etc.) become factors in selecting the proper fan. Different fans will have varying efficiencies in moving air under a given set of conditions.
- A fan's total noise levels can vary 20 dB moving the same air volume but at different operating points on its system curve.
- A large fan operating at an optimum point on its system operating curve actually can produce lower noise levels than a small one moving the same air volume but operating at other than an optimum point on its system curve.
- VAV systems having inlet vanes are particularly notorious for modulating between operating points that are favorable and ones wherein the fan is cavitating, producing sound levels up to 20 dB above those otherwise generated.

**Type of Blade and Fan**

- Variations are also due to the type of fan blade used - for many conditions, an airfoil blade is more efficient, and hence quieter performing a given task, than an equivalent centrifugal fan.
- Centrifugals, in turn are more efficient and quieter than simple propeller fan blades. Centrifugals also tend to be more forgiving of small errors in matching the optimum operating point than are airfoils.

**Spectral Sound Level Influences**

Each type of mechanical unit has a characteristic spectrum. The following enumerates general characteristics.

- Fans have a characteristic noise spectrum that is dominated by the blade passage frequency - the rate at which the fan shaft spins multiplied by the number of fan blades - typically this value is between 160 and 250 Hz. In a centrifugal or airfoil fan the sound at this frequency is 5 to 10 dB louder than at frequencies above and below this point. The noise from propeller fan blades can be entirely composed of blade passage frequency noise. This results in the characteristic
• Drone found in propeller aircraft.

• Cooling Towers are essentially very large propeller or centrifugal fans combined with water curtains. The resulting spectrum is dominated by the type of fan used (subject to all of the issues noted above) and the high frequency sound generated by the passage of water.

• Pumps are simple fan-type structures that drone at the characteristic blade passage frequency of the impeller. Because the pumps, unlike fans, are housed (that is the impeller does not directly communicate with the open air, the sound heard at a distance is influenced by the mass and construction of the pump housing. Pump noise is influenced by the same operating point considerations that affect fan noise. Pumps often operate a 1,600 - 2,000 rpm, with 12 to 20 impeller blades. The resulting sound level is typically dominated by tones in the 350 to 500 Hz range.

• Chillers have a sound level that is dominated by the noise of the internal compressor(s) and mass and air-tightness of the surrounding enclosure. Intensive high frequency output is typically associated with chiller operation.

Orientation of Unit Elements

Fans in particular have a noise output that can be strongly influenced by how the air exits the fan assembly.

• Fume Hoods. The most common of the fan types found on UCSF rooftops are the fume hood exhaust fans located above much of the lab area. The fans themselves are of simple centrifugal (squirrel-cage) type. To ensure personnel safety, the discharge of each fan typically consists of a section of circular or rectangular sheet-metal duct, causing the discharge to emanate from a nominal height of 10 above the roof deck, typically at a height above the surrounding rooftop parapet.

• The sound of an elevated discharge from a vertical pipe follows certain simple physical laws. High frequency sound will generally continue straight upward, with the sound off to the sides typically lower than the sound directly above by 8-15 dB, depending on the frequency and the diameter of the pipe (duct). At low frequencies, the radiation is more nearly uniform in all directions. The behavior of sound at frequencies in between follows a smooth transition between these states.

• In the context of the community to the east of the south campus, several specific aspects of the orientation and geometry are important. The fans are generally located above the residences, which therefore do not have line-of-sight. The sound reaching the residences from most of the fume hoods on most of the buildings is thus attenuated by both building parapets and by the natural directionality of sound exiting a pipe, as noted above. The result for the residences is that most of the fume hood fan sound they observe contains energy at low frequencies only.

4. Adding New or Replacement Mechanical Units

Rules of Thumb

When a new or replacement unit is to be installed, it is worth considering a few rules of thumb that can minimize its noise impact.

• For those rooftops that are above the east property line, it is advantageous to locate the unit well away from the edge of the roof. This allows the roof itself to provide shadowing. However, if this is done, the unit must be properly vibration isolated to avoid exciting the structure. Failure to do so may allow high noise levels to be produced in the interior of the building.

• Locating a unit adjacent to a large, planar, reflecting surface (e.g., concrete) should be avoided if possible. When a unit is located just east of and centered on such a surface in the north-south plane, its sound radiation away from the wall in the easterly direction is approximately
doubled (a 3 dB increase).

- Since most of the noise is usually radiated from the exhaust openings, whenever possible, care should be taken to orient these so that they are not facing the east (nearest) property line. It is also desirable to make sure that there is at least three duct diameters of straight duct preceding the opening. Elbows or other sudden changes in flow in this region generate noise themselves.
- Given a choice between two units that perform the same function but using different fan speeds, choose the lower speed unit to minimize the noise (other things being equal).
- If the load on a unit varies from day to nighttime, it is desirable for it to have a variable speed fan with automatic control that keeps it running only as fast as necessary.

Replacing a Mechanical Unit

- Clearly, if a replacement unit is no louder than the unit it replaces, the level at the property line will not be appreciably increased. That is an acceptable criterion to use in choosing a replacement. However, it may require some difficult measurements (by experts) on the unit to be replaced to determine exactly what its far-field radiated power is.
- It may be easier to simply require that the replacing unit meet the power level limits of Table 2. This is a conservative choice.
- Even this approach may be unreliable if the manufacturer’s noise data is used. In addition to being applicable to only the most optimistic case, the data may be old and outdated, applicable to a different configuration, and/or taken under different operating conditions.
- The purchaser should insist on an acceptance test that requires a realistic mockup of the exact unit in question operating under the anticipated conditions.

Adding a New Mechanical Unit

- Because each group of mechanical units contributes different amounts of sound power to the level measured at the property line, the amount that each group level can change without having an appreciable effect is also different (but straightforward to calculate). These maximum allowable group level changes can then be used to calculate the number of dB below the group level that an additional unit must be to produce that non-appreciable effect on the group level.
- When these are subtracted from the budgeted group power levels, we obtain the maximum allowable power level that a new mechanical unit can have so that it will not produce an appreciable increase at the property line. These values are given in Table 2.
Table 2. Additional Unit Allowable A-Weighted Power Levels

<table>
<thead>
<tr>
<th>Location</th>
<th>Maximum Allowable Power Level of New Unit (dB re 1 pW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Plant</td>
<td>82</td>
</tr>
<tr>
<td>Health Sciences - East</td>
<td>86</td>
</tr>
<tr>
<td>Long Hospital</td>
<td>86</td>
</tr>
<tr>
<td>Medical Sciences 2</td>
<td>89</td>
</tr>
<tr>
<td>Langley-Porter Psychiatric Institute</td>
<td>81</td>
</tr>
<tr>
<td>Moffitt Hospital</td>
<td>87</td>
</tr>
<tr>
<td>Medical Research 1 and 2</td>
<td>86</td>
</tr>
<tr>
<td>Health Sciences - West</td>
<td>89</td>
</tr>
<tr>
<td>Surge</td>
<td>77</td>
</tr>
<tr>
<td>Medical Sciences 1</td>
<td>90</td>
</tr>
<tr>
<td>All the rest</td>
<td>90</td>
</tr>
</tbody>
</table>

- For example, suppose a new unit is to be installed on Medical Sciences 2. Table 2 indicates that its A-weighted power level should be no more than 89 dB re 1 pW in order to keep the level increase at the property line less than 0.1 dBA.

**Derating for Directivity**

- The above power level guidelines are all based on the assumption that the sound power is radiated away from each source approximately equally in all directions. If non-uniform directivity information for a unit to be added is available, it may be used to modify the above requirements.
- For example, consider a unit to be at the center of a compass. If its sound radiation were uniform, it would radiate 25% of its sound power into each quadrant, N to E, E to S, etc. However, suppose the sound power it actually radiates into one quadrant (call it Q) is only 10% of the total sound power it radiates. The average power level in the direction corresponding to quadrant Q is then \(10 \log_{10} (25/10) \approx 4\) dB below the level that would be expected from a uniformly radiating source. If it is known that this unit will be installed with quadrant Q centered on the middle of the east property line, then the maximum power level it must meet in Table 2 may be increased by 4 dB. In other words, it is the sound power radiated in the direction of the east boundary that is of concern.
• Conversely, if it is known that the radiation of a unit in the direction of the east boundary is N dB above the level of its spatially averaged radiation level, then N dB must be subtracted from the levels in Table 2 to determine the allowable power level for that mechanical unit.

Derating for Multiple Additions

The following modifications to the Table 2 guidelines must be made if multiple units are to be added:
• Identical Mechanical Units - If M identical units are to be added to a group, then each of their maximum allowed power levels is given by the appropriate level in Table 2 decreased by 10 Log_{10} (M).
• Non-identical Mechanical Units - If M different units are to be added to a group, their total sound power in the direction of the east boundary must not exceed the levels in Table 2. This can be written mathematically as:

\[
10 \log_{10} \left[ 10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + 10^{\frac{L_3}{10}} + ... + 10^{\frac{L_M}{10}} \right] \# \text{Table 2 Value}
\]

where: \( L_1, ..., L_M \) are the A-weighted power levels of the M mechanical units.
13090  RADIATION AND RADIO FREQUENCY SHIELDING

GENERAL

1. Radiation Shielding. Include all radiation shielding in the Construction Documents. Review requirements with Project Manager. Shielding requirements do not apply to personal or portable devices.

2. Radio Frequency Shielding. When designing:

- Verify need for radio frequency shielding with Project Manager and User.
- Avoid installing shielding into partitions due to possible damage to shielding by mounting equipment, etc., on walls.
- Consider that stock-manufactured shielded rooms that stand free of building walls, constructed of either metal sheet or screen, have proven more reliable and effective than shielding walls.
- For shielded enclosures, specifically review the need for special high-quality grounds with Project Manager, because grounding to nearby electrical conduits or water piping is frequently inadequate.
13185 ANIMAL FACILITY AREAS

GENERAL

13280  ASBESTOS ABATEMENT

GENERAL

1. Known Conditions. Consult with Project Manager to identify known locations of asbestos. Project Manager will verify locations with UCSF Office of Environmental Health and Safety (EH&S). Removal of asbestos within a given project area will usually be handled as a separate construction project administered by Project Manager. If Project Manager decides to have asbestos removal performed by a subcontractor, use the standard asbestos abatement Section described below.

2. Unknown Conditions. Section 01565, Hazardous Materials Procedures, requires Contractor to immediately stop work in areas reasonably believed to contain asbestos and to notify Project Manager and Design Professional in writing. If asbestos is discovered, Project Manager will usually have asbestos removed under a separate contract. If Project Manager decides to have asbestos removal performed by subcontractor, add the standard asbestos abatement Section to the Contract by Change Order.

3. Other Hazardous Materials. The standard asbestos abatement Section may be extended to cover other hazardous building materials such as PCBs, contaminated hood exhaust ductwork, etc.

4. Standard Asbestos Abatement Specifications Section. UCSF has developed a standard asbestos abatement Specifications section, Section 13280, Asbestos Abatement. This Section is part of these Guidelines, and the current version is available from Project Manager.
13850 FIRE ALARM SYSTEMS

GENERAL

1. Existing Systems.

   **Matching:** For remodeling and for new facilities, the fire alarm system must match existing system and be made by the same manufacturer as the existing system. No substitutions allowed.

   **Parnassus Campus:** The existing fire alarm system on the Parnassus Campus is an Edwards Systems Technology (IRC3 System) using Signature Series devices. This system is an addressable multiplex type.

   **Connections:** UCSF technicians will perform existing fire alarm system disconnection and final connections for new work.

2. Design Requirements.

   **Type:** Addressable multiplex type with Class A (Style D) wiring, including initiating devices and audio/visual signaling devices. Include all hardware and software necessary to field-program/modify all functions, including input and output operations, and additions and deletions of points. Place all wiring in conduit.

   **Drawings:**

   - Show system on a separate set of floor plans unless permitted otherwise by UCSF. Plans shall include a fire alarm riser/schematic diagram that shows devices being installed. Floor plans shall indicate devices and equipment, and the zoning arrangement. Make zoning arrangement consistent with the existing systems. Use UCSF symbols for fire alarm devices.
   - Include requirement for contractor to submit shop drawings to State Fire Marshal, and in I Occupancy, to OSHPD Fire Marshal. UCSF must review and approve shop drawings before work can begin.

   **Identification:** Provide an engraved nameplate on each fire alarm device indicating the zone number. Identify conductors with numbers at all connections and at terminal strips. Provide a sequence of operation for the fire alarm system. Coordinate requirements for smoke control with Division 15.

   **Capacity:**

   - Include in the design 20% sufficient spare capacity on all addressable-device circuits and signaling circuits. Include power supplies adequate for this future load. Specify 20% expansion space in terminal cabinets.
   - For remodeling projects, verify the capacity of the existing system to support new devices or functions. Check available capacities and capability for expansion at the fire alarm control panel, terminal cabinets, risers, signal circuits, etc. Verify battery size and voltage drop for circuits. Submit this information on shop drawings to the Fire Marshal.

   **Smoke/Fire:**

   - Coordinate locations for smoke and fire separation. Make all necessary design provisions at openings through fire-rated partitions. Coordinate with Division 15 for smoke/fire damper requirements.
Part 2  Design Guide

• Smoke detectors: Edwards Signature—Series 4D type (ion/photo/heat), unless the environment in which they are located contains products of combustion under normal circumstances (e.g., generator rooms, garages). In those environments, provide photoelectric type smoke detectors. In areas close to door opening to outside, use Edwards Signature—Series 3D type (photo/heat).
• In atriums or similar areas where smoke detectors are required in hard-to-access large spaces, use “beam” type devices. Coordinate requirements with Division 15 for special atrium conditions. Provide access for maintenance and service to smoke detectors.
• Duct smoke detectors: Edwards Signature—Series 4D type with housings, furnished, powered, and wired under this Section and installed under Division 15. Determine locations and quantities in Division 15. Show duct smoke detectors on both the mechanical and electrical Drawings. Duct detectors above ceiling require remote LED with appropriate labels.
• In kitchen spaces and areas with a lot of moisture, use heat detectors.

Wiring:  Provide proper power and control wiring, including any required interface relays, for operation of smoke dampers. Indicate the division of work between this Section and Division 15. Atlas cable to match existing system, and marked to match existing nomenclature.

Panel:

• The fire alarm and control panel (FACP) shall provide power for all panel electronics, addressable device circuits, signal circuits, and all relays and auxiliary devices. The FACP shall power and control magnetic door holders.
• Provide the system power supply with an integral uninterruptible power source (UPS). This UPS shall provide continuous power to the system in the event of a commercial power failure. Require instantaneous transfer from commercial to standby power to insure proper processor operation.

Monitoring:

• Include monitoring of fire pumps, if applicable.
• Monitor, as a separate signal, fire suppression systems.

Elevators:  Coordinate elevator recall requirements with elevator design.
DIVISION 14 — CONVEYING SYSTEMS

14200 ELEVATORS

GENERAL

1. Types of Elevators.

**Electric Elevators:** Use equipment manufactured as an integrated system by a manufacturer regularly engaged in design and manufacture of electric elevators who also designs and manufactures the power unit, controller, and various electrical and mechanical safety systems. Exception: The door operator, fixtures, motor, motor generator, and controller relays may be provided by qualified manufacturers of these items.

**Hydraulic Elevators:** Use equipment manufactured as an integrated system by a manufacturer regularly engaged in design and manufacture of hydraulic elevators who also designs and manufactures the power unit, controller, and various electrical and mechanical safety systems. Exception: The door operator, fixtures, motor, pump, valves, and controller relays may be provided by qualified manufacturers of these items.

2. Permits and Inspections. Require Contractor to obtain and pay for all necessary municipal or state inspections and permits, and make tests as required by regulations of such authorities.

3. Requirements and Criteria.

**Elevator Information to be Specified:** Number and type, capacity and speed, travel, stops and openings, inside car and outside platform dimensions. Acceptable manufacturers: Otis Elevator Co., Dover Corp., or Mitsubishi Elevator Co.

**Operation:** Selective collective automatic control with independent service. Program requirements may dictate special operation.

**Control:** Solid state microprocessor type variable voltage with two-way leveling and releveling. Leveling accuracy +/-1/4 in.

**Power Supply:** 208 volts 3-phase or 480 volts 3-phase, 60 Hz.

**Lighting Supply:** 120 volts 1-phase, 60 Hz.

**Guide Rails:** 15 lb. per foot minimum for car and counterweight.

**Door Operator:** Heavy duty, high-speed master operators with direct current motor and selective operation.

**Car Enclosure:** 14-gauge sheet steel shell. Acceptable manufacturers: Tyler Company (Cleveland, Ohio), The Elevator Contractor, Globe Van Doorn Company, and Hauenstein and Burmeister Company.

**Entrances:** Stainless steel or baked enamel doors, color to be selected by University. If stainless steel, provide #302 or #304 with brushed finish. Acceptable manufacturers: Tyler Company (Cleveland, Ohio), The Elevator Contractor, Globe Van Doorn Company, and Hauenstein and Burmeister Company.
Door Protective Devices:

- Electronic scanning type door protection: Use T.L. Jones “Microscan” as standard of quality.
- Door travel: Maximum of 1-1/2 in. before reversing, if detector is interrupted.
- Car operating panel with tamper-resistant illuminated buttons.
- University-approved hands-free speaker telephone in cabinet with auto dialer, and service cabinet.
- Fire key panel, ground floor.
- One or two risers of hall buttons.
- Hall lanterns over doors.

Fire Service: Phase I or Phase II. Smoke detectors are not be installed by Elevator Contractor.

4. Miscellaneous Features. Provide the following miscellaneous features:

- Emergency stop switch in pit.
- Back contact on stop switch in car to ring alarm bell.
- Light and convenience outlet, top and bottom of car.
- Key-operated hoistway access device and top-of-car operating device. Mount key switches in door frames at top and bottom floors with ferrule exposed.
- 6 in. diameter, 110 volt, emergency alarm bell, located on car.
- Car top emergency exit opened from outside only, with contact. Cutout switch for contact in car station service cabinet.
- Emergency car lighting with short circuit protection.
- Quiet two-speed exhaust fan on sound-isolating mounting.
- Stainless steel pad hooks at ceiling and heavy quilted protection pad.

5. Electrical. Include the following electrical work:

- Feeders, including fused mainline disconnect switch.
- Conduit between machine room and hoistway.
- Outlets in hoistway and at controller for car lights and fan.
- Telephone circuit to studs on controller.
- Light and convenience outlets in pit, two convenience outlets in machine room on opposite sides of room, and lighting and light switches in machine room.

6. Noise Limits. 70 dBA measured in machine room, 55 dBA measured in elevator car during all sequences of operation, and 45 dBA measured in elevator lobby.

7. Keyed Switches. Required for fire department service, fan/blower service, independent service, and top inspection. Integrate all keys with Campus keying system.


Initial Maintenance and Warranty:

- Provide full maintenance service by skilled, competent employees for period of 12 months following date of Final Acceptance.
- Include monthly preventive maintenance, performed during normal working hours.
- Include repair/replacement of worn or defective parts or components and lubrication, cleaning and adjusting as required for proper elevator operation in conformance to specified requirements.
• Include 24-hours/day, 7-days/week emergency callback service.
• Exclude only repair/replacement due to misuse, abuse, accidents, or neglect caused by persons
  other than Contractor’s personnel.

  **Maintenance Training:** Provide:

• Instructions for UCSF personnel in proper use, maintenance, and operation of elevators.
• Operation and Maintenance manuals necessary for service, with detailed parts lists and suppliers of
  parts.
• Wiring diagrams including one set mounted under Plexiglas on machine room wall.
• Microcomputer diagnostic device/tools, maintenance tools, and software manuals:
  — When microprocessor-based control systems are used, provide maintenance tools and supporting
    software documentation as required for complete maintenance of entire system including
    diagnostics and adjusting.
  — Maintenance tools: Hand-held or built into control system not requiring recharging or
    reprogramming. Do not use the automatic destruct type.
  — Tool and supporting software may be programmed to operate only with the project’s identification
    serial numbering.
DIVISION 15 — MECHANICAL

15050 GENERAL MECHANICAL REQUIREMENTS

GENERAL DESIGN CRITERIA

1. Definitions. Following are mechanical terms with definitions commonly accepted by UCSF:

- Above grade: Not buried in ground, nor embedded in concrete slab on grade.
- Below grade: Buried in ground, or embedded in concrete slab on grade.
- Concealed: Inside building; above grade; located within walls, furred spaces, crawl spaces, attics, above suspended ceilings, etc.; not visible or directly accessible.
- Connect: Complete hookup of item with required services.
- Exposed: Either visible or subject to mechanical or weather damage, indoors or outdoors, including areas such as mechanical, electrical, equipment, or storage rooms; directly accessible without removing panels, walls, ceilings, or other parts of building.
- Finished spaces: Habitation or occupancy spaces where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- Indoor: Enclosed within building structure, including crawl spaces, roof overhangs, etc.
- Install: Place, secure, and connect as required to make fully operational.
- Outdoor: Outside of building structure, including roof, under eaves, along exterior walls, etc.
- Provide: Design (e.g., specify, draw, calculate) services required by Executive Design Professional Agreement.
- Show: Provide on drawings.
- Rough-in: Provide all indicated services and necessary arrangements suitable for making final connections to fixture or equipment.
- Unfinished spaces: Storage or work areas where appearance is not a factor; unexcavated spaces, crawl spaces, etc.

2. Existing Equipment.

Scope:

- Show existing mechanical equipment affected by project work.
- Indicate existing locations, schedule new and existing operating conditions, and specify who will disconnect, move, and reconnect to new locations.
- Clearly detail revisions or modifications required for the new locations.
- Specify rebalancing, increased motor horsepower or rpm for fans and pumps, etc., in the scope of work.

Patterns: Where existing services to a given floor follow a pattern (e.g., all service from mains below the floor), follow the same pattern for alteration projects.

3. Utilities Termination.

Coordination: Coordinate and review information regarding the preferred locations for incoming building utility services with Project Manager. Furnish in the form of a site plan with pertinent elevations noted. Do not start piping layouts until this information has been reviewed and accepted.

Integral: Do not cross over piping systems integral to any one building to another building without the express written consent of Project Manager.
4. Demolition.

   **Piping:**
   - Remove piping abandoned by project work, including hangers and supports, to within 6 in. of nearest live mainline or riser.
   - Pressure piping: Provide suitable ball type valve, and cap or plug.
   - Cap non-pressure piping.

   **Ducts:** Remove ductwork abandoned by project work, including duct straps, hangers, and supports, to an appropriate location near the live duct mains and risers, and cap. Make duct caps of the same material and gauge as the duct being capped.

5. Specifications.

   **Installation:** Do not specify installation of materials “in accordance with the manufacturer's recommendations” alone. Where a single type of material is acceptable and the method of specification is uniform for all manufacturers' products, specify the installation requirements explicitly and in detail, in addition to manufacturers' recommendations.

   **Divisions:** Indicate which Specifications section includes automatic controls, control wiring, motors, disconnect switches, motor starters, or electrical equipment related to Division 16. If furnishing or installation of electrical materials is included in Division 16, do not include in Division 15.

   **Contractor:** Do not delegate the responsibility for determining that the work will fit as designed to the Contractor.

   **Equipment:** In each Specifications section, provide a list of specific equipment requiring shop drawings and product data.

   **Phases:** Describe general, common, or collective requirements, work, and materials applicable to one or more phases of mechanical work.

6. Drawings.

   **Complete:** Make drawings sufficiently complete in detail for general mechanical installation so Contractor's installation drawings will only be required for special conditions or in cases where equipment rearrangement is required because of substitutions of materials. However, require manufacturer's detail drawings on special equipment as part of the submittal process.

   **Congested Areas:** For coordination, include sufficient detail of congested areas to show all mechanical work involved. Show details for each affected discipline.

   **Heat and Sound Isolation and Insulation:** Arrange and locate equipment rooms so that heat and sound will not be transmitted to other parts of the building.

   **Extent:** Provide separate drawings for plumbing and HVAC systems.

   **Pipe Size:** Show complete duct and pipe sizing, including sizes and locations of all transitions. Pinpoint changes in size either by symbols or by indication of sizes immediately adjacent to the point of change.

   **Ducts:** Show all ductwork “double line.”
Riser Diagrams:

- Furnish riser diagrams for plumbing and piping systems.
- To demonstrate that the existing plumbing and piping system will support the new project work, show existing risers up to the point of entry into the project area, including existing pipe sizes and locations, with the new project work clearly defined.
- Number risers on both the riser diagrams and plan drawings same as or in sequence with UCSF's master building drawings.

Scale: Draw all mechanical layouts to scale, 1/4 in. = 1’-0” minimum scale, regardless of the architectural background. Indicate all room names and numbers, including existing, on demolition plans.

Meters: Show location of all mechanical service and meter equipment.

Furnished Equipment: Indicate connections for University-furnished equipment on the Construction Drawings.

7. Preparation.

Interruptions of Service: Portions of the work may involve connections to existing work, facilities, or utilities and may require interruptive shutdowns of existing services. Include the following items in shutdown instructions to Contractor:

- Plan, coordinate, and execute work so required interruptions to services will be minimized.
- Submit requests for shutdowns to the University three weeks in advance.
- Allow only University personnel to make shutdowns.

Supports and Seismic Bracing: Provide anchorage and bracing support details, or specific references to trade standards such as SMACNA, with applicable portions clearly indicated.

PRODUCTS

1. General.

Corrosion Resistance: Fabricate materials located outdoors - or which will be exposed to the weather, moisture, or other potentially damaging conditions - of materials which resist the effects of salt-laden fog atmosphere.

- Exterior casings: Use lapped or gasketed joints effectively sealed to prevent intrusion of moisture or other injurious substances.
- Construct fans and air-handling unit casings and air-intake plenums of stainless steel.
- Bolts, nuts, screws, washers, and mounting hardware and devices: Stainless steel or hot-dipped galvanized steel; electroplated galvanized, painted, or plastic-coated steel products are not acceptable.

2. Pipe and Pipe Fittings.

Strainers:

- Place ahead of all regulators, automatic valves, or any equipment that could be damaged or rendered inoperative by foreign matter in the piping.
- Equip with plugged ball type drain valve.
Unions:

- Place at all equipment, regulators, controls, steam traps, and at all points where necessary for disassembly of piping or components. Make connections in piping 2 in. and smaller with threaded body unions; in piping larger than 2 in., with flanged type. All unions: Ground joint type.
- Make connections between copper piping or tubing and steel pipe with Schedule 40 brass nipple of at least six pipe diameters in length. No copper pipe or tubing shall be in direct contact with steel or other ferrous metals. Dielectric unions are not acceptable.

Changes in Pipe Line Sizes: Wherever changes in sizes of piping occur, use reducing fittings rather than bushings. Use eccentric reducing fittings on steam piping to provide free drainage of condensate, or wherever necessary, to provide air venting of lines.

3. Valves.

All Valves:

- Hand-controlled line shutoff valves: Full port, 3-piece type ball valves, or 2-piece ball valves with a union. Gate valves installed in horizontal lines: Specify with stems at or above the horizontal to allow lines to drain.
- Specify additional valves for isolating parts of service piping systems, equipment, and controls in order to facilitate servicing and maintenance. In general, provide separations of service to isolate floors, separate building wings, toilet rooms, machinery rooms, and other natural subdivisions of buildings.
- Show all valves on the Drawings. Do not rely on a general note like, “install valves where or as Required.”
- Fit all equipment with ball type shutoff valves with connecting unions or flanges between equipment and valve. Make all valves the same size as the pipes onto which they are installed.
- Install all valves in accessible locations.
- Exposed valves larger than 3 in. located more than 8 ft. above floor level: Equip with chains and chain operators extending to within 6'-0" of the floor.
- Do not use solder-end valves.
- Support line valves at the valve, in addition to regularly spaced pipe supports.
- Install a union downstream of each equipment isolation valve and at main floor valve.
- Avoid the usage of butterfly valves.

Relief Valves:

- Use relief valves wherever required by code, or to protect pressure vessels or equipment against dangerous pressure. Indicate the set pressure on the valve. Equip with externally operated lever lift handles.
- Provide a minimum capacity at steam pressure reducing stations so the relief valve will discharge the full capacity of the largest regulating valve without allowing the lower pressure to rise more than 6% above the highest pressure set for any valve. Relief valves are not required where a further reduction in pressure is made, unless steam is for laboratory use or where reducing valve failure would result in equipment damage. In such cases, follow the same requirement for the lower pressure. Provide capacity in other applications to match equipment rating or other pertinent design criteria.
- Discharge piping of steam relief valves: Extend to a minimum 7'-0" above the roof level. Do not allow discharge into any room or area within a building, or at any level below the roof, or where
Part 2  Design Guide

maintenance personnel may be injured.

- Extend discharge piping from water relief valves to an adequate drain.


**Components:**

- Provide with needle valve and pulsation damper.
- On steam lines: Provide with siphons.
- Gauges located outdoors, in air intake plenums, or in garages require stainless steel casing and glass face; plastic is not acceptable.

**Magnahelic:**

- Provide Magnahelic type draft gauges across air filter banks.
- Use stainless steel for sensor probes and tubing located in the air stream or located exposed outdoors.
- Draft gauges may be remotely located into occupied spaces as approved by Project Manager.

**Pressure Gauges:**

- Provide at all pressure-reducing valves to indicate both high and reduced pressures.
- Provide to measure the suction and discharge of all pumps.
- Require 3 in. minimum diameter face where gauge is 8 ft. or less above floor, and 4 in. face where located above 8 ft. Locate face so it may be easily read by observer from floor level where exposed, or from access door where concealed.

**Thermometers:**

- Provide at water heating and cooling equipment to indicate inlet and outlet water temperatures.
- Provide duct thermometers on HVAC systems to indicate outside, return, and supply air temperatures.
- Thermometers in mechanical spaces require 9 in. scale; in other locations, thermometers require 7 in. scale. Locate thermometers so scale may be easily read by observer from floor level.
- Use stainless steel for all thermometer wells and pressure gauge parts in contact with steam or steam condensate.

5. Sound and Vibration Isolation. Include details and materials to reduce objectionable noise and vibration:

- Exercise particular care in locating, supporting, and isolating vibration-producing equipment to attain the degree of isolation necessary for the particular location. Use 98% minimum vibration isolation efficiency for isolators on motorized equipment.
- Specify vibration isolators individually for each piece of equipment where required.
- Resiliently support piping connected to isolated equipment a sufficient distance from the equipment to reach full degree of specified vibration and sound isolation.
- Design acoustical duct liner or other special sound control devices on a case-by-case basis.
- If necessary, use perforated stainless steel sound traps in air intakes upstream of the first heating coil. Design exhaust ductwork to eliminate need for sound traps.
- Arrange and locate equipment rooms so that heat and sound will not be transmitted to other parts of the building.
6. **Meters.** In general, meter utility services to each building:

- Additional sub-metering may be requested by UCSF for subdivisions within the building.
- Resolve sub-metering with Project Manager before piping design layouts are started.

7. **Electrical Requirements.**

**General:**

- Include line voltage power and connections under Division 16 - Electrical. Furnish all necessary information on electrical items provided under mechanical work, and coordinate electrical connections.
- Electrical items or parts furnished as part of mechanical equipment must be suitable for and rated for operation on the power available. Verify actual power supply before specifying equipment.
- Include in Division 16 all starters and disconnect switches, except those furnished integrally with mechanical equipment. Coordinate connections of starters furnished as part of mechanical work.
- Include in this Division 15 sensing control or signal devices mounted in mechanical systems.

**Motors:**

- Motors furnished as part of mechanical equipment must be of adequate size and have sufficient torque to start a drive equipment load to which they are connected. Use high energy-efficient type, with a catalogued efficiency rating of 90% or greater.
- Motor enclosures:
  - Drip-proof or squirrel cage induction type for general interior use.
  - Totally enclosed for exterior use or where located in intake airstream.
  - Explosion-proof for hazardous location use.
- Starters: 120 volt control circuits, H-O-A switch in cover, auxiliary contacts for necessary interlocking. Enclosures to be NEMA standard to suit location. Provide solid-state starters where available.
- Fume hood exhaust starters: Wire for on/off operation so fans start automatically upon restoration of power after outage.

8. **Pipe, Valve, and Equipment Identification.** Refer to Tables 1 and 2.

**Pipe Labels and Painting:**

- All piping: Provide with identification labels. Use arrows to indicate direction of flow.
- In addition to labeling, paint piping as shown in Table 1. If painting is required, paint entire length.
- Apply a label at or near each valve or valve set, elbow, tee, and when passing through a wall or floor.

**Valve Tags:**

- Identification: Identify all valves with 2 x 4 in. minimum size laminated plastic tags. Tags shall have a light background with black or blue lettering. Exception: Use a red background for fire protection valves. If possible, state system served by the valve, the room number, and area of building served by the valve. Indicate the name and number of the equipment on tags for equipment shutoff valves.
- Control valve tags: State the design water flow rate (gpm), valve size, system or equipment served, and flow coefficient.
- Exposed valves in machine rooms below furred ceilings: Attach tags with a light chain.
- DSP, SPR, and WSP valves exposed in vertical risers in occupied spaces or stairwells: Attach to wall near valve.
• Medical gas valves, fire valves alarms, and fire or smoke dampers located above furred ceilings: Use clear plastic labels with 1/2 in.-high red lettering. Attach with screws to the wall at and below the ceiling line nearest the location of the item.
• Medical gas valve manifolds at gas cylinders: Use 2 x 4 in. laminated plastic tags, color-coded and lettered the same as for pipe labels, and attached to manifold with a light chain.

Equipment Labels:

• Label all equipment with engraved plastic labels riveted or epoxy-glued to the equipment.
• State equipment name and number and all performance data, including flow rates, pressure drops, entering and leaving temperatures, etc.
• Include indication of area served by equipment, including room numbers if possible.

9. Acceptable Manufacturers. See Table 3 for a list of acceptable manufacturers for Division 15 products.

10. DDC Controls. See Table 4 for DDC requirements.

11. Access Doors and Panels. Provide piano hinge type with screwdriver latch type operators. Key operators are not acceptable. Provide for valves and equipment located behind furring above ceiling. All mechanical and electrical components to be located in accessible locations.

12. Commissioning. For all projects, Project Manager will determine extent and contractual process of commissioning of mechanical and electrical systems.
### TABLE 1
PIPE, VALVE, AND EQUIPMENT COLOR IDENTIFICATION

<table>
<thead>
<tr>
<th>PRINT SYMBOL</th>
<th>LABEL NAME</th>
<th>LABEL COLOR (CODE 1)</th>
<th>PIPE PAINTING</th>
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<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>AG</td>
<td>Acetylene Gas</td>
<td>Y</td>
<td>N/A</td>
</tr>
<tr>
<td>CA</td>
<td>Compressed Air (2)(3)</td>
<td>Y</td>
<td>Optional</td>
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<td>Chilled Water Supply</td>
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<td>Condenser Water Supply</td>
<td>Y</td>
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TABLE 1 NOTES:

(1) Color coding for pressure-sensitive type labels:

- Y  Yellow background with Black lettering.
- GW Green background with White lettering.
- GB Green background with Black lettering.
- W  White background with Black lettering.
- R  Red background with White lettering.
- B  Blue background with White lettering.

(2) Indicate operating pressure in psig within parenthesis — e.g., Air (8).

(3) Applies to compressed air for pneumatically operated automatic doors and laboratory air.

(4) Label names must be special ordered.

(5) Where used as a medical gas. For example, at incubators, paint gray.

(6) Where used for fire quenching. For example, where piped to grease exhaust hoods in kitchens.

(7) Applies also to demineralized water.

(8) Not used.

(9) Use of Halon fire extinguishing systems, frequently found in computer rooms.

(10) Use of TCA copper piping 1/2 in. O.D. and larger.

(11) Use for mixed gases. For example, air or oxygen mixed with CO$_2$ to incubators if piped via a common line.

(12) Red labels, white lettering, no painting required.

(13) Not used.

(14) Indicate operating pressure in psig (e.g., 200, 100, 15).
### TABLE 2
PIPE AND INSULATION LETTERING

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<th>Pipe and Insulation O.D. (in Inches)</th>
<th>Minimum Letter Height (in Inches)</th>
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<tr>
<td>1/2 to 1-3/8</td>
<td>3/4</td>
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<td>1-1/2 to 2-3/8</td>
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<td>8 to 10</td>
<td>2-1/2</td>
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<td>Over 10</td>
<td>3-1/2</td>
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### TABLE 3
**ACCEPTABLE MANUFACTURERS FOR DIVISION 15 PRODUCTS**

1. **Access Doors - Ductwork:** Ventlock, Air Balance, Ruskin.
2. **Acid Waste Piping:** Duriron, Josam.
3. **Air Compressors (Lab outlets and temperature control air).**
   - < 25 scfm: Comp Air, or equal, no known equal
   - >25 scfm: Kellogg air cooled rotary screw, or equal. No known equal
4. **Air Compressor Driers**
   - Lab refrigeration compressed air: Wilkinson, Hankinson
   - Hospital medical air: Pall desiccant type, to match existing
5. **Air Diffusers:** Titus, Kreuger
6. **Air Filters (polyester for all bag filters and first filter downstream of main heating coils; all other filters may be fiberglass or other media):** Servodyne, Fiberboard.
7. **Airflow Duct-Measuring Station:** Air Monitor, Ebtron.
8. **Air Handlers:** Pace, Buffalo, Temptrol, Govern Air.
9. **Backflow Preventer, Reduced -Pressure:** Watts, Febco, Hersey.
10. **Balancing Water Devices, Manual:** Armstrong, Bell and Gossett, Gerand, Taco, Victaulic.
11. **Balancing Dampers:** Air Balance, Phillips, Ruskin, Ventfabrics, Durodyne (dampers hardware).
12. **Bearings, Fan:** Browning, Dodge.
13. **Combination Temperature-Pressure Ports:** MG Piping Products, Peterson Equipment, A. Spedco Sisco, Trerice (H.O.), Watts Regulator.
14. **Drains, Cleanouts, Shock Arresters, Grease Traps:** Josam, Duriron, J.R. Smith, Wade, Zurn.
15. **Emergency Showers Equipment:** Haws, Bradley, Guardian.
16. **EMS DDC Systems and Devices:** Andover; match existing for non-Parnassus sites.
17. **Faucets and Trim:** Chicago Faucet, T & S Brass, Water Saver.
18. **Fire, Fire Smoke, and Smoke Dampers:** Air Balance, Phillips, Ruskin, Pottorf.
19. **Fire Shutoff Valves and Check Valves:** Victaulic, Nibco, Grinell, Kennedy.
20. **Fire Inspection/Test/Drain Valve:** AGF, Victaulic, Testmaster.
21. **Fire Hydrant:** Long Beach Iron Works.
22. **Fire Post Indicating and OS&Y Valves:** Mueller, Clow Valve Co., Nibco, Stockham.
23. **Fire Post Indicators:** Stockham, Clow Valve Co.
24. **Fire Curb Boxes:** Christie G5 Traffic Valve Box, Brooks Products.

25. **Fixture Carriers:** J.R. Smith, Josam, Zurn, Wade.

26. **Flexible Duct Connectors:** Ventfabrics, Durodyne.

27. **Fume Hood Exhaust Fans:** Fan Engineering, Pacific Fan and Blower, Pace, Strobic Air.

28. **Hose Bibbs:** Josam, J.R. Smith, Zurn.

29. **Hydronic Specialties (includes air vents, relief valves, pressure and air elimination systems, suction diffusers, and combination check and shutoff valves):** Amtrol, Armstrong, Bell and Gossett, Taco, Gruvlok.

30. **Insulation**
   a. **Duct insulation**
      - **Fiberglass:** Certainteed, Manville, Knauf, Owens-Corning
      - **Neoprene rubber:** Armstrong, Rubatex
   b. **Pipe insulation**
      - **Fiberglass:** Certainteed, Manville, Knauf, Owens-Corning
      - **Neoprene rubber:** Armstrong, Rubatex
      - **Foamglas:** Pittsburgh-Corning “Foamglas”, or equal, no known equal
      - **Calcium silicate:** Pabco, Rubatex
      - **Insulated piping:** Pipe shields, or equal, no know equal
      - **Uninsulated piping:** Stoneman “Trisolaters”, Superstrut rubber, Bline “Vibrasorb”.
      - **Insulation blankets (for valves and on pipeline assemblies):** Plant Insulation “Temp-Mat”, Insultech, Shannon.
   c. **Equipment insulation**
      - **Neoprene rubber:** Armstrong, Rubatex
      - **Foamglas:** Pittsburgh-Corning “Foamglas”, or equal, no known equal
      - **Calcium silicate:** Pabco, Rubatex

31. **Lavatory Fixtures (Commercial and Institutional types):** Kohler, American Standard, Eljer, Crane.

32. **Meters**
   - **Water meters for monthly readings (must be accurate):** Kent, Neptune, Hersey
   - **Other water meters:** American, Neptune
   - **Condensate Meter:** Kent model 350 to match existing.

33. **Motors:** Reliance, Baldor, Square D.

34. **Motor Starters:** Westinghouse (Advantage), GE, Square D.

35. **Pumps, Centrifugal:** Armstrong, Bell & Gossett, Paco, Aurora.

36. **Pumps, In-line Circulators:** Grundfos, Armstrong, Bell & Gossett.

37. **Pump Set, Steam Condensate Return:** Aurora, Paco.

38. **Seismic Expansion Compensators:** Use only braided hose type. Flexonics, Mercer.

39. **Shower Trim:** Chicago Faucets, Kohler, American Standard.

40. **Sinks, Service:** Kohler, American Standard, Crane Plumbing/Fiat Products, Stern-Williams.
42. Sound Attenuators: Industrial Acoustics, Rink.
43. Strainers, Basket: Hayward, Muessco, Victaulic, Gruvlok, Sarco, Watts.
44. Strainers, Y-Type: Armstrong, Hoffman, Sarco (cast iron), Victaulic, Watts (brass)
46. Steam Flash Tank: Sarco, Ace Boiler, Industrial Steam.
47. Steam Pressure Reducing Stations (specify rotary ball valve, pneumatic pilot): Neles-Jamesbury, Cashco.
48. Steam Relief Valves: Kunkle, Spirax, Sarco.
49. Steam Traps: Armstrong, Hoffman, Johnson, Sarco.
50. Steam Traps: Armstrong, Hoffman, Sarco.
51. Time Clocks: Grasslin.
52. Thermometers and Gauges.
   a. Air Filter Gauges: Dwyer or equal
   b. Duct mounted thermometers: Tru-Tel #GT300R dial type, Trerice
   c. Pipe mounted: Palmer, Trerice, Weksler, Taylor, Ashcroft
54. Vacuum pumps: Sihi, or Travaini Dynaseal Pumps (liquid ring, air cooled, or Busch rotary van air cooled. Busch rotary van air cooled,
55. Valves, Balance: Armstrong Series CVB to match existing, no substitution.
56. Valves, Butterfly: Crane, Stockham, Milwaukee, Victaulic, Grinnell.
57. Valves, Check Valves, Non-Slam: Stockham, Victaulic, Grinnell.
59. Valves, Gate and Globe Valves: Crane, Nibco, B. Milwaukee, Stockham, Crane, Powell, Smith, Walworth, Jenkins, Lunkenheimer, Grinnell.
   a. Gate valves 2 ½ “ and over - cast steel construction.
   b. Gate valves under 1 ½ “ - cast or forged steel.
   c. LPS and MPS - 150# cast iron body - For 2 ½ “ and under, use steam rated ball type valves.
60. Valves, Plug (Use only for natural gas): Rockwell, Walworth, Victaulic.
62. VFDs: Emerson, Reliance.
TABLE 4
DIRECT DIGITAL CONTROLS (DDC)

All control devices and systems for new buildings shall be DDC, wired to and interfaced via Ethernet connection with building EMS systems. For remodel projects, contact Project Manager to determine whether control system will be DDC or will match existing building control system.

**Input/Output Summary:** Use the following list as a guideline. Review project-specific requirements with the Project Manager, and specify additional points or delete points as required.

- **AI** = Analog Input to Controller
- **AO** = Analog Output from Controller
- **DI** = Digital Input to Controller
- **DO** = Digital Output from Controller

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**Part 2  Design Guide**

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**CONDENSER WATER SYSTEM**

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Part 2  Design Guide

15080  MECHANICAL INSULATION

GENERAL

1. Piping Insulation.

**General:** Insulate all piping subject to producing condensation, in addition to piping insulated for thermal requirements. Insulate all steam and chilled water piping up to the inlet flange or connection to thermostatically controlled valves and all line drip-legs. Insulation to include valves and fittings, insulated condensate lines from trap to condensate receiver, and all pumped condensate returns.

**Interior Piping:** Heavy-density fiberglass pipe insulation, with embossed vapor barrier laminate and pressure-sealing lap adhesive.

**Exterior and Interior Piping:** Preformed hydrous calcium silicate, where subject to damage.

**Exterior Chilled Water Piping:** For piping subject to moisture condensation or subject to damage, use Foamglass type insulation.

**Fittings:**
- Place PVC fitting covers over insulation of fiberglass insulated pipe.
- Insulate irregular pipe accessories with oversized sections of pipe insulation, and finish with canvas jacket.
- Insulate valves and flanges with a manufactured, removable insulating blanket.

**Jacketing:**
- Provide insulated pipe and fittings located outdoors, with smooth finish aluminum jacketing and fitting covers secured to insulation.
- Overlap longitudinal joints to shed rainwater.
- Provide continuous jacketing through pipe hangers and supports, and over pipe thermal hanger shields.

**Hangers:**
- Install thermal hanger shields on all insulated piping. Locate centrally under each hanger and support, and where piping extends through floor or wall sleeve.
- Make vapor barriers and jacketing continuous over shield.
- Thermal hanger shields: Hydrous calcium silicate pipe insulation reinforced with galvanized sheet metal outer covering. Make thickness of calcium silicate the same as the insulation to be installed on the piping.

2. Equipment Insulation.

**Chilled Water and Condenser Water Pumps:** Rigid closed-cell polyethylene factory-machined segments, suitable for direct application on cold vessels and equipment.

**Separators, Hot Water Heaters, Hot Water Expansion Tanks, Flash Tanks, and Heat Exchangers:** Rigid hydrous calcium silicate blocks secured with wire, finished with insulating cement, and covered with canvas.
Expansion Tank, Chilled Water System: Semi-rigid glass fiber-insulated board, finished with insulating cement covered with canvas.

Exposed: Where any equipment is exposed to weather, cover entire surface with aluminum jacketing and outdoor vapor barrier mastic of aluminum color.

3. Duct Insulation.

Interior Exposed: Insulate interior exposed rectangular air ducts, plenums, and casings with rigid-board fiberglass insulation, foil scrim, kraft facing, and vapor-sealed.

Concealed: Insulate concealed ductwork with blanket duct wrap containing a factory-facing of reinforced foil kraft laminating.

Lined: Ductwork and apparatus housings lined with internal duct liner need not be insulated on the exterior.

Air-Conditioning Systems: Provide plenum casing panels for air intake, filters, coils, and fan discharge plenum housing, where not internally lined, with 100% coverage of fiberglass and duct adhesive.

Exterior Duct: Provide double-wall construction with insulation sandwiched between two layers of sheet metal for supply duct. Provide duct lining for return duct.
15300  FIRE PROTECTION PIPING

GENERAL

1. Systems Design. Sprinkler system design shall be hydraulically calculated by the installing contractor. Show main piping loops on design drawings. Show minimum required sprinkler heads on architectural ceiling plans.

2. Shop Drawings. Sprinkler system shop drawings to be approved by the State Fire Marshal prior to installation.

3. Testing. Pressure test with air prior to hydraulic testing.

PRODUCTS

1. General. Fire alarm tamper and flow valves and switches to match existing fire main and riser service.

2. Curb Boxes. Provide cast concrete curb boxes with a cast iron traffic cover marked "FIRE."

3. Fire Hose Cabinets. Flush-mounted; provide space and mounting brackets for University-furnished 10 lb. dry type fire extinguishers.

4. Sprinkler System.

   Interior Risers and Cross Mains: Use Schedule 40 black steel.

   Exterior Piping: Use Schedule 40 galvanized steel.
15400 PLUMBING

GENERAL

1. Quality Control.

Disinfection of Domestic Water Piping:

- Design standards: Include requirements for disinfection and certification for all new domestic hot and cold water systems and all additions to existing domestic hot and cold water systems.
- Supervision and testing: Contractor to disinfect plumbing systems using a UCSF-approved vendor and provide the Project Manager with a Certificate of Compliance prior to occupancy.
- Where other industrial water lines connected to the domestic mains are protected by an appropriate backflow protector; do not include these lines in the disinfection procedure.

PRODUCTS

1. General.

Backflow Prevention:

- Provide atmospheric vacuum breakers on all hose bibbs.
- Equip water faucets with serrated tips with a vacuum breaker to prevent cross contamination from sink-to-sink and floor-to-floor.

Acid Waste and Vent Piping: Separate any acid waste and vent piping system within a building from building sanitary waste and vent systems shall be piped separately to a concrete manhole located outside the building and on UCSF property.

Building Drainage: All drainage from buildings (e.g., sewer, storm drains, foundation drains) shall be by gravity. Obtain approval for use of pumps from Project Manager.

Site Drainage: Give consideration for possible catch basin or line stoppages. Arrange site contours and elevations so any ponds resulting from such stoppages overflow safely to other areas rather than into buildings or other locations where damage may occur.

Laboratory Gas, Air, and Vacuum Piping: Size piping to meet demand; determine with Project Manager early in Schematic Design Phase. Size laboratory piping with 0.5 diversity factor; size distribution piping feeding laboratory with 1.0 diversity factor. Minimum branch size: 3/4 in. for vacuum, and 1/2 in. for other gases.

Concrete and Vitrified Clay Piping: Concrete and vitrified clay piping are not permitted for use at UCSF facilities.

Laboratory Sinks and Trim:

- Where acids or bases are used, chemical-resistant sinks are required, (e.g., polypropylene or epoxy resin sinks and tail pieces).
- Unless otherwise required, use 3 x 6 in. oval type cup sinks. Verify specific requirements with Project Manager.
- Stainless steel sinks may be specified where requested by UCSF. Provide Type 316 stainless steel sinks for use with chemicals or acids. Specify only standard sizes in stainless steel sinks.
Sinks are not to be marked or embossed with manufacturer's name. Use sound-deadening treatment on the bottom of the sinks.

- Review gooseneck heights with Project Manager to assure that adequate vertical clearance exists between tip and sink.
- For laboratory gas, air, and vacuum outlets, wall- or splashback-mounted faucets are preferred. Use ground key serrated tip cocks, unless otherwise required.
- Pressure-reducing valves: Provide only when a need for unusually precise control of flow or pressure is required.
- Floor sinks: Use acid-resistant floor sinks in laboratories except when used for non-acid waste type functions (e.g., ice machines, ultracentrifuge drain, cold room drain).

Water Pressure-Reducing Stations:

- When required, water pressure-reducing stations shall consist of two reducers. Locate pressure reducing stations in mechanical rooms, readily accessible for service, and equipped with proper drainage and upstream strainers.
- Size each reducer for 100% of the estimated building demand.
- On systems with 1 in. or smaller service main where single pressure-reducers are practical, provide a 3-valve bypass to allow for service of the regulator. Use ball type valves for the 3-valve bypass.
- Use stainless steel construction on demineralized, deionized, and reverse osmosis systems.

Meters:

- Each building domestic water service, except 1 in. or smaller size, shall have one meter with a bypass for maintenance, optional pulsar register reading in cubic feet. Wire pulsar signal to a panel located in building machine room. Equip domestic water service of 1 in. size or smaller with a single meter.
- Provide each water makeup line to a heating hot water system, chilled water cooling system, or cooling tower water system with a meter registering in gallons. The meter's purpose is to detect piping leakage, to detect makeup water consumption on cooling towers, and to check for excess blowdown from overflow.
- Locate meters in mechanical rooms to be readily accessible for reading and servicing at floor level. Where these locations are not possible, coordinate alternate locations with the Project Manager.
- Provide each building gas service with a meter with register reading in cubic feet. Locate meters in mechanical rooms, readily accessible for reading and servicing at floor level.

Air Compressors:

- In sizing compressors for laboratory buildings, a figure of 0.5 CFM free air per laboratory outlet has been successfully used in the past. Make appropriate additions for air-operated centrifuges or other high demand equipment.
- Specify 1750-rpm maximum, air-cooled rotary compressors. Alternate compressors require Project Manager's review and approval.
- During design, review additional air quality program needs, which may require provision of refrigerated after-coolers, dryers, coalescing filters, etc., with Project Manager. Equip system with 5-micron pre-filter, 0.2-micron coalescing filter, and 1-micron absolute filter piped in series and valved for bypass for service.
- Campus buildings on Parnassus Avenue shall be served from the Campus compressed air system. Verify with Project Manager the need for a standby compressor within the building.
- Buildings located off-Campus, and not served by the Campus compressed air mains, shall
include a compressor installation consisting of dual compressors, and single receiver unit with each compressor sized for approximately two-thirds of the estimated peak demand. Provide controls for automatic alternation of the lead machine.

- Equip compressor receivers for periodic blowdown.

**Vacuum Pumps:**

- In sizing vacuum pumps for laboratory buildings, a figure of 0.10 CFM free air per laboratory outlet has been successfully used in the past.
- Motors: 1750 rpm.
- Vacuum pumps: Dual pump, and single receiver units with each pump sized for approximately full estimated peak demand. Controls shall provide for manual alteration of the lead machine. Equip receivers for periodic manual blowdown.
- Size distribution piping feeding laboratory with 1.0 diversity factor.

**Hot Water Circulating Pumps:** Use in-line pumps for circulation of domestic hot water.

**Equipment Drains:**

- Indicate on the Drawings drain piping for equipment having a drain connection.
- Provide drain piping on vibrating or flexibly mounted equipment with a flexible connection between piping and equipment.

**Cooling Coil Condensate Drains:**

- Equip chilled water or direct expansion-cooling coils with drain pans and piping connected to indirect waste connection.
- Provide for P-trap having trap seal equal to or greater than static pressure rating of unit. Pipe size shall be equal to or greater than equipment drain outlet. Do not vent P-trap above ceiling.
- Install trap with top of trap 2 in. minimum below bottom of condensate collection pan, and within 12 in. of pan outlet.
- Use gravity drains.

2. **Piping.**

**Domestic Hot and Cold Water and Emergency Shower and Eyewash Water Piping:**

- Above ground: Type L hard copper tubing with wrought copper or cast bronze solder joint fittings, using lead-free silver bearing solder. Provide unions larger than 2 in. size with cast brass flanges.
- Buried piping:
  - 3 in. and smaller sizes: Type K copper with wrought solder joint fittings and 1300°F, 15% silver-brazed joints, wrapped with Protective Piping Covering.
  - Water piping in larger sizes: U.S. Tyton Joint Class 220 gray or ductile iron piping and fittings.
- Protective covering (wrapping) for buried piping:
  - Alternate: Factory-applied coal tar coating and fiberglass double wrap. Apply coating to within 4 in. of ends, each pipe length.
  - Field joint cover: Prime coat and one layer of heat-applied tape, or heat-shrinkable polyethylene tube internally coated with adhesive.
  - Defect repair: Cold-applied tape or double wrap cold-applied tape spirally wrapped with half tape width overlap of preceding layer; or primer, with two wrappings of tape.
Industrial Hot and Cold Water: Type L hard copper pipe with wrought solder joint fittings, using lead-free silver solder.

Gases Including But Not Limited to Nitrogen, Vacuum, Laboratory Compressed Air, and Carbon Dioxide:

- Use Type L hard copper with wrought solder joint fittings or compression fittings.
- Solder joints with lead-free silver solder. Braze pipes 2-1/2 in. and larger using self-fluxing 1350°F phosphor-bronze (BCUP-2).
- Equip vacuum piping in sizes larger than 3 in. size with drainage fittings.

Irrigation Piping (Downstream of Backflow Preventers): Schedule 80 PVC with solvent-welded fittings, except at points of connections to sprinklers, etc., where screwed galvanized Schedule 40 pipe nipples are required.

Natural Gas Piping: Schedule 40 black or galvanized steel pipe with 150 lb. black or galvanized malleable iron screwed fittings and ground joint unions for 1-1/2 in. and smaller sizes. Larger sizes shall have standard weight butt weld fittings and 150 lb. welding neck flanges at valves and other accessories. Piping exposed outdoors on location gauges or located in garages shall be galvanized.

Distilled, Demineralized, Deionized Water, and Reverse Osmosis Piping: Use stainless steel. Faucets and outlets shall be tin-lined brass; PVC outlets are not permitted because of their susceptibility to physical damage.

Sanitary Waste, Rainwater, and Vent Piping:

- 2-1/2 in. and smaller above ground: Hubless cast iron soil pipe and fittings.
- Vent piping 2-1/2 in. and smaller: Schedule 40 galvanized steel, or hubless cast iron soil pipe.
- Larger sizes of sanitary waste, rainwater, and vent piping above ground: Hubless cast iron soil pipe and fittings. Use type DWV copper tube and fittings where the existing building systems are piped with DWV copper. Solder for type DWV piping shall be 95/5.

Acid Waste and Vent Piping:

- Silicone-impregnated cast iron pipe and fittings.
- Below-grade piping: Bell-and-spigot with lead and oakum packing.
- Above-grade piping: Hubless with TFE and neoprene couplings with stainless steel band clamps.
- Stainless steel and plastic (with SFM approval).

Miscellaneous Small Drainage Piping (Including Cooling Coil Condensate Drains 2 in. and Smaller): Type L copper with 95/5 soldered fittings, 3/4 in. minimum size.

3. Valves.

Solder Joint Valves: Not permitted; all valves shall have threaded bodies.

Ball: Use ball valves rather than gate valves for shutoff valves 2-1/2 in. and smaller.

Medical Gas and Vacuum Valves: Use 3-piece bronze fullport ball valves.
Distilled, Demineralized, Deionized, and Reverse Osmosis Systems: Use ball valves on all stainless steel construction.

4. Plumbing Fixtures and Trim.

Toilets:
- Wall-hung, direct-fed siphon jet, elongated bowl, 1.6 gal/flush water saver, flush valve type.
- Open-front, white solid hinged seats, with stainless steel check stops.

Urinals: Wall-hung type, vitreous china. 1.0 gal/flush, siphon jet with flushing ring, with 2 in. I.P.S. outlet connection.

Lavatories: Vitreous china, of size and type appropriate to the location. Wall-mounted lavatories shall have integral rear splashback with ledge-mounted supply fittings. When counter-mounted lavatories are used, detail supports, and specify stainless steel mounting frames.

Non-Acid Sinks: Provide same trim as for lavatories except use chrome-plated brass faucet sets, gooseneck type where required by UCSF.

Floor Drains: Located in each toilet room either under partitions separating toilet stalls, or between toilet stalls and urinals, minimum 2 in. size.

Hose Bibbs: Provide a 1/2 in. loose key chrome-plated brass hose bibb in each toilet room.
15600 REFRIGERATION EQUIPMENT

GENERAL

1. Design Criteria.

   **Design Temperatures:**
   - Air-cooled heat rejection equipment: 95°F ambient.
   - Suction temperature for direct expansion systems: 45°F minimum.
   - Chilled water supply temperature: 45°F minimum.
   - Chilled water supply and return temperature difference: 10°F minimum.
   - Cooling tower design wet-bulb temperature: 65°F maximum.

   **Equipment:**
   - Use air-cooled type for refrigeration systems under 100 refrigeration tons.
   - The use of once-through, water-cooled refrigeration equipment is not permitted except in situations where the application of air-cooled equipment is not feasible.
   - For systems over 100 tons, select on availability of steam from Central Plant.

PRODUCTS

1. General.

   **Temperature-Sensitive Applications:** Wire equipment serving animal care areas, computer rooms, and other temperature-sensitive applications to an emergency power source. Provide alarm status to EMS. Coordinate requirements with Project Manager.

   **Noise and Vibration:** To minimize noise and vibration transmission, mount equipment installed on grade and in building basements on neoprene ribbed pads. Above grade, install on seismic type spring isolators.

   **Chiller Systems:** Include full optimization control capability, to minimize energy use of the system.

   **Air-Cooled Package Units:** Provide with an adjustable ambient air temperature lockout control.

2. Cooling Towers. Use only induced-draft type, counter-flow, or cross-flow configuration, with propeller type fans. Centrifugal fans are not permitted. Construct of fiberglass or stainless steel.

3. Computer Room Air-Conditioning Units.

   **Preferred:** Down-flow type located on raised floors and in closets are preferred. Avoid ceiling type units.

   **Type:** Fan-coil type with either chilled water or cooling coils connected to remote chillers or the building main chilled water system, where available; or direct expansion cooling coils connected to remote condensing units.

   **Reheat:** Include reheat capability in order to maintain desired humidity control. Reheat via the existing building main heating hot water heating system, where available.
Filters: Equip with 40% efficient filters.

Humidification: Provide electrical radiant type unit, if required.
15700 HEATING, VENTILATING, AND AIR-CONDITIONING EQUIPMENT

GENERAL

1. Design Criteria.

Type of System:

- Appoint Mechanical Engineer early in the design phase to permit selection of systems most suitable for the building's needs. Coordinate selection of the type of HVAC system with Project Manager.
- Use only low-velocity systems unless there are compelling reasons to the contrary. Accompany proposals to Project Manager during Schematic Design Phase for use of other systems with complete, comparative Life Cycle Cost data.
- Where there is insufficient capacity in the existing ventilating equipment, provide supplemental mechanical refrigeration cooling. Generally, do not speed up existing air-handling equipment to satisfy project requirements because this speed-up creates objectionable noise and vibration, and no warranty protection exists when reusing existing equipment. Where project requires additional airflow rate capacity, provide new fans and upgrade the related ductwork to handle the additional airflow rate. For water conservation purposes, air-conditioning units or systems using once-through domestic water are not permitted. For energy conservation purposes, electric heat pump type units or systems are not permitted.
- Fully air-condition animal care facilities with 100% outside air and a minimum of 15 air changes per hour for animal holding rooms.
- Fully air-condition computer rooms. Allow 100% growth factor for sizing systems (e.g., provide two air-conditioners, each sized for 100% of the estimated cooling load).
- If possible, design heating using hot water coils rather than steam coils.
- If possible, provide for chilled water-cooling to allow for future connection to central chilled water system.

Energy Conservation:

- Design HVAC systems to minimize energy consumption. Submit calculations to Project Manager, with the 100% Construction Documents. Calculations are for the University records, and for the University's use in obtaining rebates.
- When used, equip all VFDs with a manual bypass that is housed in an enclosure separate from the VFD so the equipment can be put into manual operation and the VFD removed for repair and maintenance. Avoid fan outlet control vanes or cones for VAV control.
- Equip all HVAC fan motors, pumps, or chillers with new (or connected to existing) building EMS microprocessor. If not possible to connect to EMS, provide new time clocks. New time clocks: Digital type, 365-day programmable, multi-circuit, with 12-hour rechargeable battery backup. Project budget permitting, replace existing mechanical or other time clocks. Electrically connect all new HVAC equipment requiring timed operation to the EMS System.
- Animal care areas shall operate 24 hours per day.
- Design exhaust fans serving toilet rooms, darkrooms, fume or other hoods, or chemical storage areas to operate continuously, 24 hours per day.
- Use air-side economizer controls for HVAC systems handling return air.

Design Temperatures:

- Cooling coil outside ambient air design temperature: Summer, 90°F DB, 65°F WB.
• Air-cooled heat rejection equipment: 95°F ambient.
• Indoor design temperatures for offices: Summer, 78°F DB; Winter, 72°F DB.
• Indoor design temperatures for laboratories: Summer, 72°F DB; Winter, 72°F DB.
• Outside air design temperature: Use 84°F DB, 65°F WB for solar and transmission loads.

**Sound Levels:** Permissible sound power levels at hoods is 65 dBA.

**Darkroom Ventilation:**

• In addition to providing sufficient air at 12 air changes per hour minimum to maintain comfort conditions, design the arrangement of supply and exhaust outlets to maintain a flow of uncontaminated air past the persons using the room.
• Provide a slot type exhaust hood that will effectively remove chemical fumes at the rear of the wet bench.
• General ventilation may connect to building general exhaust system. Consider separate exhaust systems for individual pieces of equipment (e.g., processors).

2. Materials and Equipment.

**Roof-Mounted Equipment:**

• Avoid unnecessary exposure of equipment to weather wherever possible through use of penthouses or other means.
• Where equipment must be exposed to weather, design installations that withstand corrosion. Stainless steel casings are required. Use of epoxy and similar plastic coatings will not be allowed.
• For miscellaneous metals (e.g., pipe and duct supports), hot-dipped galvanizing after fabrication has provided acceptable protection.
• Arrange roof-mounted equipment so roofing does not run under the equipment, but terminates with suitable cant strips and counterflashings at a curb or pad upon which the equipment item is placed. Allow for roofing replacement without removal of equipment, or for work in confined spaces below the equipment.
• Integrate piping, conduit, and duct penetrations at roof-mounted equipment with the main equipment base so additional roof penetrations, patching, and flashings are not required.
• Exposed ductwork, fittings, and joint materials: Stainless steel, sealed watertight. Fume hood exhaust ductwork exterior to the building: Fiber-reinforced plastic (FRP).
• Flashing and counter flashings: 20-gauge stainless steel or copper, with welded or soldered joints and corners respectively.

**Corrosion Protection:** Require all support materials, including bolting materials, exposed to weather, including those in air-intake plenums upstream of the first tempering or heating coil, be stainless steel, nonferrous, or hot-dipped galvanized after fabrication. Use of plastic-coated or electro-galvanized material is not permitted.

**Condensate Meters:**

• Generally provide each Parnassus Campus building using steam with one or more rotary volumetric type condensate meters sized on the estimated maximum steam demand, and installed at the discharge of the return pumps. Steam condensate meters: High-temperature construction with 350°F minimum rated working temperature. Condensate meters: With digital pulser to send meter reading to UCSF Power Plant. Signal wiring: Include in Electrical Documents and wire signal to a master panel located in the building machine room.
• Locate meters in mechanical equipment rooms, accessible for reading and servicing, and placed no higher than 4 ft. above finish floor.
• Provide each meter with a 3-valve bypass.

PRODUCTS

1. Piping Systems.

   **Steam:**

   • 200 psig (High Pressure): Schedule 40 black steel ASTM A53 Grade B pipe with standard weight welding fittings, and 300 lb. welding neck flanges with ASTM A107 studs and nuts for 2-1/2 in. pipe size and larger. For 2 in. and smaller, Schedule 80 black steel ASTM A53 with 300 lb. malleable iron screwed fittings - no unions.
   • 16-125 psig (Medium Pressure): Schedule 40 black steel ASTM A53 Grade B pipe with standard weight welding fittings, and 150 lb. welding neck flanges with ASTM A107 studs and nuts for 2-1/2 in. and larger sizes. For 2 in. and smaller sizes, Schedule 80 black steel ASTM A53 pipe with 150 lb. cast or malleable iron screwed fittings and ground joint unions.
   • 15 psig and below (Low Pressure): Schedule 40 black steel ASTM A53 pipe, standard weight welding fittings for 2-1/2 in. and larger sizes, and 150 lb. cast or malleable iron screwed fittings and ground joint unions for 2 in. and smaller fittings.
   • Threaded pipe nipples, regardless of pressure service: Schedule 80.

   **Steam Condensate Return:** Type K hard copper tubing. Use cast bronze for fittings unavailable in copper

   **Chilled Water:**

   • On new buildings, chilled water piping may be steel or copper. On existing buildings, match the existing material.
   • For individual systems 4 in. and smaller, and branch runouts to individual coils, copper piping is preferred.
   • For steel piping 21/2 in. and larger: Schedule 40 black steel ASTM A53 pipe with standard weight welding fittings, and 300 lb. welding neck flanges.
   • For smaller sizes: 150 lb. banded malleable iron screwed fittings and ground joint unions.
   • For all size copper piping systems: Type L hard copper tubing with wrought copper solder joint fittings and lead-free silver solder up to 2-1/2 in., and 1300°F silver brazing alloy for larger pipes.
   • For fittings in sizes and types unavailable in wrought copper: Cast bronze.
   • Unions larger than 3 in. size in copper piping: Cast bronze flanges.
   • Nipples at outlets: Schedule 40 red brass pipe.
     — For steel piping: Brass nipples at copper connections (e.g., at coils, heat exchangers).
     — Dielectric unions are not permitted.
     — Use galvanized steel piping when exposed outdoors, or when located in garage areas or air-intake plenums.

   **Condenser Water (Cooling Tower Supply and Return):** Use the same materials as for steel Chilled Water piping, as described above.

   **Miscellaneous Drains:** Type L hard copper tubing with wrought copper solder joint fittings and lead-free silver solder.
Heating Hot Water and Hot Water Return:

- Type L hard copper tubing with wrought copper solder joint fittings. Exception: Match existing building materials where other than copper. Use cast bronze fittings in sizes and types not available in wrought copper.
- Use cast bronze flanges for unions larger than 3 in. size.
- Solder: 95-5 tin-antimony for pipe sizes up to 2-1/2 in. For larger pipe, braze with 1300°F silver.
- Nipples at outlets: Schedule 40 threaded red brass.

2. Valves:

General:

- Solder joint valves are not permitted.
- Shutoff valves 2-1/2 in. size and under, except for high-pressure steam: Use threaded body ball type valves.
- Valves for steam or steam condensate service require stainless steel ball and trim.
- Install a ground joint union downstream of each equipment shutoff valve and main floor valve.

Steam Valves:

- 200 psig (High Pressure): 300 lb. cast carbon steel, ASTM A216 Grade WCB, flanged valves for sizes 2-1/2 in. and larger; 300 lb. forged steel, flanged ends, valves for smaller sizes.
  - Valves larger than 2-1/2 in.: Equip with equalizing valves. Flanges: ASTM A193, Grade B-7 chrome-molybdenum studs and nuts.
  - Gate valves: 2 in. size and larger, OS&Y bolted bonnet, flexible or solid stellite-faced carbon steel disc, stellite-faced seat rings seal-welded into valve body; 1-1/2 in. and smaller, forged steel OS&Y, bolted bonnet, Type 316 stainless steel trim.
  - Check valves: 2 in. and larger, cast steel, swing check body, stainless steel trim; 1-1/2 in. and smaller, forged steel.
- 16-125 psig (Medium Pressure) and 15 psig and below (Low Pressure): 150 lb. cast iron, flanged, for sizes 3 in. and larger; 150 lb. cast iron or bronze body, for sizes 2-1/2 in. and smaller.
  - Gate valves, 3 in. and larger: Equalizing valves on 4 in. and larger valves in medium-pressure systems. Ball valves for 2-1/2 in. and smaller size shutoff valves.
  - Globe valves, 2-1/2 in. and smaller: Use ball type valves.
  - Shutoff and globe valves, 2-1/2 in. and smaller: 3-piece full port ball valves with stainless steel ball and trim.

Steam Condensate Return Valves: As specified above for 125 psig and lower pressure steam; except shutoff valves 3 in. and larger, 150 lb. bronze or brass body.

Condenser Water, Chilled Water, and Heating Hot Water Valves: As specified above for 125 psig and lower pressure steam; except omit equalizing valves and stainless steel ball and stem. Specify 3-piece, full port ball valves in lieu of gate valves in 2-1/2 in. and smaller sizes.

Miscellaneous Drain Valves: Use ball valves.


Pressure-Reducing Station Valves for Low-, Medium-, and High-Pressure Steam Service:

- Cast steel bodies, pneumatic pilot-operated, with pilot positioners with stellite facing, nitralloy
guide bushings, Type 316 stainless steel trim, single seat for dead-end service, normally closed, controller, and 1/2 in. filter regulator.

- Static lines: Type L hard copper with wrought copper fittings, 1300°F silver brazed, with syphon traps to protect controller mechanism from steam temperature.

**Bypasses:** Do not provide around steam pressure-reducing station valves since there will be two valves in parallel, and uncontrolled steam pressure downstream is unsafe for equipment and occupants.

**3-Valve Bypass:** Provide steam pressure-regulating or throttling valves on individual equipment inside Campus buildings (e.g., heat exchangers) to facilitate servicing the regulating valves. Locate bypass line above steam line in order to provide for proper condensate drainage from the bypass line.

4. **Steam Traps.**

**Bypass:** Install steam traps on all steam bypasses. Provide with a 3-valve bypass to facilitate trap servicing and maintenance.

**Type:** Float or thermostatic, or inverted bucket type; fixed orifice type traps are not permitted.

**High-Pressure Steam:** Inverted bucket type, cast iron body rated for 250 lb. steam service, with stainless steel bucket, valve, valve seat, valve lever, and with integral stainless steel strainer.

**Strainers:** Provide strainers ahead of all regulators, automatic valves, or other equipment.

5. **Steam Condensate Return Units.**

**Type:** Floor-mounted tank type units with duplex pumps are preferred. Use ball valves with stainless steel ball and trim between the tank and each pump so a pump may be serviced while the unit is operational.

**Pump Alternation:** Automatic with manual override. Equip units with multiple tank connections for vent, and separate condensate inlets for medium- and low-pressure steam condensate.

**Anchorage:** Anchor to concrete housekeeping pad.

**Controls:** Locate in panel with line starter, with second control switch located at tank for primary switch failure.

6. **Pumps.**

**Water Systems of 120 gpm Flow Rate or Less:** Provide in-line centrifugal pumps, all bronze construction.

**Water Systems of Greater Than 120 gpm Flow Rate:** Provide base-mounted close-coupled pumps.

**Components:**

- Provide mechanical seals.
• Do not field-trim pump impellers; instead, install a circuit-balancing valve downstream of each pump, and adjust the flow rate therefrom.
• Separate base-mounted pumps from piping system with flexible vibration isolators; use braided stainless steel for exterior applications.
• Fit pumps with inlet and discharge pressure gauge connections.
• Select pumps for 1750 rpm maximum.

Standby Pump: Provide for each water-circulating system; size for the full load, balanced, and piped in parallel with the primary pump so standby pump can be brought on-stream quickly in case of primary pump failure.

7. Expansion Tanks.

Use: Install on all heating hot water systems.

Type: Use rubber diaphragm type 150 lb. black steel construction, galvanized where exposed to weather or salt-laden fog, and equipped with main air-fitting for charging the tank.

8. Water Treatment.

Heating Hot Water Systems, Chilled Water Systems and Closed Loop Heat Rejection Systems (e.g., Closed-Loop Cooling Towers, Fluid Coolers): Provide with pot type chemical feeders, 5 gal. minimum, installed in a bypass line to the heating hot water piping system.

All Water Treatment Requirements: Coordinate with Project Manager. Initially treat all new systems by the current UCSF Water Treatment Contractor using chemicals and procedures in effect for the existing systems.

Open Type Cooling Towers: Provide with water treatment equipment and chemicals, and controls to control water hardness and biological contamination. Coordinate equipment, chemicals, and controls with Project Manager.

Filter Type: Sand type filters equipped with automatic blowdown accessory and stainless steel tank are recommended for use on open type cooling tower water systems. Install sand filters in a bypass line of the cooling tower water circuit and size as recommended by the manufacturer.
GENERAL

1. Humidity Control.

   **Space Humidity:** The control of space humidity is not normally required. However, computer rooms, animal care areas, libraries, research facilities, and other specific areas, as requested by UCSF, require humidity control with varying degrees of precision.

   **Refrigeration:** Where control is required, use refrigeration to control the upper limits of humidity levels during the summer. Humidifiers are required for winter operation to maintain minimum levels.

   **Sprayed Coils:** Use of sprayed coils for humidity control is not permitted.

   **Steam-Fired Humidifiers:** Use where steam is available; otherwise, electronic or infrared type are permitted. Use distilled water for makeup wherever possible to reduce scale buildup associated with the use of domestic cold water.

2. Testing.

   **Water and Steam Coils and Heat Exchangers:** Test as follows, and show no loss in pressure or visible leaks after a minimum duration of four hours:

<table>
<thead>
<tr>
<th>System</th>
<th>Test Pressure</th>
<th>Test Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Hot Water Coils</td>
<td>150 psig</td>
<td>Water</td>
</tr>
<tr>
<td>Water-Cooling Coils</td>
<td>150 psig</td>
<td>Water</td>
</tr>
<tr>
<td>Steam Coils</td>
<td>150 psig</td>
<td>Water</td>
</tr>
<tr>
<td>Heat Exchangers</td>
<td>150 psig</td>
<td>Water</td>
</tr>
</tbody>
</table>

   **Direct Expansion Coils:** Dehydrate with a vacuum pump to 0.2 in. HgA for 12 hours. After dehydration, leak-test coils with an inert gas to 1.5 times design pressure, then evacuate to vacuum, charge with refrigerant, and test with a halide leak detector.

PRODUCTS

1. Water Coils.

   **General:**

   - Maximum fin spacing of coils: 10 fins per inch.
   - Pipe water coils to be self-venting wherever possible. Provide manual type air vents at coil return connections only where coils are not self-venting.
   - Fit with test plugs for measurement of water pressure at supply to and return from coil. Fit with permanent thermometers on water inlet and outlet piping. Fit with circuit balancing valve assemblies for coil water flow-rate balancing, measurement, and local drainage. Install balancing valve assemblies downstream of a shutoff valve and strainer in the bottom supply inlet piping to the coil, and in the bypass pipe of 3-way valved coils.
• Coils on air-cooled equipment: Copper tubes with copper fins. For small units not available from the manufacturer with copper fin construction, use aluminum fins coated by Heresite-dipping. Extended surface type with copper tubes. Fins may be aluminum except copper finned coils to be used for cooling coils and for the first heating coil handling 100% outside air in a system. Coils exposed to weather to be copper tube, aluminum fin with Heresite (or equivalent) coating.

2. Steam Coils.

   General: For steam coils with throttling valve control, provide a 1/4 in. vacuum breaker bypass line with check valve installed around the steam trap to prevent coil flooding under throttled conditions. Lifts are not permitted in the condensate piping.

   Construction: Similar to water coils.

3. Direct Expansion Coils.

   General: Do not use on 100% outside air systems or HVAC systems that include air-size economizers.

   Construction:
   • Coils: Straight copper tube, continuous circuit type equipped with multi-port distributing benders, designed for use with environmentally acceptable refrigerants.
   • Fins: Solder-coated copper. On packaged equipment where solder-coated or copper fins are not available, factory Heresite epoxy dip coil assembly. Fin spacing: Same as water coils.


   General: Provide dual, parallel heat exchangers, each sized for 100% of the building heating load on all buildings so service and repair can be effected without interruption of building heating system.

   Construction: Shell-and-tube type with channel head, removable bundles, full-floating tube sheets, steel shell, bronze or stainless tube sheets and baffle plates, cast iron bonnet, seamless copper tubes, 150 lb. flanged water connections designed for 150 psi working pressure at 500°F steam temperature.

5. Humidifiers.

   General: Feed humidifiers with distilled or demineralized water; where not available, use an automatic dumping system. Do not use chemically treated steam from Central Plant.

   Construction: Use double-tube steam type humidifiers with steam-jacketed separating chamber, modulating control valve, steam strainer, inverted bucket trap, and temperature switch. Use stainless steel ducting downstream of the humidifier. Interlock steam control valves with air flow.
15800  AIR DISTRIBUTION

PRODUCTS

1. Ductwork.

General Duty Ductwork:

- Except for fume hoods, use galvanized steel or stainless steel. Aluminum ductwork may be used for repairs where the existing building duct system is aluminum.
- Aluminum ductwork: Provide for exhaust branch lines serving grilles in animal rooms, cage wash rooms, and sterilizer rooms. Pitch aluminum ductwork down toward exhaust inlet.
- Fabrication: To conform to SMACNA standards, and as follows:
  - Round duct: Spiral or Acme lock longitudinal seams and slip type transverse joints, secured with steel metal screws at 3 in. on center all around, minimum of three screws per joint, and taped with canvas and adhesive, mastic, or liquid sealant.
  - Elbows: Either full-radius, 5-gore type, or adjustable type. Seal joints of adjustable elbows with canvas and lagging adhesive, mastic, or liquid sealant. Crimped formed elbows not permitted.
  - Rectangular duct: Pittsburg longitudinal seams and pocket lock or ductmate transverse joints. 'S' slip and drive joints are not permitted except at connections to fire damper sleeves. Seal Pittsburg and pocket lock joints with canvas and adhesive.
- Duct tape is not permitted.
- Exterior ductwork and fittings, and all joint materials: Type 302 stainless steel made watertight with hypalon sealant.
- Horizontal exterior rectangular ductwork: Cross-broken or pitched sufficiently for water to drain off top surfaces.
- For economy, design with round ducts wherever space and appearance permit.
- Limit use of acoustical flexible ducts to short lengths (no more than 7 ft. with 45 degree maximum bend) when concealed above ceilings, for final connections to diffusers, exhaust grilles, or registers.
- Design exhaust ductwork with radius elbows only. Supply ductwork downstream of filters may have either miter elbows with turning vanes or full radius elbows.
- Interior exhaust ductwork in which condensation is likely (e.g., dishwasher exhaust): 20-gauge minimum stainless steel with no longitudinal seams on duct bottom. Tape concealed transverse joints with canvas and adhesive. Stainless steel in concealed locations: Type 304 with No. 2B finish. Exposed locations: Type 302 with No. 4 finish. Weld stainless steel joints.
- Ductwork downstream of humidifiers: 20-gauge minimum, Type 304 stainless steel, with bottom sloped back toward humidifier, and trapped and drained to an indirect waste. Install per above paragraph for 10 ft. minimum downstream of humidifier.

Fume, Radioisotope, or Biohood Exhaust Ductwork:

- Hood ducts:
  - Inside buildings: No. 20 Type 316 stainless steel.
  - Exterior to the building: Fiberglass-polyester construction.
  - Miscellaneous stainless steel transition fittings located outdoors: Continuous welded joints.
  - Inside buildings up to exhaust fan: Under negative pressure.
Stainless Steel Hood Exhaust Duct Construction:

- Rectangular:
  - Longitudinal seams: Pittsburg lock.
  - Transverse joints: Companion angle joints per SMACNA standards.
  - Companion angles may be No. 16 stainless steel or 1 x 1 x 1/8 in. steel.
  - Steel angles on exterior ducts: Hot-dipped galvanized after fabrication. Do not weld to stainless steel ducts.
  - All rivets or screws that penetrate ducts: Type 316 stainless steel.
  - Bolting exposed to weather: Type 302, 304, or 316 stainless steel.
- Round:
  - Longitudinal seams: Sheet Metal Co. Spiral or Acme Lock with welded joints.
  - Transverse joints: Welded slip joints. Elbows: Either full radius (1-1/2 times diameter) or 5-gore type with continuous welded joints.
- Horizontal ductwork:
  - Install level or sloped back toward the hood.
  - Use no traps in the hood exhaust ductwork.
  - Joints: Make so water inside the duct flows toward the hood (e.g., in vertical risers, install the top section into the bottom section).

Fiberglass-Polyester Hood Exhaust Duct Construction:

- Properties:
  - Minimum tensile strength: 7000 psi.
  - Maximum flame spread rating: 25 per ASTM E84 “Tunnel Test.”
  - Maximum smoke developed: 50 per ASTM E84 “Tunnel Test.”
  - Minimum wall thickness: 1/8 in.
  - Chemical resistance: As listed for Durex Plastic Division of Hooker Chemical Corporation Hetron 197.
  - Glass fiber: Chopped fiber between 0.5 and 2.0 in. in length.
  - Minimum glass content:
    - 30% of laminate weight.
    - Smooth inside duct and fittings surface.
    - Exterior surface texture and color to match sample provided by Contractor.
    - Duct material requires Tinivin P content in the amount of 0.1% of resin weight as an ultra-violet absorber.
    - Duct shall include a Dynel interior chemical surfacing mat with Silane finish and styrene soluble binder in 20-mil maximum thickness.
    - Obtain exterior color by a 20-mil fire retardant, air-dried gel coat.
    - Duct sections: Make without transverse joints, except that factory-made joints are permitted at point of connection between elbow and straight lengths. Use butt type with glass fiber mat wrap, resin-impregnated, extending to at least 2 in. onto each member joined, and matching in color.
    - Color: For HSIR, olive drab in finish color; ducts for other buildings shall match existing or be white, subject to review and approval by UCSF.
    - Joint draw bands: No. 22 stainless steel, Type 316 with No. 1 or 2B finish, with two Type 203, 304, or 316 stainless steel 3/16 in. stove bolts and nuts. Do not paint draw band.
    - Transitions: Make fiberglass-to-metal ducts of fiberglass as noted above.
    - Sealant: Hypalon caulking.
    - Fiberglass-polyester ducts: Factory-made wrapped joints are superior in appearance to joints made in the field. Where appearance is critical, specify ducts delivered to job site as complete assemblies with factory-made joints. Exercise care in detailing supports to avoid unsightly installations.
2. Duct Supports.

   **Attachments:**

   - To concrete: Use poured-in-place concrete inserts in new concrete and expansion fasteners in existing concrete.
   - All inserts and other support materials that are exposed to weather: Hot-dipped galvanized after fabrication, or Type 302 or 304 stainless steel.
   - Exterior ductwork: Support and brace to withstand 30 psf wind pressure.

3. Dampers.

   **Volume Control Dampers:** Adjustable balancing dampers: Indicate on Drawings, and provide in each branch takeoff for proper control of balancing of the air distribution system. Make operating levers readily accessible.

   **Modulating Control Dampers:** Provide:

   - Automatic, opposed blade, with minimum air leakage at closed position.
   - Neoprene edges and damper actuator, with sufficient torque to provide not more than 2% damper leakage, 6 CFM per sq. ft. leakage at 0.5 static pressure differential.
   - Control actuator by manufacturer of temperature control equipment.

4. Diffusers, Grilles, and Registers.

   **Performance:** Include a diffuser schedule on the Drawings showing the required performances.

   **Finish:** Diffusers, grilles, and registers: Factory-finished with baked enamel paint; field painting is not permitted. Include color selection in Construction Documents.

   **Type:**

   - Ceiling diffusers: Aluminum construction, removable core type, with opposed blade dampers. Indicate airflow pattern on Drawings. Perforated face type, with hinged free panel, is preferred.
   - Ceiling exhaust registers: Aluminum construction complete with opposed blade dampers. Hinged, perforated face type registers are preferred.
   - Wall supply or exhaust grilles: Aluminum construction with screwdriver-operated aluminum dampers, nylon bearings and bushings, double or single defraction type with horizontal or vertical face bars. Do not install wall grilles in fire-rated walls or partitions.
   - Eggcrate ceiling exhaust grilles: 1/2 x 1/2 x 1 in. aluminum grid, where used.
   - Extractors or straightening grids: Not permitted.
   - Ductwork that can be seen through grilles: Field-paint matte black.

5. Turning Vanes.

   **Elbows:**

   - May be made with square turns and applicable size airfoil double-width turning vanes. Start first vane tight at heel of elbow. Attach vanes to duct at both ends at 6 in. on center with sheet metal screws or rivets.
   - Turning vanes: High efficiency profile.
   - Vaned elbows: Use in supply air ducts only. Turning vanes are not permitted in exhaust or return ductwork.
6. **Acoustical Duct Lining:** Interior duct lining may be used on general exhaust, general air return and supply ductwork for offices only; not acceptable in hospital, laboratory, animal care supply air systems, or fume hood, radioisotope, or biohood exhaust systems.
1. **Air Intakes and Exhausts.**

   **Pigeon Roosting:** Design and locate air intakes to discourage roosting and nesting of pigeons in, above, and adjacent to intakes.

   **Louvers:**
   - Intake louvers: Type 304 stainless steel for corrosion resistance, removable bird screens of stainless steel, readily accessible for cleaning, with no mesh smaller than 1/2 in. or larger than 1 in.
   - Side-drainable type, where possible.

   **Screens:**
   - Screen exhaust discharges only where required for safety. Wherever possible, discharge upward from highest point of the building. Minimum screen mesh is 1/2 in., maximum is 1 in.
   - Material: Stainless steel for intake or exhaust screens and bolts, nuts, or other mechanical fasteners required for installation.

2. **Air Filters.**

   **Material:**
   - Provide all ventilation supply systems with air filters.
   - Use Type 302 or 304 stainless steel for filter tracks, permanent parts of the filters, and filter holding frames.

   **Drains:**
   - Provide all filter plenums with drains to remove moisture resulting from fog removal by filters, and to allow plenum washdown on major systems.
   - Waterproof plenum floors and slope at least 1/4 in. per ft. to floor drains.
   - Provide a hose bibb for each plenum equipped with a floor drain.
   - Elevate filter banks a minimum 6 in. above the surrounding floor.
   - Equip plenum floor drains with trap primers.

   **Height:** Limit filter bank heights to 8 ft. wherever possible. Provide filter banks taller than 8 ft. with suitable safe means for serving upper filters (e.g., permanent, moveable ladders, scaffolding).

   **Operation During Construction:** Require systems not be operated during construction period without filters in place. Systems require new filters for new systems and clean filters for existing systems at time of acceptance.

   **Efficiency:** Filters shall have a minimum efficiency of 35% to 40%, and an arrestance of 94%. Filter media: Polyester; fiberglass is not permitted to prevent sagging and premature rupture due to excess moisture from fog-laden atmosphere.
3. **General Duty Fans.**

   **Bearings:** Roller type with 400,000 minimum bearing L-10 life.

   **Lighting:** Units with walk-in or crawl-in access: Provide weatherproof internal lighting with weatherproof switch mounted on cabinet exterior.

   **Flexible Connections:** Provide between the fan and ductwork.

   **Belts:** Use two belts on each drive; avoid adjustable drive sheaves.

   **Lubrication Fittings:** Equip cabinet-type fans with lubrication fittings extended to the exterior of the cabinet.

   **Motors:** Use TEFC type supply fan motors located outside or exposed to weather.

   **Discharge Stacks:** Terminate not less than 7 ft. above the roof or floor level.

   **Fan Mounts:**

   - Combination spring and elastomer vibration mounts are recommended for indoor fans.
   - Spring isolators for fans exposed to the weather or located in air intake plenums: Equip with neoprene-coated springs and isolator parts. Use hot-dipped galvanized or stainless steel mounting bolts and hardware.

4. **Fume Hood, Radioisotope Hood, and Biohood Exhaust Fans.**

   **Controls:**

   - Continuously run fans without local control from hood location and independently of any time clocks.
   - Clearly label starters at motor control centers to designate which fan and hood are being controlled.
   - Indicate fan operation with pilot lights.
   - Make available emergency power circuits for fan service.
   - Provide motor starters with on-and-off switches, not momentary contacts, so fans will automatically restart upon restoration of power after an outage.

   **Mounting:** To assure all interior ducts will be under negative pressure, mount all hood exhaust fans on roof.

   **Size:** Size fans to provide a face velocity of 150 FPM at the hood served.

   **Material:** Type 316 stainless steel for all parts in contact with the air stream.

   **Discharge:**

   - Fans: Upblast discharge, with backward-curved blades. Provide 1/2 in. drain hole in the scroll bottom, and full weather cover over motor and drive, constructed of Type 316 or Type 304 stainless steel and hardware.
   - Discharge duct shall provide a transition from the fan discharge size to a size which will provide a velocity of at least 2500 FPM.
• Weather caps or bird screens are not permitted on the discharge stack.

5. **Housekeeping Pads.** Provide for floor- and roof-mounted equipment (e.g., fans, air handlers).

6. **Air-Handling Units.**

   **Unit Casing and Fan Section:** Use sectionalized heavy-gauge steel formed panels for component modules.

   **Coil Sections:** Use copper or stainless steel drain pans.

   **Lubrication:** Extend bearing lubrication fittings to unit case exterior.

   **Lighting:** Use weatherproof internal lighting.
15950 TEMPERATURE AND AIR VOLUME CONTROLS

GENERAL

1. General.

   **Match Existing:** Match existing controls. Exception: Major renovations may use new technology controls (e.g., a complete floor or wing). For proposed new controls, use either the same manufacturer as existing, or make fully compatible with existing. New technology controls must meet experience and reliability criteria acceptable to UCSF.

   **Operation:** Use system control via EMS with stand-alone DDC operation.

   **Design:** Provide:

   - System design so systems can operate at efficient part load and/or unload at low load conditions.
   - Outside air temperature shutdown.
   - Multiple units with lead/lag controls.

   **Pneumatic Tubing:**

   - Use hard copper, type L, for terminations and when exposed to the weather or concealed in walls/ceilings.
   - Use polyethylene tubing or equal inside panels.
15990 TESTING, ADJUSTING, AND BALANCING

GENERAL

1. Scope. The following steps are required on all UCSF projects:

• During the Schematic Design Phase, Project Manager will arrange for an Air and Water Balancing Contractor to make a survey of existing air and water conditions for the project site. This survey will provide information on existing systems, and will serve as the reference point for final testing, adjusting, and balancing of all systems after the construction project is completed.
• As a part of the construction project, the General Contractor will complete the pre-balancing work of all systems affected by project work, and will submit a Pre-Balancing Report.
• Project Manager will arrange for final balancing work to be completed by the General Contractor or Balancing Contractor. Contact Project Manager at the beginning of project to determine if this work will be completed as part of construction contract or under separate balancing contract. This work includes a check of the General Contractor's Pre-Balancing Report, in addition to re-balancing of affected areas of the building outside the project area. Upon completion of this work, the General Contractor or Balancing Contractor will provide a Final Balancing Report to Project Manager and Design Professional covering all affected areas.
• Review the Final Report, and require General Contractor or Balancing Contractor to make corrections, as required, to complete the work.
DIVISION 16 — ELECTRICAL

16050    GENERAL ELECTRICAL REQUIREMENTS

GENERAL DESIGN CRITERIA

1. Equipment Arrangement.

   **Access:** Arrange electrical equipment for safe and convenient access, and for efficient operation.

   **Location:**
   
   - Locate electrical equipment (e.g., switchboards, substations, panels, transformers) in dedicated electrical rooms accessible to authorized personnel.
   - Select electrical equipment locations with due regard for accessibility and proximity to load.

2. Existing Equipment. Specify changes to existing electrical equipment shown on the Drawings that is subject to be altered, relocated, or interfaced. Clearly detail revisions or modifications required for the new locations.

3. Unacceptable Locations and Connections. The following design locations are unacceptable:

   - Electrical equipment requiring periodic inspection, maintenance, or adjustment with access via ladders or crawl space.
   - Electrical substations or switchboards with only one access door, or located below mechanical equipment rooms without waterproof floors.
   - Electrical panels located in or requiring access through private offices or narrow, heavily used passageways.
   - Electrical panels or telephone cabinets in doorways, behind doors, or in narrow passageways.
   - Electrical panels located in public space. Exception: Where necessary, coordinate location with the Project Manager.

4. Utilities Termination. Coordinate all work related to utilities with the Project Manager.

5. Stray Heat. Do not locate electrical panels near heat sources or in hot rooms.


   **General:**
   
   - Meter electrical utility services to each building by both KWH and KW demand metering. UCSF may request additional submetering for special subdivisions within the building.
   - Coordinate meter requirements and locations with Project Manager.


   **Aerial:** Aerial utilities and utility poles are not permitted. Project Manager must approve special circumstances.

   **Buildings:** Building distribution systems: Either 120/208 and/or 277/480 volts, 3-phase, 4-wire, for lighting and power.
8. **Space.** In laboratory buildings, place utilities in shafts with access from each floor. Provide space for future utilities equal in area to one-half the space required for the initial installation. Where load conditions justify, use busways for riser and floor distribution as an economic alternative to conduit and wire.

9. **Special Locations.**

   **Cold Rooms and Warm Rooms:** For special electrical requirements, refer to cold and warm room standards in Division 13 of these Guidelines. Make electrical materials and equipment in these spaces compatible with ambient conditions.

   **Basement Areas:** Secure electrical switchgear located in basements against flooding.

   **Wet Areas (Spaces Cleaned with Water or Steam, and Exterior Areas):**
   - Make electrical work in these spaces (e.g., animal rooms) waterproof.
   - Enclosures for electrical equipment: NEMA 4 or 4X.
   - Seal conduits entering or leaving.
   - Where possible, locate items like switches and programmed clock for lighting outside the space.
   - Install large equipment like switchgear and motor control centers located on roofs or outside in NEMA 3R double-wall enclosures that have fully gasketed doors, interior heating, and ventilation to eliminate the possibility of condensation inside the equipment or enclosure (NEMA 4X is preferred).
   - Finish steel enclosures with a heavy-duty maintenance coating of ultraviolet-inhibited isocyanate/acrylic resin coating system of a high solids polyamide or amine cured (catalyzed) epoxy.

10. **Specifications.**

    **Installation:** Do not specify installation of materials “in accordance with the manufacturer's recommendations.” Where a single type of material is acceptable and the method of specification is uniform for all manufacturers' products, specify the installation requirements explicitly and in detail.

    **Divisions:**
    - Indicate which Specifications section includes automatic controls, control wiring, motors, disconnect switches, motor starters, or electrical equipment related to Division 16. If furnishing or installation of electrical materials is included in Division 15, do not include in Division 16.
    - Include in Division 16 the furnishing and installation of disconnect switches, motor starters, control wiring, and other electrical devices. Exception: Where integral with mechanical equipment (e.g., electric water chillers, air-conditioning units, fans, elevators).

    **Contractor:** Do not delegate the responsibility for determining that the work will fit as designed to the Contractor.

    **Equipment:** In each Specifications section, provide a list of specific equipment requiring shop drawings and product data.

11. **Drawings.**

    **Complete:** Make Drawings sufficiently complete in detail for general electrical installation so Contractor's installation drawings will only be required for special conditions, or in cases where
equipment rearrangement is required because of substitutions of materials. However, require manufacturer’s detail drawings on special equipment as part of the submittal process.

**Congested Areas:** For better coordination, include cross-sections of congested areas to show all electrical and mechanical work involved. Show sections for each affected discipline.

**Extent:** Provide separate drawings for lighting, power, and communication/signal systems, except where otherwise permitted on small projects.

**Diagrams:**

- Provide single-line diagrams to indicate electrical equipment (e.g., transformers, main circuits, circuits size and branch circuits, all protective devices) with notations for continuous duty and trip rating in amperes.
- Furnish riser diagrams for electrical systems. Where practical, show vertical dimensions on the diagrams.

**Size:** Show sizes and routing for electrical feeders.

**Dimensions:** Show overall dimensions and capacities of power and light cabinets, service, and equipment.

**Branch Circuits:** Show branch circuits, together with circuit numbers, to each outlet.

**Scale:** Draw all layouts to scale, 1/8 in. = 1'-0" minimum scale.

**Locations:** Show and locate all electrical service and meter equipment. Include complete details, including cross-sections of electrical rooms and any similar space with a high concentration of electrical and mechanical equipment.

**Supports:** Detail the type of support for light fixtures, and dimension the distance from the floor or the length of the stem.

**PRODUCTS**

1. **Conduit.**

   **Type:** Rigid steel, MC cable for branch circuits, galvanized, PVC-coated rigid steel or EMT conduit. Nonmetallic conduit is allowed underground.

   **Underground:**

   - Encase underground conduits and ducts in concrete envelope (red-dyed for high voltage).
   - Provide duct banks with steel reinforcing bars of proper size and spacing.
   - Detail ducts to slope to manholes for drainage. Trapped ducts are not acceptable.
   - Detail manholes on Drawings, externally waterproof, and provide with watertight covers.

   **In Concrete:** Use rigid conduit, IMC, or EMT with compression fittings in concrete slab or in wall construction.

   **EMT (Electrical Metallic Tubing)** Use with insulated throat connectors in ceiling spaces, wall cavities, furred spaces, and areas not subject to damage. Use compression locking ring type connectors. Set screw or indenter fittings are not acceptable.
Flexible: Use flexible steel conduit for connection to all movable motors and to vibration-producing equipment. Provide sufficient length for anticipated movement, and to prevent transmission of any vibration to the building. Use liquid-tight flexible conduit for all damp or wet locations. Use PVC-coated rigid steel for areas exposed to weather.

Liquid Tight Flexible Metal Conduit: Use liquid tight flexible metal conduit formed from spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with a liquid tight plastic cover in areas where flexible conduit is required and exposed to moisture.

PVC-Coated Rigid Steel Conduit: Use PVC-coated rigid steel conduit in areas exposed to weather or moisture.

Unacceptable Locations: Do not locate conduit:

- In concrete slab where conduit has an outside diameter greater than one-third of slab thickness.
- In a concrete slab less than 3-1/2 in. thick. Local offsets are an exception.
- Between concrete slab reinforcing steel and bottom of slab.

General:

- Install sealing fittings on conduits penetrating walls of cold rooms.
- Run all exposed conduits parallel to building walls and ceilings.
- Do not support conduit raceways by other building piping systems.
- Support vertical conduit runs by means of adequate clamps at each floor, or as required by code.
- Use 3/4 in. minimum conduit size for power wiring, except for single terminations.

2. Wire and Cable.

Type: 600 volt copper conductors for secondary power and light distribution.

Requirements for Copper Conductors Only:

- Dry locations: Type THWN or THHN.
- Wet locations or in concrete in contact with the ground: Type XHHW.
- Lighting or receptacle circuits: Do not use conductors smaller than No. 12 AWG.
- High voltage cable (4160 volt and 12000 volt systems): 5KV and 15KV, EPR type copper-shielded, with 133% insulation.


Type: Copper, minimum 98% conductivity.

Insulation: Insulate bus bars over entire length, including joints with 130°C, Class B insulation.

Ground Bus: 25% of phase bars.

Housing: Totally enclosed, nonventilated type.

4. Outlets.

Type:

- Use cast metal conduit bodies with threaded hubs for outlets in exposed wet and hazardous locations, and sheet steel boxes with sherardized or galvanized finish in concealed locations.
5. Receptacles.

Type: Where weatherproof mounting is required, mount in a cast metal conduit fitting and cover with gasketed, spring type door. Use receptacles rated at 20 amperes.

Receptacles: Specification grade, except in I occupancy where receptacles shall be hospital grade.

General:

- Install receptacles with the grounding slot at the top for vertical plate installations, and with the ground slot at the left for horizontal plate installations.
- Install receptacles in mechanical rooms and at roof-mounted equipment so no piece of equipment is more than 25 ft. from a receptacle.
- Identify all receptacles connected to emergency power. Use red toggle switches and receptacles for emergency circuits.


Type:

- Use quiet switches rated 20 amperes, 120/277 volt AC. Color and finish as selected by the Design Professional.
- Attach to each switch yoke used on 277 VAC, a 1 in. diameter red tag reading, “Caution C 277 VAC.” Do not use metal or metal-edged tags.


8. Motor Disconnect Switches.

Type: Use heavy-duty disconnect switches. For single-phase, fractional horsepower motors, thermal switches may be used.

Enclosures:

- Install disconnect switches exposed to weather in cast or stainless steel boxes with gasketed covers with spring-mounted doors.
- For larger size motors, use stainless steel enclosures.
- NEMA Type 4X sheet metal NEMA 3R enclosures are unacceptable.


Switchboard and Separately Mounted Circuit Breakers, Panelboards, Motor Starters, Disconnect Switches, Relays, and All Apparatus Used for the Operation or Control of Power Circuits, Appliances, or Equipment:

- Identify by means of descriptive engraved nameplates.
- Use 1/16 in. minimum thick laminated plastic plates with black lettering on a white background, permanently secured to equipment.
- Use red nameplate on all emergency equipment.
- Do not use adhesives for attachment of equipment nameplates.
Lighting and Receptacle Panel Circuit Breakers: Identify by permanently fixed numbers and a typewritten directory, mounted under clear plastic with a 6 x 8 in. metal frame on inside of cabinet door.

Submittal: Approve nameplates and lettering samples before installation.

10. Seismic Restraints.

Electrical Equipment:

- Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift. Submit calculations and details, signed by a Structural Engineer registered in the State of California.
- Design equipment and internal components to withstand the required seismic force criteria for Seismic Zone 4. Provide suitable structural elements for fastening restraining attachments.

Lighting Fixture Supports: Provide seismic support system for all lighting fixtures, independent of the ceiling support system. Where support wires are used, terminations require four wraps minimum.

Engine Generator Restraints and Isolators:

- Provide vibration isolation and all directional restraints. A Structural Engineer, registered in the State of California, shall sign vibration isolation details and calculations.
- Connect conduit and piping to isolated equipment with approved flexible connections, resiliently supported to achieve full degree of isolation.

11. Commissioning. For all projects, Project Manager will determine extent and contractual process of commissioning of all mechanical and electrical systems.
16060  GROUNDING

GENERAL

1. Scope.

   **System Grounding:**
   
   - Ground secondary service neutrals at the supply side of secondary disconnecting mains, and at related transformer neutrals.
   - Ground the secondary neutral on separately derived systems (transformers downstream from the service entrance).
   - Provide bonding bushings and bonding jumpers to panel and MCC feeder conduits.

   **Equipment Grounding:**
   
   - Ground all lighting fixtures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items for personnel safety, and to provide a low impedance path for possible Use bonding jumpers, grounding bushings, lugs, buses, and other approved bonding devices for connection to the equipment grounding system.
   - Accomplish equipment grounding through inclusion of a green insulated copper conductor with each conduit sized per NEC requirements. Bond this conductor to each metal enclosure associated with that conduit.
   - Provide a grounding conductor (green) for all receptacle and lighting circuits. All receptacles are to be three-pin type with a chassis ground pin. Provide an isolated ground conductor (green with orange) with an isolated ground receptacle for equipment that requires isolated grounds.
   - Provide bonding bushings at concentric and eccentric knockouts.

2. Certification. Two weeks prior to final inspection, submit documents certifying the grounding work has been completed in accordance with the Construction Documents.
16300  POWER DISTRIBUTION

GENERAL


*New Buildings:* Provide service to new buildings on Parnassus Campus from the 12KV distribution system unless specifically approved otherwise by the Project Manager.

*Type of Electrical Service:* The following criteria defines the type of electrical service required:

<table>
<thead>
<tr>
<th>Category</th>
<th>Shutdown Tolerance</th>
<th>Main Size (Amperes)</th>
<th>Feeder Size (Amperes)</th>
<th>Substation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>3200-4000</td>
<td>&gt;400</td>
<td>Double-Ended</td>
</tr>
<tr>
<td>2</td>
<td>None</td>
<td>&lt;2001</td>
<td>100-1200</td>
<td>Double-Ended</td>
</tr>
<tr>
<td>3</td>
<td>Some</td>
<td>&lt;4001</td>
<td>100-1200</td>
<td>Single</td>
</tr>
</tbody>
</table>

Category 1 and Category 2 facilities should have a primary selective system provided from two different 12KV feeders. Each 12KV line should be able to carry the complete building load. Each of two transformers should be fed by both 12KV lines. Transformers should use a duplex switch arrangement.

*Substations:*

- Make secondary selective.
- Size transformers so the fan rating of each transformer can carry the full load—present and future—indefinitely.
- Unless otherwise determined, assume future growth at 25% of the full load.
- Include fans with the transformers.
- Provide transformers no larger than 2500KVA base KVA for 480/277-volt systems, and no larger than 1500KVA for 120/208-volt systems.

*Double-Ended Load Center Substation:*

- Arrange to make a closed transition possible from secondary main to secondary main and maintain continuous service to the loads. Limit time period that both mains and ties are closed by adjustable timers.
- Locate main-tie-main controls in the center tie compartment.
- Switchboards: Include approximately 25% space for future circuit breakers.
- Future circuit breakers: Clearly delineate on the one-line diagram.

*Category 1 Facilities:* Are facilities requiring high reliability, and with large power needs. Category 1 facilities employ individually mounted switchboards with the following characteristics:

- Individually mounted draw-out circuit breakers.
- 30-cycle withstand rating on bus similar to UL 1558 Switchgear.
- Low-voltage power circuit breaker mains and ties at 4000 or 3200 amperes, electrically operated.
- Stored energy, insulated case circuit breakers for feeders.
- Fully insulated and isolated bus. Fully compartmentalized circuit breakers.
- Mains and ties: LT, ST, and GF adjustable trips. No instantaneous. No GF on 120/208-volt systems.
systems.
- Feeders: LT, ST, I, and GF adjustable trips. No GF on 120/208-volt systems.
- Switchboards: Front- and rear-accessible.
- Bus: Copper, tin, or silver-plated.
- Breakers: Electronic trips suitable for secondary injection testing and IMPACC com network.

**Category 2 Facilities:** Are facilities smaller than Category 1 facilities, but also require a high reliability of service. Loads should not be greater than 2000 amperes. Category 2 switchboards employ individually mounted breakers with the following characteristics:

- Individually mounted draw-out low-voltage power CB mains and ties (UL 1066) breakers. Mains and ties: Of same size, and electrically operated.
- 30-cycle withstand rating on bus similar to UL 1558 Switchgear.
- Molded-case circuit breaker (MCCB) feeders: Plug-in or draw-out.
- Fully insulated and isolated bus. Fully compartmentalized circuit breakers.
- Mains and ties: LT, ST, and GF adjustable trips. No instantaneous. No GF on 120/208-volt systems.
- Feeders: LT, ST, I, and GF adjustable trips. No GF on 120/208-volt systems. Feeders smaller than 251 amperes do not require adjustable trips.
- Switchboards: Rear-accessible.
- Bus: Copper, tin, or silver-plated.
- Breakers larger than 250 amperes: Electronic trips suitable for secondary injection testing and IMPACC com network.

**Category 3 Facilities:** Are those facilities that do not require very high reliability and have a low initial cost budget. These facilities may utilize single-ended substations with group-mounted circuit breakers. Switchboards require the following characteristics:

- Mains: Individually mounted, draw-out, stored energy, insulated case type circuit breakers with LT, ST, I, and GF adjustable trips.
- Feeders: Molded-case circuit breakers. 480/277 volt systems feeders rated 251 amperes and above require LT, ST, I, and GF adjustable trips. May be group-mounted, bolted, or plug-in.
- Switchboard: Front-accessible.
- Breakers larger than 250 amperes with adjustable trips: Electronic trips suitable for secondary injection testing and IMPACC com network.

**Substation Transformer Requirements:**

- All transformers:
  - Copper windings.
  - Sound levels to conform to NEMA standards.
  - 4 taps, two above and two below nominal voltage.
  - Primary switches with spare fuse storage, clamp type terminals, and a viewing window.
  - “Make Before Break” primary switch arrangement.
  - Hinged door access.
  - Breakers with auxiliary contact wired to remote panels for breaker position and control with SCADA and IMPACC.
- Indoor transformers:
  - Dry type, employing Vacuum Pressure Impregnated insulation.
  - 115°C rise with 220°C insulation, 95KV BIL primary, with fan rating of 33%.
  - Include over-temperature protection, and station class arresters on primary.
- Outdoor transformers:
  - Silicone-filled preferred, verify with Project Manager.
  - A fan rating of 25% or 15% per ANSI standards.
  - Temperature rise of 55/65°C.
— With testing valves, oil over-temperature and pressure release mechanism.
— 95KV primary BIL.
— With station class MOV, gapless arresters on primary.

**Metering:**

- Provide each main circuit breaker with a multifunction electronic meter that:
  - Provides measurements of amperes, volts, KW, KWH, demand, peak demand, KVA, KVAR, power factor, and harmonics.
  - Has discrete I/O capability and internal set point for controlling output contacts for alarm and trip purposes.
  - Provides waveform capture capabilities for transient detection and harmonic analysis.
  - Provides IMPACC communications.
- In Category 1 and Category 2 facilities, provide each main and feeder circuit breaker with a frame at or above 400 amperes, with a meter or monitor that:
  - Provides for volts, amperes, KW, KWH, KVA, and KVAR.
  - Provides visible information on circuit breaker settings, trip status, and fault current magnitudes.
  - Provides entire system communication on IMPACC communications link.
  - Is visible with the circuit breaker's cubicle door closed.
- Software package: Review desirability of making available a software package that is:
  - Able to take data from all metering devices and display it in tabular and graphical form.
  - Capable of showing active system one-lines, equipment front views, trends, and other systems data.
  - Match existing IMPACC system, provide IMPACC Modbus gateway or utilize existing IMPACC gateway and program I/O's to suit data requirements by SCADA system/RS232.

**Testing, Studies, Training, and Reports:**

- Request certified factory test reports on all transformers and switchboards.
- Provide startup and commissioning services by the manufacturer's trained field-testing and warranty organization.
- Require complete factory and field test reports as part of the operating and maintenance manuals provided prior to final acceptance by UCSF. Include the coordination and short circuit studies in the reports.
- Manufacturer shall provide training to maintenance personnel. One 4-hour period minimum on Category 3 facilities, and two 4-hour periods on Category 1 and Category 2 facilities.

**Spare Circuit Breakers:** Require that substations be supplied with spare circuit breakers, one of each frame size. These spare breakers are not future breakers, but necessary to supply power while testing load breakers. Wiring bus work provisions are required. Also, in the event a load-carrying breaker malfunctions, the spare would be put in service, limiting building electrical system outage.

2. **Low-Voltage Distribution Equipment.**

**Stepdown Transformers:**

- 480 volt primary, 120/208 volt, 3-phase, 4-wire, secondary, unless required otherwise.
- Open-ventilated, dry type Class H insulation (220°C), 150°C rise designed for full load operation at 80°C rise, with separate primary and secondary windings.
- Transformers supplying nonlinear loads: UL-K 13 rating, unless otherwise determined by Design Professional.
Distribution Panels:

- Power panels: Deadfront, totally enclosed, with bolt-on molded-case circuit breakers.
- Bus bars: Copper.
- Circuit breakers: Fully rated for the available short circuit.
- Short circuit interrupting rating shall be listed the same as the rating of the lowest installed electrical component interrupting rating. All electrical components inside the distribution panels shall be fully rated to withstand the *available fault current*. Refer to the Master Electrical Power Study for fault currents.
- Where the *available fault current* at the line side of the downstream panel board exceeds the short circuit interrupting rating, a current limiting device shall be installed to limit the fault current (let-through current).

Lighting and Appliance Panel boards:

- Panel boards: Deadfront assemblies of copper bus bars, bolt-on circuit breakers and sheet metal cabinets, and finished trim covers.
- Lighting and appliance panels: Door-in-door trim.
- The neutral bars in the 120/208-volt panels feeding nonlinear loads: 200% rated.
- The IC rating of the entire panel assembly is equal to the IC rating of the component with the lowest IC rating. The panel assembly and circuit breakers inside the panels shall be fully rated to withstand the *available fault current*.
- Locks on panel boards in a single building: Key alike the outer locks of the door-in-door assembly. Key alike the inner locks of the door-in-door assembly, but different from the outer locks.
- Circuit Breakers: 120/208-volt systems: Commercial class. 1 inch wide per pole (minimum), bolted to the bus. 277/480-volt systems: Commercial class. 1-3/8 inch wide per pole (minimum), bolted to the bus.

Motor Control Centers:

- Motor control centers (MCC): NEMA Class I, Type B.
- Bus bars: Copper, minimum 98% conductivity, silver or tin-plated at joints.
- Provide ground bus, 25% of main bus, extending full length of motor control center, and bolt at each vertical section.
- Provide minimum 25% spare capacity in the MCC, including bus work for future starters addition.
- Provide for future extension at ends of horizontal bus.
- Line starters: Compatible with existing IMPACC system.
16500 LIGHTING

GENERAL

1. Lighting Fixtures.

   **General:** Use 2 x 4 ft. recessed, fluorescent two or three lamps, with parabolic louvers. Fixture design: Meet the IES RP1 preferred standard for VDT application.

   **Fixtures with Four or More Fluorescent Lamps:** Do not specify because of their inherent inefficiency. Consider fixtures manufactured with specular metal reflectors to improve efficiency.

   **Non-VDT Areas:** Fluorescent fixtures with lenses, clear virgin acrylic, conical-prism, injection-molded may be used, subject to approval by Project Manager.

   **Emergency Exit Signs:** LED type.

2. Lamps.

   **Typical Fluorescent Lamps:** 4 ft. instant-start parallel, T-8, 3500-Kelvin color temperature, unless required to match existing. Rapid-start lamps may be used to match existing.

   **Compact Fluorescent Lamps:** Use whenever possible in place of incandescent lamps.

   **High-Intensity Discharge:**
   - Mercury vapor lighting fixtures: Do not specify.
   - Metal halide lamps: Coated color-corrected type.
   - High-pressure sodium lamps: Unless otherwise approved in writing, use only in areas of noncritical viewing tasks (e.g., parking lots). Use color-corrected lamps where possible.

3. Lamp Ballasts. Fluorescent lamp ballasts: Instant-start parallel, high-frequency solid state, total harmonic distortion (THD) less than 20%, high-power factor, Class A, with auto-resetting built-in thermal protection. Rapid-start lamps may be used to match existing.

4. Lighting Controls.

   **Location:** Locate light switches for lobbies, corridors, and similar circulation areas to accommodate persons entering or leaving the building at night.

   **Night Service:** Design corridor light circuits so a small number can be left on for night service, and for extended building shutdowns (e.g., the winter holiday).

   **Ultraviolet:** Design system to prevent activation when space is occupied.

5. UV Lighting Systems. The UV lights and the normal overhead lights can never be on at the same time. The normal lighting switch must override and de-activate the UV light switching system from inside the room. There must be an indicator light at all entrances to the room indicating UV light in use.

**Remodeling:** Most of existing buildings are provided with emergency service either from the Campus steam turbine-driven generators located in the Power Plant, from generator sets serving the individual building, or by a combination of the two. Emergency power for altered or renovated areas can normally be connected to these systems. However, to avoid unanticipated load growth, review all load increases resulting from occupancy changes, unusual equipment, changes in code requirements, etc., with Project Manager during the Schematic Design Phase.

**New Construction:**

- Because of capacity limitations of the existing Campus steam turbine-driven generators, provide new buildings with separate engine-generator units.
- Since the Campus high-voltage feeders are re-energized automatically from the Campus generators in a time sequence following a PG&E outage, new buildings require automatic disconnecting from the feeders by under voltage trips upon PG&E service failure. Return of building to power upon restoration of PG&E service will be manually reset by UCSF.

**Engine-Generators:**

- Design new engine-generator installations with particular care to avoid objectionable noise during operation.
- Provide fuel tank locations so tanks can be filled conveniently and without odors being drawn into building air intakes or windows. Locate engine exhaust and tank vent terminations above roofs, and fit exhausts with critical type mufflers.
- Attenuate radiator fan noise, if necessary.
- Size fuel storage for at least 24 hours running capacity of the engine-generator.
- Provide remote status indicator for engine generator and transfer bypass switch, wire to SCADA.

**Battery-Powered Units:**

- All major UCSF buildings have existing emergency electrical circuits. Some existing UCSF buildings are not equipped with engine-generators and do not have dual feeders from the generators. Verify all actual existing conditions.
- Because of high maintenance requirements, limited capacity, and limited duration capabilities, avoid the use of battery-powered units.

2. Engine-Generators.

**Type:**

- Use air-cooled, diesel-engine-driven generator sets, 3-phase, 4-wire.
- Rating: 277/480-volt, whenever possible.
- Maximum size generator: 1,000 KW, unless larger units are justified by specific site conditions.
- Equip generator with 4-cycle, 1,800-rpm engine, arranged for unattended automatic operation.
- Provide required accessories, with complete wiring and piping to provide emergency power within ten seconds, when utility company power fails.
- Unit to operate on a commercial grade of No. 2 diesel fuel.
Location: Carefully coordinate the location of generators to minimize transmission of noise and vibration, and to provide optimum space for maintenance and service access.

Mechanical Work: Include fuel oil piping between main tank and day tank, and between day tank and engine, exhaust piping, hot pipe insulation, and radiator duct in Division 15 sections. If only a single tank exists in building, then provide external delivery piping.


At Plant:

- Test equipment at the plant prior to shipment to the job site.
- Perform the factory test 8-hour duration at 100% rated load and .8-power factor.
- Certify the entire test, including safety shutdown devices.
- Witness the testing.
- Do not exceed the specified operating limits of engine and generator.
- Test as follows:
  — Test and calibrate pressure, temperature, frequency, current, and voltage meters to assure conformance with manufacturing tolerances and accurate indications.
  — Apply four repetitive 5-minute cycles of one-step application and removal of full load.
  — Make recordings each 15 minutes for water temperature, voltage, current, frequency, KW, power factor, and generator frame temperature.
  — Perform additional operational tests within the performance requirements as requested by UCSF.

At Job Site:

- After installation at the job site is complete, test equipment at full load and .8-power factor. Use building load supplemented with load banks. Do not exceed specified engine and generator operating limits. Test the equipment as follows:
  — Test and calibrate operation of safety shutdown and alarm systems.
  — Test and calibrate operation of accessory equipment (e.g., starting system, fuel oil system, radiator fan, pumps).
  — Demonstrate operation of transfer switches.
  — Record water temperature, oil pressure, ambient air temperature, voltage, current, frequency, and KW each 20 minutes.
  — Demonstrate the following control features:
    - Remote voltage adjustment.
    - Remote frequency adjustment.
    - Preliminary alarm and safety shutdown verification.
    - Proper functioning of controls and related equipment.
    — Perform additional operational tests as directed within the performance requirements and scope of the Construction Documents.


Drawings: Include plan and elevation of generator room showing unit with accessories and auxiliary equipment, including interconnection wiring, piping, radiator connection (if applicable), anchor bolt plan, and anchorage/isolator details and calculations signed by a registered Structural Engineer.

Equipment Specifications: Provide complete engineering details of engine-generator, including voltage regulator, radiator, jacket water heaters, safety shutdown system, governor, battery and
charger, thermostatic and solenoid valves, starting equipment, exhaust silencer, and related accessories.

**Electrical Diagram:** Show interconnection of generator, voltage regulator, control panel, and all electrical accessories. Include details of terminal and related markings.

**Test Reports:** Witness the testing.

5. **Instructions.** Require factory-authorized representative to instruct UCSF personnel in the operation and maintenance of the equipment. UCSF requires eight hours of instruction at intervals scheduled by UCSF.

6. **Maintenance Manuals and Guarantees.**

**Information:** In addition to the required Maintenance and Operating Manuals, provide one complete set of drawings, wiring diagrams, and service information. Locate in a metal case attached to control panel.
16960 TESTING REQUIREMENTS

GENERAL

1. Scope.

Requirements: Test all cable, equipment, and systems to assure proper installation, settings, connections, and functioning in accordance with the Drawings, Specifications, and the manufacturer's recommendations. Field-testing is intended to be extensive and complete in order to provide assurance of correct installation and operation of equipment.

Items to Test: Tests shall include, but are not limited to, the following:

- All wiring: Free of unintentional shorts and grounds.
- Molded-case breakers, 150 amperes and larger: Time and instantaneous tripping, physical condition, contact resistance, insulation resistance.
- Power circuit breakers: Calibration to time/current curves, physical condition, contact resistance, insulation resistance.
- Grounding system: Ground resistance (impedance), ground integrity.
- Secondary service bus ducts: Proper torque on connections, insulation resistance, physical condition.
- Motor controls: Proper overload heater sizes.
- Ground fault system: Neutral, free of improper grounds and pickup.
- Protective relays: Pickup, timing, insulation resistance, physical condition.
- Switchboards, panel boards, and similar circuit breaker equipment: Insulation resistance, physical condition.
- Feeder cables: Insulation resistance.
- Motors: Proper rotation, insulation resistance.
- Generator.
- Transformers.
- Automatic transfer switches.
- Fire alarm system.

2. Thermographic Survey.

Visual and Mechanical Inspection:

- Remove all necessary covers prior to scanning.
- Inspect for physical, electrical, and mechanical condition.

Equipment: Scan the following:

- Medium/low-voltage switchgear.
- Busways.
- Transformers-dry-type (larger than 300 KVA).
- Main distribution switchboard.

3. Field Adjustments. By testing firm for final setting and adjustments on protective devices in accordance with the coordination study values.
   - Perform a UCSF fire alarm test prior to State Fire Marshal Final Acceptance Test.
   - Perform fire alarm system operational tests in the presence of the State Fire Marshal.
   - Manufacturer shall certify (NFPA 72 Form) that the fire alarm system has been installed, tested, and will function in accordance with specifications and State Fire Marshal requirements.

5. Testing Agency Qualifications. Use a firm that is:
   - Financially independent and can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the firm.
   - A member of the International Electrical Testing Association, specializes in the testing of equipment or apparatus specified in this Section, with a minimum three years experience.
APPENDIX 1

Area Calculations

See Part 1:
ADM-2, Paragraph 3
SCH-2, Paragraph 5
APPENDIX 1 — AREA CALCULATIONS

1. ASSIGNABLE SQUARE FOOTAGE (ASF).

Description: ASF is the sum of the areas inside the walls or vertical projections (in the case of covered, unenclosed ASF) of the spaces that can be used by occupants to carry out their functions. Circulation space within a suite of rooms is included in ASF. Circulation space which is not within an assigned suite of rooms (e.g., space in “public” corridors) is not included in ASF. ASF does not include the thickness of any walls.

Basis for Measurement: ASF area is measured from inside face of walls, partitions, or doors at or near floor level. Space is to be covered by a ceiling 6'-6" or higher and enclosed on all sides by walls, partitions, doors, or functionally equivalent. Express ASF to the nearest whole number. Include columns or similar structural elements, built-in or freestanding furniture and equipment, and alcoves and other similarly recessed areas.

Included Spaces:

- Offices.
- Classrooms and laboratories.
- Seminar and conference rooms.
- Libraries.
- File rooms and storage rooms.
- Special purpose rooms (e.g., auditoria, cafeterias, TV studios).
- Locker and shower rooms.
- Maintenance garages.
- Phantom corridors for large unpartitioned spaces.
- Private toilets.

Special Examples of Included Spaces:

- Capital Projects & Facilities Management Department offices, locker rooms, storage areas, shops, etc., located in Campus buildings, which are generally usable by other activities. Include separate central heating, cooling, or generating plant buildings.
- Separate mechanical service or equipment areas within buildings supporting or serving specific laboratories or program activities generally classified as laboratory service.
- Loading docks within the environmentally-controlled envelope of a building directly assignable to a specific department or program within the building. Exception: Loading docks serving multiple departments or programs are counted as circulation and are nonassignable.
- Phantom corridors within departmental suites.
- Within an assignable facility, a 6'-0" strip for circulation in front of public-use facilities such as elevators and public toilets rooms.
- Lobbies which are internal corridors serving operational functions (e.g., reception areas, waiting areas, areas serving display cases).
- Library stack areas, including aisles, stairwells, elevators, and book lifts within book stacks.
- Library reading rooms, including aisles.
- Toilet rooms for:
  — Residence hall and apartment occupants.
  — Hospital inpatients receiving treatment or diagnostic-related services.
  — Clinic outpatients receiving treatment or diagnostic-related services.
  — Executive suites.
  — Instructional and research activities dedicated solely to a department (e.g., nonpublic).
2. NONASSIGNABLE SQUARE FOOTAGE (NSF).

**Description:** NSF is the sum of circulation, custodial, mechanical, and structural areas (e.g., all the space which is not considered ASF). NSF does not include the thickness of walls.

**Included Spaces:**
- Janitor's closets, interior incinerator rooms, and other specialized custodial facilities which are usable only for building maintenance.
- All areas in central plant buildings devoted to mechanical services or equipment, either for the building itself or for service to other buildings.
- Elevators and dumbwaiters.
- Stairways.
- Telephone and data network closets.
- General (shared-use) corridors.
- Public toilet rooms.
- Enclosed parking.
- Enclosed driveways.

3. GROSS SQUARE FOOTAGE (GSF).

**Description:** GSF is the sum of all floor areas of a building, based on exterior dimensions. GSF includes the sum of ASF, and NSF, plus the thickness of the walls.

**Basis for Measurement:** Compute GSF area by measuring from the outside faces of the building, disregarding architectural and structural projections extending beyond the building face. Express GSF to the nearest whole number. Within the building, count vertical circulation space—whether floored or not—and vertical mechanical and electrical shafts at each floor. Include vertical mechanical and electrical shafts located outside the building as though they were inside the building (structures only - count surface area of decking).

**Included Spaces:**
- Basements and attics.
- Garages.
- Enclosed porches.
- Penthouses.
- Mechanical equipment floors.
- Areaways, lobbies, and mezzanines.
- Inside balconies utilized for operational functions.
- Unfinished areas.
- Vertical circulation with and without floors (count at each floor).
- Mechanical and electrical shafts (count at each floor).
- Piers (structures only - count surface area of decking).

**Excluded Spaces:**
• Attics without flooring.
• All open to the weather spaces (e.g., corridors, porches, balconies, courts).
• Light wells.
• Portions of upper floors eliminated by rooms or lobbies which rise above single floor height.
• Floored areas with less than 6'-6" clear headroom (unless they can be properly designated and used as mechanical or custodial areas).
APPENDIX 2

Construction Documents Review Checklist

See Part 1:
CD-3, Paragraph 3

Note: This document is taken from the University of California Facilities Manual, Volume 4, Resource Directory, RD1.6
RD1.6 CONSTRUCTION DOCUMENTS REVIEW CHECKLIST
(see [I]:6.1.1)

ASSEMBLY AND CONTENTS

——— Are all documents present?

• Check Table of Contents with actual contents.
• Are any improper documents included (parts of other projects, estimates, etc.)?

CERTIFICATION

——— Is the Certification properly signed by the design professional?

ADVERTISEMENT FOR BIDS

——— Is there a project description in the Advertisement for Bids? The scope in the project
description should agree with scope in Specifications, Division 1.

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

——— Are any special additions needed? Are the bidders informed of special bidding
conditions?

——— Are the contract time and liquidated and ascertained damages (LAD) correctly stated?

——— Do other documents agree with the Supplementary Instructions to Bidders?

INFORMATION AVAILABLE TO BIDDERS

——— If site work requires the use of a soils report, is the report listed?

BID FORM

——— Are alternates or unit prices listed in Specifications, Division 1?

• If alternates or unit prices are listed in Division 1, is there a place to enter bids for
these items in the Bid Form?

——— Cross-check alternate listing descriptions with descriptions in Division 1. Alternates must
be listed on the Drawings. Make certain descriptions do not conflict.

——— Check the format for listing alternates. Is the format arranged to avoid bidder confusion?

——— Is the contract time filled in?
RD1.6 CONSTRUCTION DOCUMENTS REVIEW CHECKLIST
(cont.)

AGREEMENT

——— Are the contract time and Liquidated Damages (LD) filled in?

——— Are separate LDs specified for phased work?

SPECIFICATIONS

——— Are all sections in the Specifications listed in the Specifications table of contents? Are all sections listed in the Specifications table of contents contained in the Specifications?

——— Do page numbers (or some other method) correctly show the placement of Specifications content?

——— Review Division 1 for incomplete, unclear, or ambiguous statements. Most such errors occur in Division 1.
  • Check cross-references (include the Drawings).
  • Look for missing content.

——— Review Division 1 for alternates and unit prices.
  • Cross-check other specifications and the Bid Form to make certain alternates and unit prices agree.

——— In regard to special sequencing and phasing, make certain all required data is in other documents (Agreement, Supplementary Instructions to Bidders, Drawings).

——— Is the schedule in Division 1 adequate?

——— For large projects: Does the trenching article in Division 2 require additional modifications?

——— If special guarantees are in Specifications sections, are requirements stated (see RD1.6, item 5)?

——— Review Division 2 for proper references to inspection and soils engineer (see RD1.6, item 3). Note: The soils engineer is usually an inspector and cannot make approvals.

——— Review Divisions 2 through 16 for specification format. Make sure there are no closed specifications (see RD1.6, item 1).

——— Check the reference to subcontractors (usually in Divisions 15 and 16) for errors (see RD1.6, item 6).
RD1.6 CONSTRUCTION DOCUMENTS REVIEW CHECKLIST (cont.)

—— If bidding information is contained in Specifications sections, make sure the information is referenced in the Supplementary Instructions to Bidders.

—— Check the general requirements portion of each division or section for conflicts with Division 1, General Requirements. General requirements in Divisions 2 through 16 that supplement general requirements in Division 1 must reference the Division 1, General Requirements, and not conflict with them.

—— General requirements applying to all sections must be in Division 1. If a general requirement applies to only one division, then it must be located in that division only.

LIST OF DRAWINGS

—— Are drawing dates included on the List of Drawings?

DRAWINGS

—— Is the title block properly completed? The title block must include the following:

• Project title
• Drawing title
• Date
• Drawing number
• Design professional's signature and stamp with license expiration date

These items must agree with data entered in the List of Drawings or other construction documents.

—— Frequently the Drawings are prepared before the Specifications are prepared, and items are specified on drawings. If this is so, make certain of the following:

• There are no closed specifications.
• Items specified agree with the Specifications in every detail.

—— Alternates must be clearly delineated.

—— Specifications sometimes refer to drawings for contract limits. If this reference is made, the contract limits must be shown. The contract limits must also be complete.

—— Revisions must be clearly noted.
CONSTRUCTION DOCUMENTS REVIEW CHECKLIST
(cont.)

—— Do drawings clearly distinguish between new and existing work? One method of distinguishing between new and existing work is to show the existing work in muted lines and the new work in dark bold lines.

—— Drawings must be complete. A good check is to ask yourself the question, "Can the project be built from these drawings?" If not, provide the required information.
APPENDIX 3

Errors Commonly Made in the Construction Documents

See Part 1:
CD-3, Paragraph 3

Note: This document is taken from the University of California Facilities Manual, Volume 4, Resource Directory, RD1.7
RD1.7 ERRORS COMMONLY MADE IN THE CONSTRUCTION DOCUMENTS
(see [I]:6.1.1)

1. **Closed Specifications.** A "closed" specification limits a product to a single manufacturer or group of manufacturers. An "open" specification allows products of any manufacturer to be used if the manufacturer's product meets the specified requirements. The use of closed specifications is generally prohibited by the University.

   Common "closed" specification errors:
   - Not using the phrase "or equal."
   - Listing only one brand plus "or equal" when it is obvious there are other known brands.
   - Using wordy formats that either do not specify items or contain a multitude of words to substitute for the phrase "or equal."
   - Using the term "approved equal" instead of "or equal." "Approved equal" is not defined in the Specifications.

2. **Incomplete, Unclear, or Ambiguous Statements.** Some examples are:
   - Words missing from sentences.
   - Sentences (or lines) missing from paragraphs.
   - Meaningless or garbled statements.
   - Statements that conflict with other statements, or parts of the same statement that conflict with each other.

3. **Inspection and "Approval" by Soils Engineer or Any Person Other Than the University's Representative.** Only the University's Representative is authorized to "approve"; the soils engineer performs tests, and reports results to the University and University's Representative.

4. **"Continuous Supervision" or "Continuous Inspection.** Only the contractor can supervise the work. "Continuous" inspection of certain operations is hard to achieve and subjects the University to possible damages from the contractor if something is missed. If "continuous" is used, then the Facility (or University's Representative) must be prepared to provide such inspection. Use the statement that "work cannot proceed unless the inspector is present."

5. **Insufficient Conditions for Bond of Product or Guarantee of Product.** The General Conditions requires all items to be guaranteed for a period of one year. Frequently, however, specifications require a roof (or other item) to be guaranteed for five years, but no mention is made of what is to be guaranteed, for example, leaks, cracks, or color. The special conditions must be specified.

   The Guarantee form in the General Requirements, Division 1, is used for guarantees of more than one year. Specifications sections must not require special guarantees for only one year. Other common, related errors are:
   - Requiring special guarantees but not providing the proper Guarantee forms.
RD1.7  ERRORS COMMONLY MADE IN THE CONSTRUCTION DOCUMENTS  
(cont.)

- Requiring a warranty on the contractor's furnished form. (Contractor's conditions vary and do not provide equal bidding standards.)

It is helpful to the bidders if the locations of the special guarantees are listed in Division 1 and if the proper paragraph in Division 1 is referenced in the various sections requiring special guarantees.

6. **Reference to Subcontractors.** Specifications are sometimes written as follows: "The Mechanical Contractor shall be responsible for,..." The contract is with the contractor and not with subcontractors; therefore, specifications must not be drafted to assign responsibility for work to the various subcontractors or require the subcontractors to perform tasks. The contractor assigns the work to subcontractors. This same principle also applies to material suppliers and manufacturers.

7. **Non-Agreement of Alternates or Unit Prices with the Bid Form.** This error is the result of lack of coordination: Alternates or unit prices are listed in Specifications sections without provision in the Bid Form of a place for the bidder to enter a price for the alternate or a unit price.

8. **Failure to List Soils Investigation Report in the Information Available to Bidders.** A soils disclaimer is required whenever site work requires the use of a soils investigation report. The Information Available to Bidders provides this disclaimer.

9. **Incomplete or Improper Reference to Trenching Requirements.** The Specifications Cover Sheet and Instructions in Part II gives instructions on adding to the Specifications for trenching requirements. Other modifications, such as protection to adjacent buildings, can also be added.

10. **Unenforceable Phasing of Work.** If certain phases (portions) of the work require completion before the whole project is completed, then separate liquidated damages must be assigned to ensure the separate completion dates.

11. **Lack of Coordination between Drawings and Specifications.** If specifications refer to drawings for contract limits, location of fences, parking areas, etc., then these items must be shown on the drawings.

12. **Incorrect Content References.** References to Specifications sections or other documents are frequently necessary. These references must be correct. Some incorrect examples are:

- "Fill out Form of Proposal properly"—(use "Bid Form").
- "See Supplemental General Conditions"—(when there are none).
- Referencing paragraphs, sections, divisions, etc. that do not exist.
- Referencing one document while information is actually in another.

13. **Use of the Word “Inspector” without Defining the Term.** If "inspector" is used, the term must be defined because the General Conditions does not define "inspector."
14. **Improper Requirements for Drawing Submittals.** Instructions sometimes improperly require the contractor, subcontractor, or even suppliers to submit drawings to the state or other entities. The contractor should make all drawing submittals to the University's Representative.

15. **Listing or Description of Alternates Is Confusing.** Refer to the Specifications Cover Sheet and Instructions in Part II for the proper use of alternates.

16. **Improper Reference to City or County Jurisdictions.** University work is not normally subject to city or county laws and regulations.

17. **Drawing Dates Missing from the List of Drawings.** For proper identification, each drawing must have a date, or a common date may be noted on all drawings.

18. **Lack of Content Documentation for Specifications.** The Specifications Table of Contents must identify and show the number of pages for each Specifications section. Each Specifications page must be numbered and identified: e.g., "01030-1."

19. **Incorrect References.** Some examples are:
   - Referencing a Specification section for additional details which have not been included in that section.
   - Requiring a roofing guarantee when there is no roof.

20. **Improper Statements or Instructions.** These errors are usually located in Specifications, Division 1, General Requirements, and also appear in the general requirements portions of other divisions. These errors include:
   - What type of construction equipment to use.
   - Making the contractor responsible for errors or omissions on drawings.
   - Including instructions to subcontractors, suppliers, etc.
   - Instructions that conflict with University policy, the Executive Agreement, or standard industry practice.
APPENDIX 4

Specifying Construction Products

See Part 1:
CD-4, Paragraph 5

Note: This document is taken from the University of California Facilities Manual, Volume 4, Resource Directory, RD1.4
RD1.4 SPECIFYING CONSTRUCTION PRODUCTS  
(see [I]:4.6.5)

The four methods of specifying construction products are:

1. Descriptive
2. Performance
3. Reference Standards
4. Proprietary

For a discussion of the four methods, see Construction Specifications Institute's Manual of Practice.

The University has elected to follow Section 3400 of the Public Contract Code which requires the use of nonrestrictive (open) specifications. Nonrestrictive specifications use one or more of the four methods written in such a manner as to make the specification "open".

A "closed" specification limits a product to a single manufacturer or group of manufacturers. This type of specification is generally prohibited by the Code. An "open" specification allows products of any manufacturer to be used if the product meets the specified requirements.

Examples and discussion of the four specification methods and their nonrestrictive specifying application follow.

1. **Descriptive Specifications.** A descriptive specification provides a written detail of a products properties without the use of trade or brand names.

   Ex: Sand: Clean, washed, sharp, durable natural particles, free from soluble salts or organic impurities. Sand for grouting shall be screened to pass a 30 mesh sieve with not more than 5% passing a 100 mesh screen.

   The above descriptive specification is "open." However, a descriptive specification drafted to limit the product choice to one brand or a limited number of brands is "closed". Simply copying a manufacturer's descriptive specification would probably produce a "closed" descriptive specification.

2. **Performance Specifications.** Performance specifications set forth the ends to be achieved, not the means of achieving the desired result.

   Ex: Exhaust fan performance. Capacity of 500 CFM against a static pressure of 0.5 inches of water column. This type of specification is "closed" when the specifier uses the performance standards of a single manufacturer and no one else can meet those standards.
RD1.4 SPECIFYING CONSTRUCTION PRODUCTS (cont.)

3. **Reference Standards.** Reference standards specify standards such as ASTM, State of California, Federal, etc. The various manufacturers must meet these standards.

   Ex: Portland Cement: Conform to ASTM C150, Type I or Type II, low alkali. Maximum total alkali shall not exceed 0.6 percent. This type of specification is "closed" when some requirement of a standard limits competition by referencing certain subcontractors or manufacturers.

4. **Proprietary Specifications.** Proprietary specifications identify the desired product by manufacturer, brand name, model or type designation, or important characteristics.

   Ex: Floor tiles shall be "Contempo" as manufactured by Kentile Corp.

   A proprietary specification is allowed only under the conditions listed in Volume 4, Chapter 1 Approval of Materials. Also see paragraph 5.b.(3) below.

   Proprietary specifications can be made “open” by adding the phrase "or equal" as described in paragraph 5, Nonrestrictive specifications.

5. **Nonrestrictive Specifications.** Nonrestrictive specifications are “open” specifications; the type required by the Public Contract Code. Descriptive, Proprietary, Reference Standards or Performance Specifications or combinations of such methods, are written in such a manner as not to limit competition.

   a. Descriptive and performance specifications are made nonrestrictive (open) by making certain the description or performance requirements do not refer to manufacturers or trade names or do not use the description or performance requirements of a single manufacturer or subcontractor.

   b. Proprietary specifications may be made nonrestrictive (open) by using brand or trade names with specific model numbers or styles to show the quality desired; followed by the phrase "or equal". Long Form Specification Section 01630 Product Options and Substitutions, defines "or equal".

   Ex: **Globe Valves**: All bronze, union bonnet, Walworth No.95 or 96; Kennedy Fig. 89 or 90; Crane No.7 or 17, or equal.

   Ex: **Waterproof Glue**: Polyvinyl acetate emulsion with 55% solids. "Wihold" manufactured by Acorn Adhesives; "Weldwood" manufactured by U.S. Plywood; or equal.

   (1) At least two brand names of comparable quality or utility must be listed.
RD1.4 SPECIFYING CONSTRUCTION PRODUCTS
(cont.)

(2) Specifiers may use a format listing two brand names with only one model number.

Ex: Thermometers shall be J.P. Marsh type 59, Bristol, or equal.

Ex: Thermometers shall be J.P. Marsh type 59, equivalent Bristol, or equal.

If this format is used, the following conditions result.

(a) The bidders are informed of only one brand that they know will be accepted.
(b) The second named brands' model must be determined by the bidder and approved by the University's Representative after the contract is let. Studies have shown the bidder will usually select the first brand; thus competition is reduced and the bid may be increased.
(c) Since the University's Representative has to approve the second brand, time delays may result, and there will usually be a disagreement with Contractor if the proposed substitution is rejected as not being equal.

(3) The Facilities Manual explains the exceptions to specifying two brands. See Cover Sheet and Instructions, **FM4[II]**, Specifications, Divisions 2-16. However, there seems to be much confusion over these exceptions. The following explanation should help.

(a) Naming only one brand followed by "or equal" is permissible if the specifier knows of only one brand that will satisfy the use. The phrase, "No known equal" should follow the specification.
(b) Naming only one brand not followed by "or equal" is allowed only under the following circumstances.
   1) The product is to match an existing installation, such as, "Locks, floor surfaces". Terms such as, "Convenience for maintenance," "the vendor gives us good service", are not valid reasons. These terms frequently appear in specifications. The phrase, "To match existing" should follow the specification.
   2) Use of a unique product is approved by the Office of the President.
RD1.4 SPECIFYING CONSTRUCTION PRODUCTS (cont.)

3) Use of an experimental product is approved by The Regents.

An easy way to determine the valid use of items (a), (b)1), (b)2), or (b)3) is to ask this question:

Can a restricted specification be justified? Be aware that "to match existing" is limited to situations which truly must match for some valid purpose (i.e., the light fixture in a closed office does not have to match that in entryway).

c. A combination of descriptive and proprietary methods may be used.

   Ex: Door louvers shall be aluminum Type NL-138 with push frame both sides of door, primed finish, as manufactured by Construction Specialties, Inc., Aerolite, Co., or equal, (no known equal).
APPENDIX 5

Responsibilities of the Inspector

See Part 1:
C-2, Paragraph 5.3

Note: This document is taken from the University of California Facilities Manual, Volume 5, Resource Directory, RD1.7
RD1.7 RESPONSIBILITIES OF THE INSPECTOR (see [II]:2.2)

The inspector, whether employed by the design professional or the University, shall:

1. Become thoroughly familiar with contract document requirements, applicable codes and standards, approved submittals, and all instructions or clarifications issued by the design professional.
2. Generally act as liaison between the contractor and the design professional.
3. Keep a log of written communications including submittals received from or issued to the contractor.
4. As appropriate to the nature and extent of construction, monitor the quality and quantity of the work and promptly report to the design professional nonconforming work or nonconforming work performance.
5. Prepare a daily report recording:
   - Inspector's time and activities on the project.
   - Weather conditions.
   - Nature and location of work being performed and by whom.
   - Number of workers by trade.
   - Oral instructions and interpretations given by the design professional.
   - Specific observations on results of oral instructions and interpretations.
   - Any occurrence or work which might result in a claim for a change in the contract sum or contract time.
   - Names of visitors, their titles, and the time and purpose of their visit.
   This report shall be prepared for each normal workday or for each day on which the contractor performs work, and a copy shall be promptly sent to the design professional and the University.
6. Observe testing and inspection done by the contractor as required in the contract documents and coordinate and observe special testing and inspection when requested by the design professional or University.
7. Monitor the contractor's proposed schedule and the actual construction schedule and promptly report to the design professional discrepancies between the schedules and any conditions which may cause construction delays.
8. Periodically photograph the work, paying special attention to portions of the work that have been or may be rejected or may be associated with a claim or delay.
9. Review in detail the contractor's Application for Payment and report the findings of this review to the design professional.

The inspector shall not:

1. Authorize deviations from the contract documents.
2. Approve substitute materials or equipment.
3. Advise on or issue directions concerning aspects of construction means, methods, techniques, sequences, or procedures in connection with the work.
APPENDIX 6

Division 1 — General Requirements

See Part 1:
CD-4, Paragraph 5.3

See Part 2:
INSTR-1

Note: 1. This document is based on a standard document in the University of California Facilities Manual, Volume 4, Part II, Specifications.

2. Division 1 Sections are in UCSF’s Construction Document format.
DIVISION 1 — GENERAL REQUIREMENTS

Please obtain the latest version of DIVISION 1 — GENERAL REQUIREMENTS from the Project Manager.
APPENDIX 7

Universal Design Guidelines
University of California, San Francisco

Universal Design Guidelines for Campus Facilities
December 2002

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Acknowledgements .................................................. 3
I. Introduction: the purpose of these guidelines ........ 4
II. Accommodating people with disabilities in the Facilities .................................................. 5

III. Universal design: an environmental design approach to creating access for everyone ............. 9

IV. Campus Facilities: The Research Laboratory ........ 11
   a. General Guidelines for Interior Spaces
   b. Labstations
   c. Common Areas
   d. Path of Travel in Laboratories

V. Appendix .................................................................. 27
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I. Introduction

Providing a friendly, accessible and easy-to-use campus for all students, faculty and the public means going beyond mere code compliance. It is essential that people responsible for making design decisions, furniture selection, and equipment purchases understand that their decision-making process has a direct affect on how usable and accessible the campus is for people with and without disabilities.

From designing a classroom to selecting a trash receptacle, both large and small decisions can significantly affect how people with different abilities can use a place, product, or program. In the best cases, these decisions help facilitate the use of the setting and there is a seamless connection to the services offered in the facilities. When decisions are made that do not take into account the range of users that the environment must support, the result is frustration and unintentional segregation. In the worst case, an individual’s civil rights may be violated.

The Capital Projects and Facility Management Department prepared this document as a supplement to the UCSF Campus Design Guidelines. It describes the University’s philosophical approach to inclusion and provides practical suggestions for making facilities on the campus accessible to the widest possible audience.
II. Accommodating People with Disabilities

You don’t need medical training to successfully accommodate people with disabilities. You simply need an openness to explore alternatives and the ability to talk with people with disabilities about how they need to use the setting. You need to know the functional characteristic(s) that affects performance and movement through the environment, not the medical nature of disability.

These guidelines provide environmental design options that can help accommodate people with various functional characteristics resulting from a variety of disabilities. It is important to systemically address the entire campus environment in order to avoid a piecemeal design approach. For example, providing a powered cart may help accommodate an individual (student, staff, or faculty) who has limited stamina get around the campus. But, if the lab and computers that the individual uses cannot accommodate the dimensions of the power cart at a workstation, the University has failed to provide program access for that individual.

Descriptions for 19 functional characteristics of disabilities are listed below, along with selected data from the 1990 National Health Interview Survey (NHIS). NHIS data relates to the 17 million Americans ages 18-69 who report a “work limitation” due to a chronic condition. Many people with disabilities do not report a work limitation, because they either do not require accommodation, do not wish to self-identify, or are not in the workforce. For example, more than 23 million working and non-working Americans of all ages report having some hearing impairment, while only 398,000 report a work limitation due to a hearing impairment. Despite this potential inaccuracy, the data included below serves as a baseline to understand the numbers of people potentially affected by a given disability.

Some disabilities result in multiple functional characteristics and temporary or minor conditions should also be considered. An individual with a broken arm, or who is pregnant, or elderly would also experience some of these functional characteristics.


“Limitation of Stamina”
Limitation of stamina is defined as fatigue, shortness of breath and/or abnormal elevation of blood pressure due to mild exercise or sensitivity to chemicals. Among Americans experiencing this characteristic are approximately 6,935,000 workers ages 18-69 with heart disease, emphysema, or other respiratory or circulatory conditions.

Difficulty in Lifting, Reaching, Carrying
This characteristic is defined as impaired mobility, range of motion, and/or strength of one’s upper extremities. Among Americans experiencing this characteristic are approximately 9,522,000 workers ages 18-69 with arthritis, bursitis, tendinitis, loss/paralysis/deformity of extremities, back impairment, hernia, or quadriplegia, paraplegia, or hemiplegia.

Difficulty in Manipulating
Difficulty in manipulating means impaired hand or finger mobility, range of motion, and/or strength. Among Americans experiencing this characteristic are approximately 2,833,000 workers ages 18-69 with arthritis, carpal tunnel syndrome, cerebral palsy, or multiple sclerosis.

Inability to Use Upper Extremities
This characteristic is defined as complete paralysis, severe incoordination, or bilateral absence of upper extremities. Though not specifically itemized in the National Health Interview Survey data, this characteristic is experienced by Americans ages 18-69 with severe cases of conditions such as multiple sclerosis, spinal cord injury, or cerebral palsy, as well as by those without arms as a result of amputation or congenital loss.

Difficulty in Sitting
Difficulty in sitting is defined as excessive pain, limited strength, range of motion, and/or control in turning, bending, or balance while seated. Among Americans experiencing this characteristic are approximately 4,367,000 workers ages 18-69 with curvature of the spine, deformity or impairment of the back, intervertebral disc disorders, complete or partial paralysis, or quadriplegia, paraplegia, or hemiplegia.

Difficulty in Using Lower Extremities
This characteristic is defined as slowness of gait, difficulty in kneeling, sitting down, rising, standing, walking, and/or climbing stairs or ladders. Among Americans experiencing this characteristic are approximately 1,915,000 workers ages 18-69 with cerebral palsy, multiple sclerosis, deformity/absence/impairment of one or both lower extremities, or quadriplegia, paraplegia, or hemiplegia.

3 All descriptions and text are quoted from Mueller, ix-x.
Limitation of Balance
Limitation of balance means a difficulty in maintaining balance while standing or moving. Among Americans experiencing this characteristic are approximately 939,000 workers ages 18-69 with cerebral palsy, cerebrovascular disease, complete or partial paralysis, or Parkinson’s Disease.

Difficulty in Processing Information
This characteristic is defined as an impaired ability to receive, interpret, remember, or act on information. Among Americans experiencing this characteristic are approximately 614,000 workers ages 18-69 with learning disabilities, mental retardation, mental health issues, or senility.

Limitation of Sight
This characteristic is defined as a difficulty in reading newsprint-size copy, with or without corrective lenses, and extends to “legal blindness” (but not TOTAL blindness). Among Americans experiencing this characteristic are approximately 829,000 workers ages 18-69 with glaucoma, cataracts, or other eye disorders.

Total Blindness
Total blindness is the complete inability to receive visual signals. It is experienced by approximately 164,000 American workers ages 18-69.

Limitation of Hearing
Limitation of hearing is defined as a difficulty in understanding normal speech (but not TOTAL deafness). It is experienced by approximately 320,000 American workers ages 18-69.

Total Deafness
Total deafness is the complete inability to receive auditory signals. It is experienced by approximately 78,000 American workers ages 18-69.

Limitation of Speech
This characteristic is defined as a capability of only slow or indistinct speech, or non-verbal communication. Among Americans experiencing this characteristic are approximately 280,000 workers ages 18-69 with cerebral palsy, a distinct speech impairment, or total deafness.

Susceptibility to Fainting, Dizziness, Seizures
This characteristic may be spontaneous or inducible by environmental factors such as sudden sounds or flashing lights, resulting in loss of consciousness, balance, or voluntary muscle control. Among Americans experiencing this characteristic are approximately 2,094,000 workers ages 18-69 with epilepsy, diabetes, or cerebrovascular disease.
Incoordination
Incoordination is defined as limited control in placing or direction extremities, including spasticity. Among Americans experiencing this characteristic are approximately 442,000 workers ages 18-69 with multiple sclerosis, cerebral palsy, Parkinson’s Disease, quadriplegia, paraplegia, or hemiplegia.

Limitation of Head Movement
This characteristic is defined as a difficulty in looking up, down, and/or to the side. Among Americans experiencing this characteristic are approximately 1,732,000 workers ages 18-69 with curvature of the spine or intervertebral disc disorders.

Limitation of Sensation
Limitation of sensation means an impaired ability to detect heat, pain, and/or pressure. Among Americans experiencing this characteristic are approximately 1,789,000 workers ages 18-69 with diabetes, multiple sclerosis, or full or partial paralysis.

In addition to Mueller’s above listed 17 functional characteristics, the following should also be considered:

Variability in Height, Weight and Reach
This condition addresses the individual differences in abilities to function based on height, weight and reach differences. Dwarfism or obesity can be examples that could result in this condition.

Allergic Conditions
This characteristic is attributed to extreme sensitivity to various environmental chemicals, as in air, food, water, building materials, or fabrics. Environmental illness is an extreme allergic condition.

Understanding the functional characteristics that are caused by a disability makes it easier to design environments that can help compensate for a limitation. For example, if a person has difficulty manipulating, providing lever handles rather than knob door handles will help that person compensate. You can increase safety for people with limitation of sensation by covering hot water pipes. And, providing non-glare walls that contrast with the floor enables those with limitations in sight to wayfind.

That is the goal of Universal Design: create environments that enable everyone.
III. Universal Design: An environmental design approach to creating access for everyone

Universal design incorporates the general principles of its predecessor, barrier-free design, which emphasized removing physical barriers and creating specially designed features for people with disabilities. Barrier-free design was based on the assumption that wheelchair-accessible facilities are also accessible to individuals with other disabilities. But for some people, even barrier-free features can be hazardous. Universal design avoids these limitations by incorporating a comprehensive view of human needs and abilities.

Universal design is not a set of inflexible rules. Its proponents recognize the value of standards such as the ADA Accessibility Guidelines, but realize that compliance alone does not guarantee accessibility for all people. Instead, universal design focuses on the complicated interrelationships that exist between the physical environment and the user.

There are seven principles of universal design that need to be incorporated into all design decisions that will be “literally” set in concrete. These principles were developed by practitioners in the field and are meant to help guide or evaluate settings.

Principles of Universal Design

- **Equitable Use** – Provide the same means of use for all users; identical when possible, equivalent when not.
- **Flexibility in Use** – Accommodate a wide range of individual preferences and abilities.
- **Simple and Intuitive Use** – Eliminate unnecessary complexity; be consistent with user expectations.
- **Perceptible Information** – Communicate necessary information regardless of the ambient conditions or user’s sensory abilities.
- **Tolerance for Error** – Minimize hazards and adverse consequences of unintended actions.
- **Low Physical Effort** – Design for efficient and comfortable use.
- **Size and Space for Approach and Use** – Provide adequate space and clear lines of sight.

Universal design is based on four goals:

**Accommodate human movement characteristics.** Universal design addresses three aspects of human movement: body space; reach range; and effort. Body space is the area immediately surrounding a person and any mobility aid she or he may use – in other words, the space needed to move through an environment. Accessible design requirements for clear space, such as vertical clearance and minimum passage width, address this need for maneuvering space. Reach range is the
distance users can reach to retrieve an object. These ranges are used to determine where items should be placed to be accessible. Effort is the physical exertion required to perform a function, such as flipping a switch or ascending a ramp. The required level of effort is determined by the dexterity (i.e., required degree of manipulation), force, and sequence of steps needed to perform the function.

**Ensure safety.** Facilities that are designed to accommodate the way people work and move through the environment have minimized obstructions and hazards. A well-designed pathway, for example, provides a smooth and secure path of travel for someone walking, using a wheelchair, or carrying a bulky item.

**Provide adaptability.** Facilities must be planned with both present and future needs in mind to accommodate constant changes in population, technology, and building regulations. Every aspect of a facility should be designed for maximum flexibility and use by the broadest spectrum of people.

**Be cost-effective.** Universal design values both affordability and cost-effectiveness. Expenses are reduced when designs accommodate the rearrangement, addition, or removal of structural elements. Rather than requiring constant retrofitting or renovation selecting products based on the general requirements of human movement eliminates the need to purchase costly specialized equipment. Lever-type door handles, for example, are not significantly more expensive than other types of handles, yet they make doors easier to open for all users.
IV. Universal Design Guidelines

People who design and build environments are expected to already know and understand the federal ADA guidelines and the California Title 24 Building Code; however, this does not ensure that elements are designed or selected using a universal design approach. The general guidelines listed below are a supplement to these regulations in order to assist in designing environments for use by everyone.

A research laboratory was used as a case example. Different aspects of the space were analyzed and discussed with the Chancellor’s Advisory Committee on Disability Issues. Based on this feedback, a system of photographs, matrices, and element descriptions was then developed to address each of the following components of the laboratory setting environments: interior space, typical lab workstations, path of travel, and common areas. Each environmental setting has a photograph that is numbered to identify a specific element in the setting. The numbers correspond to a matrix. The matrix has specific guidelines that respond to functional requirements that enable an individual with that disabling condition to function more readily in the setting. These guidelines are further described on the page after each matrix.

The laboratory is a sample setting and is representative of one of the many different environments comprising the University of California, San Francisco. Each environment in the University should be treated with the same analysis as resources become available. The goal of the analysis is to be a reference to designers, department staff, purchasing agents, and individuals responsible for managing the settings in making the University facilities as easy to use for the people the University serves.

Other settings or room types which need to be studied include: seminars, research offices, research laboratory service rooms, research office service rooms, scholarly activity rooms, scholarly activity service rooms, class laboratories, special class laboratories, class laboratory service rooms, academic offices, other offices, office service areas, conference rooms, conference service areas, central computer or telecommunications areas, central computer or telecommunications service areas, storage – general and research, storage – teaching laboratory, storage – office, classrooms, classroom service areas, stacks, processing rooms, tutorial or training rooms, tutorial or training room service areas, athletics areas, media production areas, animal quarters, animal quarters service areas, food facilities, food facility service areas, recreation areas, merchandising areas, assembly areas, day care, shop – general and research, shop service areas – general and research, and central service areas.
A. Interior Space
### A. Interior Space

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Lighting</th>
<th>Air</th>
<th>Sound</th>
<th>Heating &amp; Ventilation</th>
<th>Walls</th>
<th>Floors</th>
<th>Doors</th>
<th>Hardware</th>
<th>Electric</th>
<th>Workspace</th>
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</table>
A. Interior Space

Lighting
1. Use tinted windows, blinds, or shades to reduce glare
2. Provide adequate lighting to minimize facial shadows for lip reading
3. Provide up-lighting rather than down-lighting to limit glare
4. Provide task lighting—fixtures with flexible arms for individual control
5. Provide adequate lighting controls within each area to adjust for different needs and incremental lighting of areas
6. Avoid strong backlighting
7. Avoid flickering fluorescent lighting

Air
8. Avoid smoke, dust, fumes and extremely dry air (ensure adequate HVAC and air purification)
9. Use non-scented, non-emitting cleaning products, room deodorizers, and paints
10. Perform pesticide treatments after-hours or on weekends only with prior notification posted
11. Provide windows that open when possible
12. Allow enough time for materials and furniture to off-gas before occupancy; use low-emitting materials/items

Sound
13. Minimize ambient noise and vibration

Heating and Ventilation
14. Place outside air intakes away from potential sources of contamination such as parking garages, cooling towers, building exhausts, roadways, etc
15. Provide 10 complete air changes per hour*
16. Zone the facility as finely as possible; control over individual areas is the goal
17. Ensure that electrical loads can accommodate the addition of a personal heater or fan
18. Provide adequate filtering and antimicrobial ductwork to minimize mold and other allergens

Walls
19. Provide non-glare surfaces
20. Have the ability to minimize ambient noise but not be completely sound absorbent unless it is required by the activity in that room (e.g., a media studio)
21. Contrast in color and brightness with the floor; wall should be lighter than floor color
22. Long corridors and gathering areas should have railings for support

Floors
23. Materials should be stable, firm, slip resistant, and non-absorbent
24. Covering should not have strong, confusing patterns or textures with changes in direction, especially near floor level changes
25. Contrast floor color with walls; floor should be darker than wall color
26. Floor electrical outlets should not be in the path of travel
A. Interior Space (continued)

Doors
27. Provide windows in doors to prevent door/pedestrian conflict
28. Color should contrast with wall color

Hardware
29. Provide levers, u-shaped handles or pulls, or magnetic push release hardware on all doors, cabinets and drawers; no grasping or twisting.
30. Locate hardware for windows at a level reached while seated.

Electrical
31. Provide electrical outlets and outlet strips within reach, not only on the floor

Workspace
32. Alternate workstations in a common area; don’t place them back to back to avoid chairs bumping into each other

*This number is approximate. Air exchange ratios vary based on numerous conditions and there is no definitive air exchange ratio that addresses the various conditions that have been outlined thus far. Three exchanges an hour is common for general indoor spaces while 6 exchanges an hour is used in UCSF’s tuberculosis care areas. Areas with special uses require different exchange rates. ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) recommends 10 exchanges an hour for dilution ventilation; this is the exchange recommended as a baseline figure in this document.

Indoor air quality and air exchange ratios are governed by a variety of regulatory bodies. This is an area of research receiving a lot of attention due to sick building syndrome and other allergic reactions to the indoor environment. Early air exchange ratios focused on the individual moving through space; however, today’s work conditions are often sedentary and now the air needs to move past the individual, a change that may not be reflected in the various codes. Indoor air quality is critical to a productive and healthy work and living environment. As further research is conducted in this area this number should be modified.
B. Laboratory Workstations
### B. Laboratory Workstations

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Chair/Space</th>
<th>Desks</th>
<th>Lab Station</th>
<th>Storage</th>
<th>Equipment</th>
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</tr>
</tbody>
</table>
B. Laboratory Workstations

Chairs/Chairspace
1. Provide a swivel base for easier face-to-face communications
2. Provide pressure-distributing seat cushions
3. Install “rising assist” seat cushions
4. Ensure chair material including cushions don’t emit gases
5. Provide full armrests and backrest with seatbelts if needed
6. Equip chair with height and seat back controls within easy reach
7. Provide approach space for transfer from a wheelchair or other mobility device
8. Provide footrests
9. Provide alternatives to stationary seating such as leaning or perching

Desks
10. Provide contrasting-colored and/or slightly raised bull-nosed edges to prevent items rolling off (at lab/workstations consider using removable raised edging as permanent raised edging may interfere with equipment sitting level)
11. Provide grab bars within easy reach (at lab/workstations also)
12. Provide adequate space for a wheelchair to pull under a desk
13. Provide “lazy susan” desk-top files or organizers (at lab/workstations also)
14. Provide adjustable work surfaces (height and angle of surface)

Lab/Workstations
15. Provide fixtures to help position materials and tools (clamps, suction feet, magnets, “velcro,” non-slip mats)
16. Provide wheeled carts for additional work surfaces, carrying materials and storage, especially for hazardous materials
17. Provide footstool for shifting weight at standing stations
18. Install powered lifting tables for heavy work.
19. Provide convenient location for wheelchair or mobility aid
20. Provide a standing support frame or elevated wheelchair if work requires standing position
21. Provide vertical and horizontal flexibility in computer monitor placement
22. Provide quieter equipment or dampen loud equipment noise; provide quiet work space away from loud equipment
23. Provide anti-fatigue floor mats where standing is required for long periods of time; keep a clear path of travel through the area for those using assistive mobility devices
B. Laboratory Workstations (continued)

Storage
24. Maximize waist-high storage
25. Clearly mark contents of each drawer and cabinet with words and Braille
26. Provide lever handles or magnetized push release hardware on cabinets
27. Provide “lazy susan” storage organizers
28. If latches are necessary on containers, build up the handles or use “velcro” or magnetic latches.
29. Provide pull-out shelves with rubber dividers; consider pull-out shelves’ impact on aisle space when designing

Equipment
30. Provide mechanical “reachers”
31. Provide rubber pinchers for holding smaller glass items
32. Attach cords to tools and small equipment to keep them within reach
33. Provide cuffs or gloves with gripping surfaces
34. Provide automated systems for pipetting
35. Place all appliances within reach (e.g., not stored on upper shelves)
36. Place any additional outlet strips on counters, not on floors
37. Provide clear, simple written instructions for use
38. Ensure all alarms/timers are both auditory and visual
39. Provide carts or attachable trays to assist in moving elements/items
40. Provide adjustable height equipment, tables, workspaces, etc when possible (fume hoods, burners, microscopes, etc)

Sinks
41. Provide well-identified, temperature controlled faucets
42. Provide lever handles within reach range of a wheelchair (positioned 9” – 54” above the floor if approached from side; positioned 15” – 48” above the floor if approached from front or if reach exceeds 10” from the clear area)
43. Provide side access for wheelchairs
44. Provide stepping stools for height limitations
45. Provide additional foot-powered controls or push bar activation with timed water release
46. Ensure the sink depth is not too low (not deeper than 6-1/2”)

Waste
47. Integrate trash and recycling containers into cabinetry; keep path of travel clear
48. Provide foot controls and levered hand controls
49. Clearly mark receptacles with contents
50. Provide protective gear for handling messy or hazardous materials (also for waste disposal)
C. Path of Travel
C. Path of Travel

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Wayfinding</th>
<th>Visibility</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamina</td>
<td></td>
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<td>Lifting, Carrying, Reaching</td>
<td></td>
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<td></td>
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<tr>
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<td>Upper Extremities</td>
<td></td>
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<td>Sitting</td>
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<td></td>
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<td>3</td>
<td>4,5</td>
<td></td>
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<td>Sight</td>
<td>1,2,3</td>
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<tr>
<td>Total Blindness</td>
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<tr>
<td>Speech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fainting, Dizzy, Seizures</td>
<td></td>
<td>4</td>
<td>9</td>
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<tr>
<td>Incoordination</td>
<td></td>
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</tr>
<tr>
<td>Head Movement</td>
<td></td>
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<td>Sensation</td>
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<td>Height/Weight/ Reach</td>
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<td>Allergies</td>
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<td></td>
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</tbody>
</table>
C. Path of Travel
Wayfinding
1. Provide tactile indicators on the floor of both sides of the doorway
2. Provide textured wayfinding along the walls and colored wayfinding on the floors
3. Provide clear signage to label rooms and areas

Visibility
4. Avoid glass walls: glare, privacy, distraction, sound reflection, and perceived ability to lend support
5. Use low-gloss paint to limit reflection
6. Provide fish-eye mirrors at corners to increase visibility

Mobility
7. Provide adequate clear space for wheelchairs – at least 60 inches in corridors and in aisles between backs of chairs
8. Provide a bench to sit along corridors over 30' in length
9. Provide grab bars or railing along the hallway (inside can be marked with Braille)
10. Integrate trash/recycling containers into rooms, out of paths of travel
D. Common Areas in Laboratories
## D. Common Areas in Laboratories

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Chair</th>
<th>Chairspace</th>
<th>Tables</th>
<th>Sinks</th>
<th>Countertop</th>
<th>Storage</th>
<th>Waste</th>
<th>Appliances</th>
<th>Utensils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamina</td>
<td>1,3,4</td>
<td>7</td>
<td>9</td>
<td>15,6</td>
<td>18</td>
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<td>Lifting, Carrying</td>
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<td>14</td>
<td>17</td>
<td>21,23</td>
<td>25</td>
<td>26,29</td>
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<tr>
<td>Sitting</td>
<td>1,2,3,4</td>
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<td>1,3,4</td>
<td>7,8</td>
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</table>
D. Common Areas in Laboratories

Chairs
1. Provide chairs with a swivel base for easier face-to-face communications
2. Provide pressure-distributing seat cushions
3. Install “rising assist” seat cushions
4. Provide full armrests and backrest
5. Equip some chairs with height controls
6. Ensure chair material including cushions don’t emit gases

Chairspace
7. Provide approach space for transfer from a wheelchair or other mobility device
8. Provide sufficient space for a wheelchair to pull up to the table

Tables
9. Ensure surface is non-slippery with slightly raised bull-nosed edge for gripping

Sinks
10. Provide well-identified, temperature controlled faucets
11. Provide lever handles within reach range of a wheelchair (positioned 9" – 54” above the floor if approached from side; positioned 15” – 48” above the floor if approached from front or if reach exceeds 10” from the clear area)
12. Provide side access for wheelchairs
13. Provide stepping stools for height limitations
14. Provide additional foot-powered controls
15. Ensure the sink depth is not too low (not deeper than 6-1/2”)
16. Provide grab bars within easy reach

Countertop
17. Provide contrasting-colored and/or slightly raised bull-nosed edges to prevent items rolling off; consider using removable raised edging as permanent raised edging may interfere with equipment sitting level
18. Provide grab bars within easy reach
19. Ensure surface does not retain heat or cold
20. Provide side access for wheelchairs

Storage
21. Maximize under-counter storage and use “lazy susan” turntables in corner cabinets
22. Clearly mark contents with words and Braille (waste receptacles also)
23. Provide lever or pull handles
D. Common Areas in Laboratories (continued)

Waste
24. Integrate trash and recycling containers into cabinetry; keep path of travel clear
25. Provide foot controls and levered hand controls

Appliances
26. Place all appliances within reach (e.g., microwave on counter, not on top of refrigerator)
27. Place any additional outlet strips on counters, not on floors
28. Provide clear, simple written instructions for use
29. Use side by side refrigerators

Utensils
30. Provide set of utensils with large rubber handles (non-heat conducting) and build up with grip tape if needed
V. Appendix/Resources for ongoing support

There are a growing number of websites that offer information and suggestions regarding universal design and accessibility. The following are some that offer specific information:
http://barrier-free.arch.gatech.edu

The following suppliers/supplies are specifically for lab equipment:
- Piezo Electric Gas Lighter from Scienceware. Potentially easier to use than matches for using a Bunsen Burner.
- Maxi-Aids and The Lighthouse Inc. make a variety of products including: tactile markings and adhesive dots; tactile paint; and large print or Braille labels.
- American Printing House for the Blind makes a variety of tactile rulers and gages.
- Science Products for the Blind, The Lighthouse Inc., and Ann Morris carry several liquid level indicators as well as talking scales.
- Cole-Parmer sells a dispenser that attaches to reagent bottles with a rotation volume control; and digital readings of liquid measurements.
- Maxi-Aids and Ali-Med have a variety of non-slip mats for glass stabilization.

- Wards-Lab Supplies carry a wide range of plastic measuring devices and containers for avoiding breakage concern.

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4 Lab equipment information was acquired from http://barrier-free.arch.gatech.edu/Lab/accom_vision.html. This site gives some cost information, descriptions and links to some of the products.
(UNDER DEVELOPMENT)
MASTER PLANS AND DESIGN GUIDES

The following Master Plans are available from Project Manager:


9. *UCSF Universal Cable Plan Standards*.


100% COMPLETION SUBMITTAL (CD-3)  BIDDING PHASE (B-1)
50% COMPLETION SUBMITTAL (CD-1)  Blocking (O6100-1)
Acceptable Manufacturers (15050-7)  Blow-Offs (02660-1)
Acceptance of the Work (C-4)  Built-Up Systems (07500-1)
Access Doors and Panels (15050-7)  Bus Duct (16050-4)
Access for the Physically Disabled (GD-3)  California Code of Regulations (ADM-2)
Acoustical Duct Lining (15800-4)  Capacity (SCH-2)
ACTION ON HIGH BIDS (B-1)  CARPET (09680-1)
Adding New or Replacement Mechanical Units  Casework (13031-3)
(13080-3)  Ceilings (13033-1)
ADMINISTRATIVE REQUIREMENTS (ADM-1)  Certification (16060-1)
Agreement (INTRO-1)  Change Order Text (C-2)
AGREEMENT CHANGES (ADM-5)  Change Orders (C-1)
AIR DISTRIBUTION (15800-1)  Checklist (SCH-3)
Air Filters (15850-1)  Chemical and Flammable Storage (13034-2)
AIR HANDLING (15850-1)  Civil Engineering Drawings (CD-1)
Air Intakes and Exhausts (15850-1)  CLIENT (ADM-1)
Air Quality (ADM-2)  Coastal Commission (ADM-2)
Air Reliefs (02660-1)  CODES (ADM-2)
Air-Handling Units (15850-3)  COLD ROOMS (13031-1)
Air-Intake Plenums (07100-1)  COLOR SCHEDULE (C-2)
Alarms (13031-1), (13032-2)  Commissioning (15050-7), (16050-6)
Aluminum Finishes (07600-1)  Comparison to Budget (SCH-2)
Analysis of Mechanical Systems (DD-2)  Completed Drawings (CD-3)
ANIMAL FACILITY AREAS (13185-2)  Completed Specifications (CD-3)
Approved Shop Drawings (C-4)  Compressed Gas Cylinders (13034-1)
Approved Submittals (C-4)  Computer Room Air-Conditioning Units (15600-1)
Architectural Drawings (CD-1)  Concrete Construction (02700-2)
ARCHITECTURAL REQUIREMENTS  Concrete Cover (03050-1)
(SCH-1), (DD-1)  Condensing Units (13031-2)
AREA CALCULATIONS (ADM-2)  Conduit (16050-3)
AREA TABULATION (SCH-2), (CD-3)  Connections (02500-1)
AREA TABULATION/ROOM NUMBERS  Connections to Existing Mains (02660-1)
(DD-3)  CONSTRUCTION BUDGET (ADM-1)
ASBESTOS ABATEMENT (13280-3)  Construction Documents (CD-3)
Asphalt Concrete Surface Restoration  CONSTRUCTION DOCUMENTS PHASE
(02950-1)  (CD-1)
Assumed Noise Budget (13080-1)  CONSTRUCTION MANAGER
Authority of Construction Manager (ADM-5)  (In Lieu of General Contractor) (ADM-5)
Autoclaves and Sterilizers (11600-2)  Construction Manager Services (ADM-5)
Backfill (02300-1)  CONSTRUCTION MEETINGS (C-1)
Backflow Prevention Devices (02810-2)  Construction Notification (C-1)
Back to be Stud Partition or Furring (09100-1)  CONSTRUCTION PHASE (C-1)
BASES, BALLASTS, PAVEMENTS, AND  CONSTRUCTION PHASING SCHEDULE
APPURTEMENCES (02700-1)  (DD-4)
BASIC CONCRETE MATERIALS AND  Cooling Towers (15600-1)
METHODS (03050-1)  COST ESTIMATE (CD-2, 3), (SCH-2)
BASIC DOOR AND WINDOW MATERIALS  COST ESTIMATE (ESTIMATED PROJECT
AND METHODS (08050-1)  CONSTRUCTION COST) (DD-4)
BASIC MASONRY MATERIALS AND  Cost Proposals (C-1)
METHODS (04050-1)  COUNTERTOPS (06415-1)
Below Grade Walls (07100-1)  Check List (SCH-3)
BIDDER CALLS (B-1)
Index

Cover Plates (16050-5)  Equipment Testing (16600-2)
Curb Boxes (15300-1)  Estimated Project Construction Cost (ADM-1)
CUSTOM CABINETS (06410-1)  Exhaust (13034-2)
Dampers (15800-3)  Existing and Proposed Floor Plans (SCH-1)
DAMPPROOFING AND WATERPROOFING Existing Capacity (DD-2)
(07100-1)  Existing Conditions (02500-1)
DARKROOMS (13033-1)  Existing Drawings (ADM-5)
DDC Controls (15050-7)  Existing Equipment (15050-1), (16050-1)
Demolition (15050-2)  Existing Subsurface Utilities (02200-1)
DESIGN DEVELOPMENT PHASE (DD-1)  Existing Systems (13850-1)
Design Guides for Divisions 2C16 Sections  Existing Utilities (02315-1)
(2-INTRO-1)  Expansion Joints (05700-1), (09250-1)
DESIGN OBJECTIVES (GD-1)  Expansion Tanks (15700-6)
Design Professional (INTRO-1)  Exterior Design (GD-3)
Design Professional Responsibilities (CD-4)  Exterior Doors (08700-1)
Diffusers, Grilles, and Registers (15800-3)  Exterior Ornamental Metal (05700-1)
Direct Expansion Coils (15750-2)  Exterior Railings (05700-1)
Diskettes (C-4)  Exterior Skin Penetrations (13031-2)
Disposal (02200-1)  Extra Stock (C-3)
Division 1 (CD-4)  Facilities Management (INTRO-1)
Door Closers (08700-2)  Fasteners (09100-1)
Doors (08050-1), (13032-1), (13033-1)  Field Adjustments (16960-1)
Draft Specifications (CD-2)  Field Orders (C-1)
DRAWING AND SPECIFICATIONS  Final Inspection (C-3)
FORMAT (ADM-6)  Final APPROVAL AND INSPECTION (C-3)
Drawing Execution (ADM-7)  Fire Alarm System (16960-2)
Drawing Submittal Requirements (ADM-6)  FIRE ALARM SYSTEMS (13850-1)
Drawings (15050-2), (16050-2)  Fire Hose Cabinets (15300-1)
Duct Insulation (15080-2)  Fire Hydrants (02660-1)
Duct Supports (15800-3)  Fire Protection (GD-2)
Ductwork (15800-1)  FIRE PROTECTION PIPING (15300-1)
EARTHWORK (02300-1)  Fire Safety (09680-1)
EH&S Design Guides (13034-1)  Fire Sprinkler Service Lines (02660-2)
ELECTRICAL (DD-3)  Flammable Liquid Storage Cabinets (11600-1)
Electrical Circuits (13031-3)  FLASHING AND SHEET METAL (07600-1)
Electrical Equipment Identification (16050-5)  Floor Checks (08700-2)
Electrical Lighting and Power Drawings (CD-2)  FLOOR MATS (12690-1)
Electrical Requirements (15050-6)  Floor Plans (SCH-1), (DD-1, 2, 3)
Elevations and Sections (SCH-1), (DD-1)  Floors (13032-1)
ELEVATORS (14200-1)  Formats (CD-4)
EMERGENCY ELECTRICAL SYSTEMS  Framing (SCH-2)
(16600-1)  Frozen Storage Space (13031-1)
Emergency Evacuation Route Diagrams  Fume Hood, Radioisotope Hood, and Biohood
(10400-1)  Exhaust Fans (15850-2)
Emergency Eyewash and Safety Shower  Fume Hoods (11600-1), (13034-1)
Equipment (11600-1)  Functional Requirements (GD-1)
Emergency/Standby Power Systems (16600-1)  FURNITURE (12620-1)
ENERGY ANALYSIS REQUIREMENTS (ADM-5)  Gauges (15050-5)
Energy Code Certification (CD-2)  General Design Considerations (2-INTRO-1), (GD-1)
Energy Conservation (GD-4)  General Duty Fans (15850-2)
Engine-Generators (16600-1)  GENERAL ELECTRICAL REQUIREMENTS
Environmental Quality (GD-3)  (16050-1)
Environmental Requirements (02300-1)  (16050-1)
<table>
<thead>
<tr>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL MECHANICAL REQUIREMENTS</strong> (15050-1)</td>
</tr>
<tr>
<td>Glass (08050-1)</td>
</tr>
<tr>
<td>GRILLES AND SCREENS (10240-1)</td>
</tr>
<tr>
<td>Ground Fault (13032-2)</td>
</tr>
<tr>
<td>Ground Fault Protection (13031-3)</td>
</tr>
<tr>
<td>GROUNDING (16060-1)</td>
</tr>
<tr>
<td>Guarantee Period (02900-2)</td>
</tr>
<tr>
<td>Guarantees (C-3)</td>
</tr>
<tr>
<td>GYPSUM BOARD (09250-1)</td>
</tr>
<tr>
<td>HARDWARE (08700-1)</td>
</tr>
<tr>
<td>Header Boards (02700-2)</td>
</tr>
<tr>
<td>Heat Exchangers (15750-2)</td>
</tr>
<tr>
<td>HEATING, VENTILATING, AND AIR-CONDITIONING EQUIPMENT (15700-1)</td>
</tr>
<tr>
<td>Heating, Ventilation, and Air-Conditioning Drawings (CD-2)</td>
</tr>
<tr>
<td>Herbicides (02200-2)</td>
</tr>
<tr>
<td>Housekeeping Pads (15850-3)</td>
</tr>
<tr>
<td>Humidifiers (15750-2)</td>
</tr>
<tr>
<td>Humidity Control (15750-1)</td>
</tr>
<tr>
<td>Hydraulics (02530-1)</td>
</tr>
<tr>
<td>Hydrology (02530-1)</td>
</tr>
<tr>
<td>Industry Codes and Standards (ADM-3)</td>
</tr>
<tr>
<td>INSPECTION (C-2)</td>
</tr>
<tr>
<td>Instructions for Division 1C</td>
</tr>
<tr>
<td>General Requirements (2-INTRO-1), (INSTR-1)</td>
</tr>
<tr>
<td>Interior Design (GD-3)</td>
</tr>
<tr>
<td>Interior Details (DD-2)</td>
</tr>
<tr>
<td>INTERPRETATIONS (C-1)</td>
</tr>
<tr>
<td>INTRODUCTION (1-INTRO-1), (2-INTRO-1)</td>
</tr>
<tr>
<td>IRRIGATION SYSTEMS (02810-1)</td>
</tr>
<tr>
<td>Keyed Switches (14200-2)</td>
</tr>
<tr>
<td>Keys and Locks (08700-1)</td>
</tr>
<tr>
<td>Kickplates (08700-1)</td>
</tr>
<tr>
<td>LABORATORIES (13034-1)</td>
</tr>
<tr>
<td>LABORATORY EQUIPMENT (11600-1)</td>
</tr>
<tr>
<td>Lamp Ballasts (16500-1)</td>
</tr>
<tr>
<td>Lamps (16500-1)</td>
</tr>
<tr>
<td>Large Scale Drawings of Equipment Rooms (DD-2, 3)</td>
</tr>
<tr>
<td>Layout (02810-1)</td>
</tr>
<tr>
<td>Life Cycle Analysis (SCH-2)</td>
</tr>
<tr>
<td>Light Switches (16050-5)</td>
</tr>
<tr>
<td>Lighting (13031-3), (13032-2), (13034-1), (16500-1)</td>
</tr>
<tr>
<td>Lighting Controls (16500-1)</td>
</tr>
<tr>
<td>Lighting Fixtures (16500-1)</td>
</tr>
<tr>
<td>LIQUID HEAT TRANSFER (15750-1)</td>
</tr>
<tr>
<td>Local Building Codes (ADM-3)</td>
</tr>
<tr>
<td>Locksets or Latchsets (08700-1)</td>
</tr>
<tr>
<td>LOUVERS AND VENTS (10200-1)</td>
</tr>
<tr>
<td>Low-Voltage Distribution Equipment (16300-3)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Section</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Plumbing Fixtures and Trim</td>
</tr>
<tr>
<td>PUTLAND CEMENT PLASTER</td>
</tr>
<tr>
<td>Power and Communication Utility</td>
</tr>
<tr>
<td>Transmission and Distribution</td>
</tr>
<tr>
<td>POWER DISTRIBUTION</td>
</tr>
<tr>
<td>PRE-BID CONFERENCE AND SITE VISIT</td>
</tr>
<tr>
<td>Preconstruction Meeting</td>
</tr>
<tr>
<td>Preliminary Evaluation</td>
</tr>
<tr>
<td>Preliminary University Review</td>
</tr>
<tr>
<td>Presentation Drawings</td>
</tr>
<tr>
<td>Processors (13033-1)</td>
</tr>
<tr>
<td>Program (ADM-4)</td>
</tr>
<tr>
<td>PROGRESS PAYMENTS (C-2)</td>
</tr>
<tr>
<td>PROJECT CLOSEOUT PROCEDURES</td>
</tr>
<tr>
<td>Project Manager (INTRO-1)</td>
</tr>
<tr>
<td>Protection of Existing Facilities and Surrounding Landscapes (02200-1)</td>
</tr>
<tr>
<td>Pumps (15700-5)</td>
</tr>
<tr>
<td>Purpose of Reviews (ADM-4)</td>
</tr>
<tr>
<td>Quick couplers (02810-2)</td>
</tr>
<tr>
<td>RADIATION AND RADIO FREQUENCY SHIELDING (13090-1)</td>
</tr>
<tr>
<td>Radiation Shielding (13090-1)</td>
</tr>
<tr>
<td>Radio Frequency Shielding (13090-1)</td>
</tr>
<tr>
<td>Receptacles (16050-5)</td>
</tr>
<tr>
<td>Recirculating System (13032-2)</td>
</tr>
<tr>
<td>RECORD DOCUMENTS (C-4)</td>
</tr>
<tr>
<td>Record Drawings (C-4)</td>
</tr>
<tr>
<td>Reference Data (ADM-1)</td>
</tr>
<tr>
<td>Refrigeration (13034-2)</td>
</tr>
<tr>
<td>REFRIGERATION EQUIPMENT (15600-1)</td>
</tr>
<tr>
<td>Refrigeration System (13031-2)</td>
</tr>
<tr>
<td>Regents and Chancellor (ADM-1)</td>
</tr>
<tr>
<td>Regular Construction Meetings (C-1)</td>
</tr>
<tr>
<td>REGULATORY REVIEWS AND APPROVALS (ADM-4)</td>
</tr>
<tr>
<td>Remodeling (09250-1)</td>
</tr>
<tr>
<td>REMODELING PROJECTS (ADM-5)</td>
</tr>
<tr>
<td>REQUIREMENTS FOR CONSTRUCTION DOCUMENTS (CD-3)</td>
</tr>
<tr>
<td>REQUIREMENTS FOR SPECIFICATIONS (CD-4)</td>
</tr>
<tr>
<td>RESILIENT FLOORING (09650-1)</td>
</tr>
<tr>
<td>REVIEW AND EVALUATION OF PROGRAM (SCH-3)</td>
</tr>
<tr>
<td>Review Scope (SCH-2)</td>
</tr>
<tr>
<td>Reviews (CD-1)</td>
</tr>
<tr>
<td>REVISIONS (INTRO-1), (C-1)</td>
</tr>
<tr>
<td>REVISIONS TO BID DOCUMENTS (B-1)</td>
</tr>
<tr>
<td>Roadways, Parking, and Service Areas (02700-1)</td>
</tr>
<tr>
<td>ROUGH CARPENTRY (06100-1)</td>
</tr>
<tr>
<td>Salvage (02200-1)</td>
</tr>
<tr>
<td>SCHEMATIC DESIGN PHASE (SCH-1)</td>
</tr>
<tr>
<td>Seals and Hardeners (03050-1)</td>
</tr>
<tr>
<td>Seismic Restraints (16050-6)</td>
</tr>
<tr>
<td>Seismic Safety (GD-2)</td>
</tr>
<tr>
<td>Seismic Support (13031-3)</td>
</tr>
<tr>
<td>Service Saddles (02810-2)</td>
</tr>
<tr>
<td>Sewage Flow (02530-1)</td>
</tr>
<tr>
<td>Shaft Casings (14200-2)</td>
</tr>
<tr>
<td>Shop Drawings (15300-1)</td>
</tr>
<tr>
<td>Shower Rooms (09300-1)</td>
</tr>
<tr>
<td>Signs (02800-1)</td>
</tr>
<tr>
<td>SIGNS AND GRAPHICS (10400-1)</td>
</tr>
<tr>
<td>Site and Street Shelters (02800-1)</td>
</tr>
<tr>
<td>Site Furnishings (02800-1)</td>
</tr>
<tr>
<td>SITE IMPROVEMENTS AND AMENITIES (02800-1)</td>
</tr>
<tr>
<td>Site Meeting (C-3)</td>
</tr>
<tr>
<td>SITE PREPARATION (02200-1)</td>
</tr>
<tr>
<td>SITE RESTORATION AND REHABILITATION (02950-1)</td>
</tr>
<tr>
<td>Site Utilization Plan (SCH-1)</td>
</tr>
<tr>
<td>Soil and Subsurface Conditions (02210-1)</td>
</tr>
<tr>
<td>SOILS AND MATERIALS TESTING (DD-4), (CD-3)</td>
</tr>
<tr>
<td>Sound and Vibration Isolation (15050-5)</td>
</tr>
<tr>
<td>Space (16050-2)</td>
</tr>
<tr>
<td>SPECIAL CONSIDERATIONS (GD-2)</td>
</tr>
<tr>
<td>Special Locations (16050-2)</td>
</tr>
<tr>
<td>Special Preparation by Design Professional (ADM-5)</td>
</tr>
<tr>
<td>Specifications Page Format (CD-5)</td>
</tr>
<tr>
<td>Specifications (15050-2), (16050-2)</td>
</tr>
<tr>
<td>Specifications Fundamentals (CD-4)</td>
</tr>
<tr>
<td>Sprinkler Heads (02810-1)</td>
</tr>
<tr>
<td>Sprinkler Heads and Controllers (02810-2)</td>
</tr>
<tr>
<td>Sprinkler System (15300-1)</td>
</tr>
<tr>
<td>Standard Asbestos Abatement Specifications Section (13280-3)</td>
</tr>
<tr>
<td>Standard Division 1 Sections (INSTR-1)</td>
</tr>
<tr>
<td>Standards Manual (10400-1)</td>
</tr>
<tr>
<td>State Agencies (ADM-4)</td>
</tr>
<tr>
<td>Steam Coils (15750-2)</td>
</tr>
<tr>
<td>Steam Condensate Return Units (15700-5)</td>
</tr>
<tr>
<td>Steam Pressure-Reducing/Regulating Valves (15700-4)</td>
</tr>
<tr>
<td>Steam Traps (15700-5)</td>
</tr>
<tr>
<td>Stray Heat (16050-1)</td>
</tr>
<tr>
<td>Structural Design and Evaluation (ADM-2)</td>
</tr>
<tr>
<td>Structural Drawings (CD-1)</td>
</tr>
<tr>
<td>STRUCTURAL REQUIREMENTS (SCH-2), (DD-2)</td>
</tr>
<tr>
<td>Structural System (SCH-2)</td>
</tr>
<tr>
<td>Submittal Review (C-3)</td>
</tr>
<tr>
<td>Submittals (CD-1), (16600-2)</td>
</tr>
<tr>
<td>SUBSURFACE INVESTIGATION (02210-1)</td>
</tr>
<tr>
<td>Sun-Control Film (12500-1)</td>
</tr>
<tr>
<td>Support of Funds (ADM-4)</td>
</tr>
<tr>
<td>Technical Guidelines (GD-1)</td>
</tr>
<tr>
<td>Index</td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td>TELEPHONE ENCLOSURES (10755-1)</td>
</tr>
<tr>
<td>Temperature (13032-1)</td>
</tr>
<tr>
<td>TEMPERATURE AND AIR VOLUME</td>
</tr>
<tr>
<td>CONTROLS (15950-1)</td>
</tr>
<tr>
<td>TERMS (INTRO-1)</td>
</tr>
<tr>
<td>Testing (15750-1)</td>
</tr>
<tr>
<td>Testing Agency Qualifications (16960-2)</td>
</tr>
<tr>
<td>TESTING REQUIREMENTS (16960-1)</td>
</tr>
<tr>
<td>TESTING, ADJUSTING, AND BALANCING (15990-1)</td>
</tr>
<tr>
<td>Thermographic Survey (16960-1)</td>
</tr>
<tr>
<td>TILE (09300-1)</td>
</tr>
<tr>
<td>TIME OF SERVICE (ADM-2)</td>
</tr>
<tr>
<td>TOILET PARTITIONS (10150-1)</td>
</tr>
<tr>
<td>TOILET ROOM ACCESSORIES (10815-1)</td>
</tr>
<tr>
<td>Toilet Rooms (08700-2)</td>
</tr>
<tr>
<td>Training (C-3)</td>
</tr>
<tr>
<td>Tree-Trimming (02200-2)</td>
</tr>
<tr>
<td>Trench Surfacing (02315-1)</td>
</tr>
<tr>
<td>TRENCHING, BACKFILLING, AND</td>
</tr>
<tr>
<td>COMPACTION (02315-1)</td>
</tr>
<tr>
<td>Turning Vanes (15800-3)</td>
</tr>
<tr>
<td>Types of Elevators (14200-1)</td>
</tr>
<tr>
<td>Unacceptable Locations and Connections (16050-1)</td>
</tr>
<tr>
<td>UNDERGROUND STORM DRAINAGE AND</td>
</tr>
<tr>
<td>SANITARY SEWERAGE SYSTEMS (02530-1)</td>
</tr>
<tr>
<td>UNDERGROUND UTILITIES (02500-1)</td>
</tr>
<tr>
<td>UNDERGROUND WATER SYSTEMS (02660-1)</td>
</tr>
<tr>
<td>Undesirable Plants (02900-1)</td>
</tr>
<tr>
<td>University (INTRO-1)</td>
</tr>
<tr>
<td>University Assistance (ADM-5)</td>
</tr>
<tr>
<td>University Responsibilities (CD-4)</td>
</tr>
<tr>
<td>UNIVERSITY REVIEW AND APPROVAL (ADM-4)</td>
</tr>
<tr>
<td>Utilities Termination (15050-1), (16050-1)</td>
</tr>
<tr>
<td>Utility Layout and Distribution (02500-1)</td>
</tr>
<tr>
<td>Utility Tunnel Design (02500-1)</td>
</tr>
<tr>
<td>Utility Tunnel Penetrations (02500-1)</td>
</tr>
<tr>
<td>UV Lighting Systems (16500-1)</td>
</tr>
<tr>
<td>Valves (02660-2), (02810-2), (15050-4), (15400-4), (15700-4)</td>
</tr>
<tr>
<td>Valves and Circuit Breakers (13034-2)</td>
</tr>
<tr>
<td>Ventilation (13033-1)</td>
</tr>
<tr>
<td>Walk-In Storage (13032-1)</td>
</tr>
<tr>
<td>Walking Pads (07500-1)</td>
</tr>
<tr>
<td>Walks and Paths (02700-2)</td>
</tr>
<tr>
<td>Walks, Road, and Parking Appurtenances (02800-1)</td>
</tr>
<tr>
<td>WALL AND CORNER GUARDS (10260-1)</td>
</tr>
<tr>
<td>WALL COVERINGS (09720-1)</td>
</tr>
<tr>
<td>WARM ROOMS (13032-1)</td>
</tr>
<tr>
<td>Water Coils (15750-1)</td>
</tr>
<tr>
<td>Water Mains (02660-2)</td>
</tr>
<tr>
<td>Water Services (02660-1)</td>
</tr>
<tr>
<td>Water Treatment (15700-6)</td>
</tr>
<tr>
<td>Waxes (09650-1)</td>
</tr>
<tr>
<td>WINDOW TREATMENT (08050-1), (12500-1)</td>
</tr>
<tr>
<td>Windows (08050-1)</td>
</tr>
<tr>
<td>Wire (02810-2)</td>
</tr>
<tr>
<td>Wire and Cable (16050-4)</td>
</tr>
</tbody>
</table>