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special report D-73
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effective use of systems building technology

Open Systems Catalog

volume II: prototype performance specifications

by
richard l. schneider

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This volume of performance specifications is intended to be an aid in the use of advanced building technology and methods. This document is intended to be utilized in conjunction with its companion volumes of *Effective Use of Systems Building Technology: Open Systems Catalog--Vol. I, Open Systems Guide*, by Tibor D. Csizmadia, and *Vol. III, Building Products Information*, by Thomas A. Kenney.

Included in this document are prototype performance specifications for

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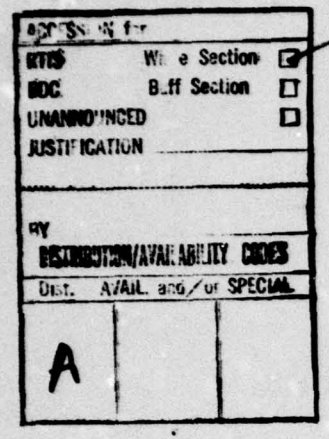
BLOCK 20 continued.

office and classroom spaces, which were developed and organized from previously published specifications and specification guides. Specifications are outlined in terms of structure; interior partitions; heating, ventilating, and cooling; lighting-ceiling; and electrical-electronic subsystems.

foreword



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The report was prepared by the Master Planning and Systems Building Branch (HPM), Habitability and Planning Division (HP) of the U.S. Army Construction Engineering Research Laboratory (CERL). Contributing CERL personnel were Dale A. Bryant, Michael G. Carroll, Tibor D. Csizmadia, Thomas A. Kenney, and Richard L. Schneider of HPM. Dr. D. Gordon Bagby is Chief of HPM and Dr. Robert M. Dinnat is Chief of HP.

COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

contents

introduction

Background:

Traditionally, buildings have been fully designed, detailed, and prescriptively specified before selection of the construction operators, i.e., the construction manager, contractors, subcontractors, manufacturers, etc. Current trends, problems, and necessities suggest that in a significant number of cases, consideration of alternatives to traditional approaches may be justified. One alternative is the open systems approach, which utilizes pre-engineered, industrialized subsystems. These are now available competitively for use in private and public building projects.

Although these building subsystems may be used in a traditional approach to project design and construction, they are used most profitably with the systems approach. Properly used, the systems approach provides a means for tapping the creativity and judgment of an assortment of relevant technical and professional disciplines.[1]

[1] *Building Systems Planning Manual*, Building Systems Information Clearinghouse, Special Report Number Three, BSIC/EFL, Menlo Park, California, 1971.

Purpose:

Performance specification is only one aspect of the open systems approach to building procurement, but it is essential to its success. Demands

for the reduction of first costs and life-cycle costs, and for maintenance of facility quality and flexibility, can be met in both the public and private sectors if the actual needs are properly communicated to the subsystems manufacturers. Stating procurement needs in terms of performance criteria allows industry the freedom to innovate, reduce production costs and develop industry performance standards.

Steps have been taken to establish performance criteria for the procurement process. Government agencies have successfully procured building facilities utilizing performance specifications; however, many problems must be solved if the benefits and developments of the open systems approach are to be fully applied to public projects. The prototype performance specifications and associated documents[2] comprising the Open Systems Catalog are aimed at facilitating the effective use of advanced building procurement techniques.

A performance specification is a statement of required results, verifiable as meeting stipulated criteria and free of unnecessary process limitations.[3] Basically, a performance specification defines the ends to be achieved, in a manner that is capable of being measured, tested,

[2]Tibor D. Csizmadia, *Effective Use of Systems Building Technology: Open Systems Catalog--Vol I, Open Systems Guide*, Special Report D-73 (U.S. Army Construction Engineering Research Laboratory [CERL], 1977).

[2]Thomas A. Kenney, *Effective Use of Systems Building Technology: Open Systems Catalog--Vol III, Building Products Information*, Special Report D-73 (CERL, 1977)

Performance Specification - Definition:

[3]*CSI Manual of Practice, Performance Specifications, MP-3F* (Construction Specification Institute, Washington D.C., 1972), p.3.

or evaluated. Traditional proprietary, descriptive, or other prescriptive specifications are the opposite of performance specifications, because they explicitly define what is necessary to achieve a result. The prescriptive specification offers the subsystem manufacturer little or no choice of materials, product design, fabrication, or installation; a performance specification leaves the manufacturer freedom for innovation.

Use:

These performance specifications have been compiled for two specific uses: 1. To help owners compile performance specifications for procuring building facilities, either with or without the remainder of the "Open Systems Catalog" and its associated documents.[4] 2. To identify accepted performance levels for a specific building type or space use and to develop selection criteria for determination of a building product's inclusion in the Computerized Data Bank described in the "Open Systems Catalog, Building Products Information."[5]

[4] Tibor D. Csizmadia, *Effective Use of Systems Building Technology: Open Systems Catalog--Vol I, Open Systems Guide*, Special Report D-73 (CERL, 1977).

[4-5] Thomas A. Kenney, *Effective Use of Systems Building Technology: Open Systems Catalog--Vol III, Building Products Information*, Special Report D-73 (CERL, 1977)

Organization:

This volume of prototype performance specifications is subdivided into seven major sections: the introduction, the master specification format, and the five subsystems prototype performance specifications. The introduction supplies general background information, explains the organization of the prototype performance specifications, and provides instructions

for their use. This section includes a list of performance specifications and direct reference publications, a bibliography of related sources and a list of definitions important to performance specifications. The master format, taken from BRAB/FCC,[6] is an expandable listing of performance attributes for all subsystems. Each performance specifications section includes its own format of applicable attributes, as derived from the master format.

The performance specifications and publications listed as references were reviewed for applicability of their performance requirements, criteria, and format to the "Open Systems Catalog." The BRAB/FCC[6] format was chosen for this project for several reasons. The format appeared to represent the most recent published performance specification format especially tailored to government procurement of building subsystems. Since it was based on a published CSI performance specification format[7] (an organization whose specification guides are widely used and accepted in the industry), it seemed to have the largest general applicability and number of potential users in the public and private sectors. This format also appeared to offer the best blend of performance specifications and common construction practices. The specification format is divided into three major parts: GENERAL, DELIVERY

[6] *The Use of Subsystems in Building Construction for BRAB & FCC,* Marvin E. Goody, John M. Clancy & Associates, Inc., with Dublin-Mindell-Bloome Associates, P.C. Volume 1, pp. 89-93.

[7] *CSI Manual of Practice, Organization and Format for Performance Specifying, MP-2D* (Construction Specification Institute, Washington, D.C.) pp. 8-9.

PROCEDURES, AND PERFORMANCE REQUIREMENTS. GENERAL defines the subsystem; describes local conditions, offeror requirements, and qualifications; outlines subsystem evaluation criteria; and provides requirements for offeror submission or proposal. DELIVERY PROCEDURE deals with site and special project conditions. PERFORMANCE REQUIREMENTS is divided into three major categories: SAFETY, FUNCTIONAL, AND PRACTICAL. Each subcategory is divided into performance attributes. When attributes are numbered in the format, each must be considered; if there are no requirements for the attribute, this should be noted in the specifications. At the finest subdivision, attributes are unnumbered so that the list may be expanded or attributes ignored (if not needed.)

*See Definitions, pp. 07-08.

Each attribute is broken down into *requirement, criteria, test and evaluation* subdivisions,* although all are not needed in every case. The presence of *criteria* implies the presence of a *test;* however, a *test* may or may not need further clarification by an *evaluation.* Any *criterion* is generated by *requirement;* however, the *requirement* need not be stated in cases where it is implicitly stated by the *criteria.* Conversely, the *requirement* may state a section's essential needs. In this case, the *requirement* may or may not be followed by a *criterion* or include a *test.*[8]

[8] *The Use of Subsystems in Building Construction for BRAB & FCC,* Marvin E. Goody, John M. Clancy & Associates, Inc., with Dublin-Mindell-Bloome Associates, P.C., Volume 1, p. 88.

In the formation of requirements, criteria, tests and evaluations for each subsystem attribute, certain quantitative and dimensional information has been left to the discretion of the designers. When this occurs, the text of the requirement remains, but the missing information is noted by ( ) empty parentheses.

Further Stages:

Further "upgrades" of the catalog may be written after expansion, field testing and revision of this "Information Catalog." The first of these stages is "Upgrade 2," or a "Catalog of Certified Products." "Upgrade 3" is proposed to be a catalog of pre-purchased or pre-contracted products; this will be developed through competitive bidding, which must include certain guarantees from the client and the manufacturer. The present catalog (Upgrade 1), is now only an information catalog. The prototype performance specifications must undergo two major advances to meet the requirements of Upgrades 2 and 3. First, they must be carefully compared with current product information for their overall applicability and compatibility. Second, performance requirements and criteria must be developed for varying space types, facilities, and a combination of subsystems for a closer comparison with producer information. The relationships between the performance specifications and the product information are extremely important and imperative to the success of product certification.

definitions

BUILDING SYSTEM:
A set of coordinated *subsystems*, suitable for many building types, that perform the major functions of a building.

SUBSYSTEM:
A coordinated, pre-engineered assemblage of *components*, forming a package that can be readily manufactured, shipped to, and installed in a total system (the building).

COMPONENTS OR PRODUCTS:
The basic unit of construction (material or an item of equipment); the usual level of prescriptive specification.

IN-SYSTEM:
All of the parts that make up a *subsystem* or *the building system*.

OUT-OF-SYSTEMS or NON-SYSTEMS:
All that is not part of a *subsystem* or the *building system*.

PERFORMANCE CRITERIA:
The set of detailed statements of verifiable requirements that must be met to fulfill user needs.

ATTRIBUTE:
As used in this specification, one of a list of qualities or properties that a subsystem or component must have to function according to the owner's/user's needs.

ASPECTS:
As used in this specification, the four basic steps for conversion of a designed attribute into specification text: *requirement*, *criteria*, *test*, and *evaluation*.

REQUIREMENT:
The qualitative statement of desired performance for the environment.

CRITERIA:

A quantification of desired performance.

TEST:

The evaluative techniques for insuring *component* or *subsystem* conformance with the *criteria;* testing may be performed in the prototype stage, during manufacture, at the site during or after installation, and after project completion, or at any combination of times; testing may also be performed by the design professional, owner, testing consultant, public agencies, or the manufacturer.

COMPATIBILITY or INTERFACE:

The common boundary or area of connection between two or more *subsystems,* including both the physical fit and the overlap or performance characteristics.

references

These published performance specifications were utilized in the compilation of the Open Systems Catalog's Prototype Performance Specifications. The Prototype Specification Format was taken directly from the BRAB/FCC publication, *The Use of Subsystems in Building Construction*, whose format was in turn derived from the *CSI Manual of Practice: Organization and Format for Performance Specifying*. Specified performance requirements and criteria for office and classroom spaces were derived directly from the listed specifications.

CSI Manual of Practice (Construction Specification Institute, Manual of Practice, Washington, D.C., 1970-197-).

A manual published by the Construction Specifications Institute for use as an office reference by architects, engineers, and professional consultants and as a comprehensive text for educators and students, covering the complete scope of construction documentation. The manual is in two volumes; Volume One, the Project Manual, deals with procedures and technology, and Volume Two, Formats, deals with specifications and manuals.

First California Commission on School Construction Systems Development, First Contract Documents & Performance Specifications, Volumes 1 and 2 (1963).

A set of educational specifications drafted by the First California Commission on School Construction Systems which provides information about bidding procedures, a description of the current construction program, procedures for submitting a proposal, data and conditions related to the development phase of the project, component contracts, and general conditions and procedures. Performance specifications are outlined in terms of structure; heating, ventilation, and cooling; lighting-ceiling; interior partitions. Also included are materials--cost matrices, construction timetables, and addenda to the specifications.

First Construction Systems Program Building System Specifications (Detroit Public Schools, Detroit, Michigan, 1970).

A set of educational specifications drafted by the Detroit Public Schools' Construction Systems Program which provides information about bidding procedures, procedures for submitting proposals, contract requirements, and procedures. Performance specifications are outlined in terms of structure, atmosphere, lighting-ceiling, interior space division, and vertical skin subsystems.

Performance Specifications for Building Subsystems, Schoolhouse Systems Project, Programs 3 and 4 (Bureau of School Facilities, Division of Elementary and Secondary Education, Department of Education, State of Florida).

Program No. 3. A set of educational facilities specifications and a collection of project documents, drafted for the Schoolhouse System Project by the Florida State Department of Education. Lists of manufacturers receiving plans and specifications are given for each subsystem. Gives information about bid tabulation; evaluation, proposal, and bid sheets; advertisement; instructions for bidding; and general conditions. Performance specifications are outlined in terms of structure; heating, ventilation, and air conditioning; lighting-ceiling; interior partitions; and roofing subsystems.

Program No. 4. A set of educational facilities specifications drafted for the Schoolhouse Systems Project by the Florida State Bureau of School Facilities, Division of Elementary and Secondary Education, Florida State Department of Education. Gives advertisements for bids, instructions to bidders including proposal formats, and general and special contract conditions. Performance specifications are listed in terms of structure; heating, ventilation, and air conditioning; lighting-ceiling; demountable partitions; carpet; roofing/insulation; cabinets; electric-electronic; and fire protection subsystems.

Performance Specification for Office Buildings, Second Edition, Volumes I and II (PBS, GSA, Public Building Service, Office of Construction Management, June 1973).

Volume I deals mainly with process; it contains a general description of the procedures to be followed during PBS projects, and the legal framework for procurement of the system and the requests for technical proposals.

Volume II contains the performance specifications, which are indexed according to a two-dimensional matrix (attributes and built elements, or subsystems). Both In-System and Out-of-System aspects are considered.

SEF T8, *Specifications for the Second SEF Building Systems* (Metropolitan Toronto School Board, Study of Educational Facilities, Toronto, November 1972).

A set of educational facilities specifications drafted by the Metropolitan Toronto School Board, Study of Educational Facilities, for the Second SEF Building System. Gives instructions to tenderers, tender documents, agreement forms, and general conditions. Performance specifications are outlined in terms of structure, supplementary structure, atmosphere, lighting-ceiling, interior space division, vertical skin, plumbing, outside mechanical services, electric-electronic, caseworks, roofing, carpet, gymnasium flooring, resilient flooring, hardware, and light control subsystem.

University of Alaska, *Contract Documents and Subsystems Specifications* (March, 1975).

A set of educational facilities subsystem specifications giving general requirements, general conditions, and special conditions, drafted by the University of Alaska, Office of Institutional Studies and Physical Plant Development. Performance requirements are outlined in terms of structure, exterior closure, roofing, integrated ceiling, elevators, plumbing, heating, ventilation, cooling, automatic fire sprinklers, modular power and communication distribution, and service columns subsystems.

The Use of Subsystems in Building Construction for BRAB and FCC (Marvin E. Goody, John M. Clancy & Associates, Inc. with Dublin-Mindell-Bloome Associates, P.C.).

This report drafts prototype performance specifications defining requirements and criteria of nine subsystems for use in V.A. Hospitals, low-rise housing, and mid-rise (4-10 story) office buildings.

The subsystems have been specified to fit into typical (or "yardstick") buildings modeled after those built by the governmental agencies belonging to the Federal Construction Council and by the private sector.

To aid the consumer of buildings (the "owner-user"), advantages and implications of employing subsystems are discussed, together with strategies for insuring their successful use.

bibliography

Academic Building Systems (ABS, Indiana University, 1971).

Adams, Velma, *The Trend to School Building Systems*, School Management (August 1969) pp. 24-30, 49-54, (September 1969) pp. 66-73.

Boice, John R., *A History & Evaluation of School Construction Systems Development Project* (BSIC/EFL, Menlo Park, California, 1971).

BOSTCO, Boston Standard Component System (Wilson Rains & Associates, City of Boston Public Facilities Department, 12 October, 1971).

Brill, Michael, *Systems Design, Performance Specifications & Building Systems: Summing Up* (Construction Products & Technology, September 1969), pp. 33-37.

Building Procurement; Proceedings of a Workshop, IF Occasional Paper Number 1 (IF TEAM & CERL, December 1974).

Building Systems Planning Manual, Building Systems Information Clearinghouse, Special Report Number Three (BSIC/EFL, Menlo Park, California, 1971).

Burns, Joshua A., *Documentation for BSIC/EFL Systems Building Data Bank* (Educational Facilities Laboratories, Menlo Park, California, April 8, 1975).

Carroll, Michael G., *Procuring Today's Building Technology*, Special Report D-72, Vol I/ADA031000, Vol II/ADA030520 (CERL, 1976).

Chase, William W., *Systems and the Single School* (Construction Products & Technology, September 1970), pp. 41-46

Cleland, Wallace B., *New Tactics for Building: Experience/Analysis/Recommendations from the Detroit Public Schools Construction System Program* (Detroit Public Schools, Office of School Housing, Detroit, Michigan, January 1975).

Contract Documents for Richard Stockton State College, Geddes Brecher Qualls Cunningham: Architects (Princeton, New Jersey, June 17, 1970).

Csizmadia, Tibor D., *Effective Use of Systems Building Technology: Open Systems Catalog--Vol I, Open Systems Guide,* Special Report D-73 (CERL, 1977).

Featherstone, Richard L., *An Assessment of the Detroit Public Schools Construction Systems Program,* for Members of the Board of Education, Detroit (MSU, 1972).

Florida's Systems Schools, CEFP Journal (January-February 1970), pp. 9-16.

Gores, Harold B. and Alan C. Green, *Building Ideas That Save Money* (American School & University, February 1971), pp. 13-32.

Griffin, C. W., *Systems: An Approach to School Construction* (EFL, New York, New York, 1971).

Industrialization Forum, Building: Systems Construction Analysis Research, IF, Vol. 5, Number 1-2 (1974).

Kenney, Thomas A., *Effective Use of Building Technology: Open Systems Catalog--Vol III, Building Products Information,* Special Report D-73 (CERL, 1977).

K/M Associates: A Case Study in Systems Building, Building Systems Information Clearinghouse, Research Report Number One, (John R. Boice and Joshua A. Burns, Systems Division, School Planning Laboratory, School of Education, Stanford, California, 1970).

Listing of Schools Constructed with a Building System, Building Systems Information Clearinghouse Special Report Number 2 (Educational Facilities Laboratories, Menlo Park, California, April 7, 1975).

Manufacturers Compatibility Study, Building Systems Information Clearinghouse Special Report Number One (John R. Boice & Joshua Burns, Systems Division, School Planning Laboratory, School of Education, Stanford, California, 1969).

Manufacturers Compatibility Study, Building Systems Information Clearinghouse Special Report Number One (John R. Boice & Joshua Burns, Systems Division, School Planning Laboratory, School of Education, Stanford, California, 1970).

Manufacturers Compatibility Study, Third Edition, Building Systems Information Clearinghouse Special Report Number One (BSIC/EFL, Menlo Park, California, September 1971).

The PBS Performance Specifications for Office Buildings (David Hattis & Thomas Ware, 1971).

Promotion of the Development and Use of the Subsystem Concept of Building Construction, Building Research Advisory Board-Federal Construction Council, Technical Report Number 62 (National Academy of Sciences, Washington, D. C., 1972).

The Role of Hardware Information in Using Industrialized Building Products in Military Construction (Center for Architectural Research, School of Architecture, Renssalaer Polytechnic Institute, Troy, New York, January 1975).

SCSD: Development of Systems Building Components by Performance Specifications, Patric Hislop & Christopher Walker, Building Center Intelligence Report Number 3 (London: The Building Centre Trust, 1970).

SCSD: General Project Information (BSIC/EFL, Menlo Park, California).

SCSD: the Project & the Schools (EFL, New York, New York, 1967).

SEF; Education Specifications and User Requirements for Secondary Schools, Study of Educational Facilities (Municipality of Metropolitan Toronto School Boards, Toronto, 1970).

SEF; Report T-1: Introduction to the First SEF Building System, Study of Educational Facilities (Municipality of Metropolitan Toronto School Boards, Toronto, 1970).

SEF; Report T-2: Specifications for the First SEF Building System, Study of Educational Facilities (Municipality of Metropolitan Toronto School Boards, Toronto, 1970).

SEF; Report T-7: Sub-System Proposals for the First SEF Building System, Study of Educational Facilities (Municipality of Metropolitan Toronto School Boards, Toronto, 1970).

SER, School Environments Research Project, Publication Number 1 (Ann Arbor, Michigan, 1965).

Student Housing at State University College at Brockport, Request for Turnkey Proposals (New York State Dormitory, New York, 1971).

A Systems Approach to Building, BEAM Program (Canada Department of Industry, 1969).

URBS, University Residential Building System, Building Systems Program Feasibility Study for University of California Student Housing (Building Systems Development, Inc., October 1965).

URBS, University Residential Building System, Contract Documents and Performance Specifications, URBS Publication 1 (California University, Berkeley, California, June 1967).

URBS, University Residential Building System, Performance Specification Illustrative Information (California University, Berkeley, California, March 31, 1967).

URBS, University Residential Building System, Storage Study, URBS Publication 4 (California University, Berkeley, California, October 1967).

URBS, University Residential Building System, Student Housing Cost Study, URBS Publication 3 (California University, Berkeley, California, October 1967).

URBS, University Residential Building System, Phase I Report Revised December 15, 1966 (California University, Berkeley, California, December 1966)

URBS, University Residential Building System, Phase II Report (California University, Berkeley, California, September 1968).

University of Alaska, Contract Documents & Performance Specifications (March 1975).

University of Alaska, Subsystem Schematic Plans (January 1975).

performance specification format

1.0	GENERAL
1.1	SUBSYSTEM DEFINITION AND SCOPE
1.11	Included
1.12	Excluded
1.2	LOCAL CONDITIONS
1.21	Available Inputs
	Energy
	Raw Materials
1.22	Available Labor
	Technical Skills
	Resolved Jurisdictional Disputes
1.3	OFFEROR REQUIREMENTS AND QUALIFICATION
1.31	Reliability
	Economic Stability
	Production Capacity
1.32	Existing Installations
1.33	Documentation
1.34	Vendor Guaranty or Warranty
1.4	EVALUATION PROCEDURE
1.5	PROPOSAL PROCEDURE
2.0	DELIVERY PROCEDURE
2.1	TRANSPORTATION
2.2	HANDLING
2.21	Equipment Required
2.22	Labor Required

*For the purposes of this catalog's example specification, only General Sections 1.1, 1.11, 1.12 and performance requirements sections are included. The section on Delivery Procedures is excluded.

2.3 STORAGE

2.4 PROTECTION

2.5 SCHEDULING EFFECTS

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY
3.11 Life
3.111 Fire
Flame Spread
Fire Resistance
Combustibility/Fuel Contribution
Smoke Production (and Toxic Substances)
Fire Generation
3.112 Toxicity Characteristics (not fire related)
3.113 Radiation Characteristics
3.114 Azoic Characteristics (undesirable life support)
3.115 Electrical Characteristics
3.116 Hazardousness (other than the above)

3.12 Property
3.121 Fire
Endurance
Strength when Exposed
3.122 Theft Security
3.123 Vandalism Security
3.124 Resistance to Misuse

3.13 Specific Code Restrictions

3.2 FUNCTIONAL
3.21 General Functional Performance Characteristics
(More complete description than in 1.1 above--includes characteristics/ requirements not covered elsewhere)

3.22 Size, Weight, Dimensional
Dimensions
Plumbness/Levelness
Flatness
Volume
Weight

3.23 Strength
- Static
- Dynamic
  - Wind
  - Seismic
  - Impact
- Thermal
- Temporary (transit)

3.24 Durability

3.241 Surface Stability

Cleanability	Crack
Scratch Resistance	Spall
Abrasion Resistance	Craze
Hardness	Blister
Stain Resistance	Chalk
Impact Resistance	Fade
Resilience	Delamination

3.242 Material Stability

Toughness	Friability
Brittleness	Dimensional
Malleability	Moisture
Ductility	Thermal
Creep	Chemical
Viscosity	Cohesiveness
Corrosion	Adhesiveness

3.243 Life of Subsystem and Component Parts
Cycles, Hours, Years, etc.

3.25 Transmission
- Sound
- Light
- Heat
- Air, Gases
- Moisture, Liquids
- Electricity
- Other Radiation: Electromagnetic or Particle

3.26 Dynamic and Operating Characteristics
Outputs (nonenvironmental)

Quantity
Rate
Methods of Operating
Motions
Force
Cycle Time
Speed of Operation

3.27 Environmental Quality

3.271 Acoustic
- Sound Generation
  - Airborne
  - Structureborne
- Reverberation Time
  - Absorption
  - Reflection

3.272 Illumination

Color Rendition	Glare
Level	Reflection
Shadow	Other Quality

3.273 Air

Temperature	Cleanliness
Humidity	Freshness (changes)
Velocity	Odors

3.274 Tactile
- Touch
- Friction--slipperiness, traction
- Vibration
- Resilience

3.275 Pollutants (by-products)
- Particulates
- Gases
- Energies
- Wastes

3.28 Planning and Visual
- Relationship of Functions
- Modularity (dimensional)

Uniformity/Variety
Color
Appearance

3.3 PRACTICAL

3.31 Interface
Fit
Tolerances
Installation
Attachment
Relocatability
Sequence of Erection
Special Templates, Jigs, Patterns, etc.

3.32 Service
Accessibility
Maintenance Required-Frequency
Repairability
Replaceability
Interchangeability
Disturbance to Other Subsystems and Occupants
Modifiability in Place
Future Extendability

3.33 Personnel
Availability of Maintenance and Repair Personnel and Facilities
Required Education, Trainability of Maintenance and Repair Personnel
Labor Restrictions

structure

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE
1.11 Included
1.12 Excluded
Definitions

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY
3.11 Life
3.111 Fire
3.114 Azoic Characteristics
3.115 Hazardousness
3.12 Property
3.121 Fire
3.13 Specific Code Restrictions

3.2 FUNCTIONAL
3.21 General Functional Performance Characteristics
3.22 Size, Weight, Dimensional
3.23 Strength
3.24 Durability
3.241 Surface Stability
3.242 Material Stability
3.243 Life of Subsystems and Component Parts
3.25 Transmission
3.27 Environmental Quality
3.271 Acoustic
3.28 Planning and Visual

3.3 PRACTICAL
3.31 Interface
3.32 Service

2:30 STRUCTURE FORMAT 01

structure

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE

The structural subsystem consists of both floor and roof assemblies including columns. These assemblies contain both mechanical and electrical distribution and serve as support for the other subsystems and nonsystems components. The structure not only safely transmits all anticipated vertical and horizontal loads, but provides a framework within which the mechanical and integrated ceiling-lighting subsystems may be integrated with one another, and jointly attain desired levels of flexibility between these subsystems.

1.11 Included:

1) Structural frame and framing complete to deliver all vertical and horizontal loads to the ground as specified.

2) Primary and secondary horizontal spanning members, including attachments to vertical structure.

3) Vertical and lateral load resisting components including attachments.

4) Supply and layout information of anchor bolts and leveling plates with supervision and inspection of setting.

5) Floor and roof deck elements.

6) Structural facias.

7) Temporary handling attachments.

8) Chords at diaphram edges.

9) Devices and surfaces complete and installed for the attachment and support of exterior walls.

10) Expansion, contraction, and seismic joints as required.

11) Fireproofing as required, integrated with structural components, except where other subsystems or nonsystems components are specially designed and constructed to provide fireproofing.

12) Corrosion treatments for metals including prime coat painting and field touch up.

1.12 Excluded:

1) Site work.

2) Site preparation for access and movement of erection equipment.

3) Foundations.

4) Bearing walls.

5) Keys in concrete foundations.

6) Recesses in foundation walls.

7) Slabs on grade.

8) Installation of anchor bolts or dowels including grouting.

9) Interior and exterior structural elements as canopies, covered walks, and loose lintels.

10) Structural elements forming parts of other subsystems, such as lateral bracing, tracks, and support frames for operable partitions, and hangers for ceilings.

11) Provisions to support elements not forming parts of subsystem except as stated.

12) Stairs, stair railings, and connections.

Definitions:

1) Primary spanning members--a structural member carrying vertical

reactions from secondary spanning members, loads from vertical skin, and occasional special loads to columns.

2) Secondary spanning members--a structural member carrying vertical loads from floor deck elements and roof deck elements, the vertical skin, and in isolated cases, special loads to columns or to primary spanning members.

3) Floor deck--a complete structural element spanning between secondary spanning members supporting live loads, partition loads, ceilings, and nominal loads from mechanical and electrical services.

4) Roof deck--a complete structural element between secondary spanning members supporting live loads, insulation, roofing, ceiling, and nominal loads from mechanical and electrical services.

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY

3.11 Life

3.111 Fire

1) Flame Spread
R: Control Flame Spread
C: This subsystem, in use, shall have a flame spread rating of not over 25.
T: Subsystem/Physical/ASTM E-84, Surface Burning Characteristics of Building Materials, or ASTM E-162, Surface Flammability of Materials.

2) Fire Resistance
R: Provide fire safety.
C:1) This subsystem's structural floor and roof, secondary and primary beams, in use, individually or as an assembly, shall be provided with a 2-hour fire protection; or the structural floor and roof and secondary beams shall require 0.2 hour rating as determined from the "Calculations of Fire Resistance of Steel Constructions," translation No. 1425, from the National Research Council of Canada, and the primary beams shall be provided with a 3/4-hour fire

protection, if a fully automatic fire protection sprinkler system, as specified in CRITERIA: (3) in this requirement is provided by the System Contractor as part of the System. The automatic closing of openings or penetrations of any part of the Floor/Ceiling assembly such as by means of secondary fire dampers, shall not be used in meeting these criteria.

2)This subsystem's columns and/or hangers, and their connections to other parts of this subsystem, shall be provided with a 2-hour fire protection; or they shall be provided with a 1-hour fire protection, if a fully automatic fire protection sprinkler system as specified in CRITERIA: (3) of this requirement, is provided by the System Contractor as part of the System.

T: System-Subsystem/Physical/Fire Tests of Building Construction and Materials/ASTM E-119/Modification: General Services Administration, PBS 5920.9, Appendix A, in total, except the requirement for one-half inch minimum fireproofing on metal deck as specified in paragraph 5.a, will be waived if a fully automatic fire protection sprinkler system is provided.

C:3)If a fully automatic fire protection sprinkler system is provided as part of the System, as indicated in CRITERIA: (1) and (2) above, it shall conform to the material and support requirements of NFPA 13, and the piping arrangement shall be approvable by the authority normally having jurisdiction at the locale of the particular system. It shall have a pipe sizing and head spacing as needed to provide a uniform discharge density of no less than that defined by 0.1 gallons per minute per square foot over an area of 750 square feet and 0.075 gallons per minute per square foot over an area of 1,500 square feet, at any single area on any story throughout the building. Design shall be based on 50 psi at 100 gpm available for sprinklers on the highest story.

T: Subsystem/Calculation-Observation

C:4)CRITERIA: (1), (2) and (3) above shall not be impaired when subjected to seismic forces as specified in the GSA Handbook, "Structural Engineering" with the modification that Z = 1.5 instead of 1.0 for the project building located in Zone 3.

T: System/Calculation/Structural analysis.

3) Combustibility/Fuel Contribution

R: Control Combustibility

C:1)All parts of this subsystem except columns shall not contribute more than 2,000 BTU per square foot of horizontal ceiling projection to the fire load of the System.

2)This subsystem's columns and/or hangers shall not contribute more than 1,000 BTU per pound of their structural element, and more than 5,000 BTU per square foot of projected surface area of their enclosure, to the fire load of the System.
T: Subsystem/Physical/Potential Heat of Materials/Proceeding of ASTM, Volume 61, 1961.

3.112 Toxicity Characteristics

No requirement.

3.113 Radiation Characteristics

No requirement.

3.114 Azoic Characteristics

R: This subsystem in use shall not produce or retain odors, be subject to verminal or organic deterioration, or provide life support for any organic media.
T: Subsystem/Physical/Offeror shall propose tests in his Technical Proposal.

3.115 Electrical Characteristics

No requirement.

3.116 Hazardousness

a) R: Provide structural reliability.
C:1)This subsystem shall sustain the specified loads in accordance with the requirements of the specified codes, if applicable.
C:2)If this proposed subsystem is not currently qualified by the specified codes, it shall sustain the specified loads in accordance with the structural theory, submitted in this case with the Technical Proposal, as approved by the Project Manager.
T: Subsystem/Calculation-Physical/Structural analysis.

b) R: Provide safety during erection.
C:1)In addition to the safety requirements specified, any part of this subsystem erected and augmented, if required by additional temporary structure, shall sustain forces and moments incurred during

erection, including those due to dead loads, erection procedures, erection equipment, temporary structure, actual live loads, changes in temperature and volume changes, and shall sustain wind and earthquake forces as specified in the General Services Administration Handbook, "Structural Engineering." The zone coefficient "Z" shall be changed to 1.5 instead of 1.0 for the project buildings located in seismic Zone 3.

2) This subsystem augmented, if necessary, by additional temporary structure shall conform to (1) above at the time of implementation of the building expansion indicated on the A/E design drawings without impairing the functional use of any building story. The system offeror shall submit adequate documentation with his technical proposal.

T: Subsystem-Subsystem erection/Calculation/Structural analysis.

c) R: Provide anthropometric fit.
C: This subsystem shall not in itself effect, or cause other subsystems to effect, personal injury.
T: Subsystem-System prototype-System field/Observation.

d) R: Provide accessibility to, and usability by the physically handicapped.
C: This subsystem shall not impair each project building's compliance with ASA A117.1-1961 "American Standard Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped."
T: Subsystem/Observation.

3.12 Property

3.121 Fire

1) Endurance
See 3.111 "Fire Resistance" above.

3.122 Theft Security

No requirement.

3.123 Vandalism Security

No requirement.

3.124 Resistance to Misuse

No requirement.

3.13 Specific Code Restrictions

a) R: This subsystem should comply with all applicable national codes, regional codes, and state and local codes, including but not limited to the following:
1)AISC, "Specification for the Design, Fabrication and Erection, of Structural Steel for Buildings," Seventh Edition, Section 1.4.
2)AISC, Seventh Edition, "Standard Specifications for Deep Longspan Steel Joists-DLJ- and DLH-Series," Section 202; "Standard Specifications for Longspan Steel Joists-LJ- Series and LH-Series," Section 102; "Standard Specifications for Open Web Steel Joists-J-Series and H-Series," Section 3.
3)AISI, "Specification for the Design of Cold-Formed Steel Structural Members," Section 1.2.
4)ACI 318-71, Part 2, Chapter 3.
5)ACI 525-63.
6)ACI 711-58.
7)AISI "Design of Light Gauge Cold-Formed Stainless Steel Structural Members," Section 1.2.
T: Subsystem-Subsystem manufacturing-Subsystem erection and installation/Physical-Observation/Structural analysis.

b) R: All codes and tests referred to herein are the latest published version of said document.

3.2 FUNCTIONAL

3.21 General Functional Performance Characteristics

(See General--Section 1.0)

3.22 Size, Weight, Dimensional

1) Plumbness
R: This subsystem shall transfer all vertical loads to the top of the foundation so that the center of gravity of each load as transferred shall fall within a horizontal distance of 1/2 inch of its theoretical nominal center of bearing.
T: Subsystem/Calculation-Physical/Structural Analysis

3.23 Strength

1) Static

a) R: Sustain gravity loads

C: This subsystem shall sustain:

1) The dead load of the HVC, Lighting/Ceiling, Electric/Electronic, and Interior Partitions Subsystems;

2) The dead load of the structural frame and framing for the entire buildings above the foundation;

3) The dead load of the Out-of-System ducts and piping in the interstitial space, located as specified;

4) The dead load of Out-of-System partitions at 100 pounds per square foot of wall surface located as specified in the A/E's preliminary designs of the buildings;

5) The dead loads of Out-of-System ceiling, luminaires and their electrical distribution, in any of its possible locations at either ten (10) pounds per square foot or the weight per square foot of the Lighting/Ceiling Subsystem and Electric/Electronic Subsystem, whichever is greater;

6) The dead loads of the Out-of-System exterior walls, as specified in the A/E's preliminary designs of the buildings;

7) The dead loads of special spaces on any stories, of Out-of-System rooms in the typical office/classroom spaces, of Out-of-System partitions in the typical office/classroom spaces, of Out-of-System mechanical equipment throughout the buildings, of Out-of-System roof finishes, as specified in the A/E's preliminary designs of the buildings;

8) The dead and live loads of stairs in stairwells in the typical office/classroom space, as specified in the A/E's preliminary designs of the buildings, in accordance with the General Services Administration Handbook, "Structural Engineering";

9) The live load of the typical office/classroom space at 100 pounds per square foot;

10) The live load of the corridors at one hundred (100) pounds per square foot;

11) The live load imposed by the specified maintenance of all subsystems, when regular custodial maintenance is performed;

12) The snow loads as specified in the General Services Administration Handbook, "Structural Engineering."

T: Subsystem/Calculation-Physical/Structural analysis.

b) R: Sustain loads imposed on other subsystems.
C: This subsystem shall sustain all other subsystems for forces and/or moments specified to be resisted by those subsystems.
T: Subsystem-System prototype/Calculation-Physical/Structural analysis.
R: Sustain the foundations.
C: This subsystem shall sustain any lateral loads transmitted through foundations in special spaces below grade, if applicable, as specified by the A/E's preliminary designs.
T: Subsystem/Calculation/Structural analysis.

2) Dynamic

a) R: Sustain wind loads.
C: This subsystem shall sustain wind forces as specified in the General Services Administration Handbook, "Structural Engineering" which would be imposed on the buildings as designed.
T: Subsystem/Calculation/Structural analysis.

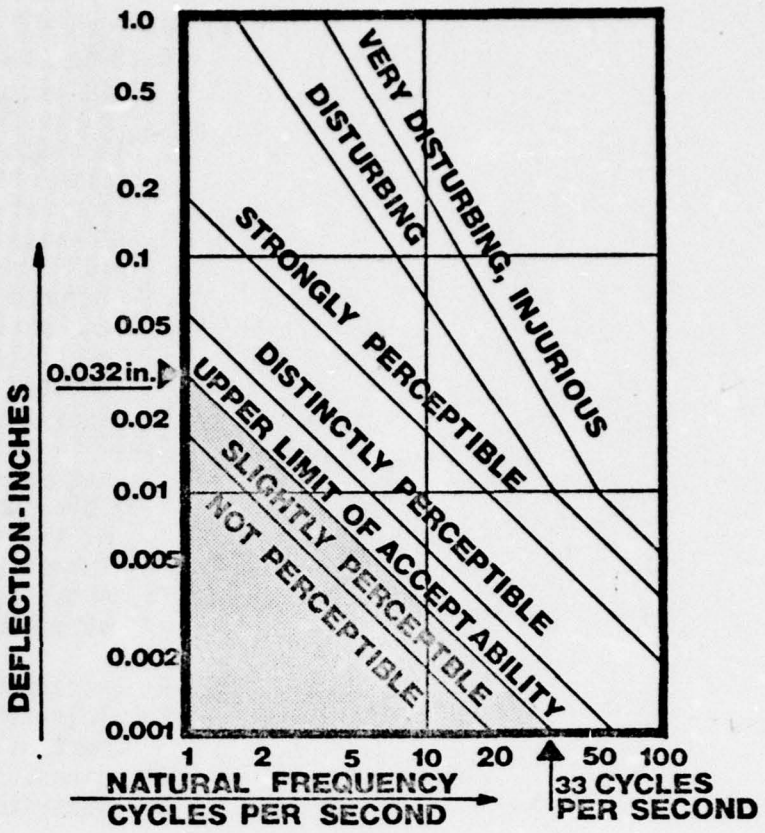
b) R: Sustain earthquake loads.
C:1) This subsystem shall sustain seismic forces as specified in the General Services Administration Handbook, "Structural Engineering" which would be imposed on the buildings as designed. The zone coefficient "Z" shall be changed to 1.5 instead of 1.0 for project buildings located in seismic Zone 3.
2) The horizontal deflection due to earthquake load of any Floor/Ceiling assembly in the building shall not exceed the vertical distance between the assemblies divided by 200.
T: Subsystem/Calculation/Structural analysis.

c) R: Requirements under Section 3.111 above shall not be impaired when subjected to seismic forces as specified in the GSA Handbook, "Structural Engineering" with the modification that Z = 1.5 instead of 1.0 for the project building located in Zone 3.
T: System/Calculation/Structural analysis.

d) R: Sustain combinations of specified loads.
C: This subsystem shall sustain any combination of the specified gravity loads, wind loads and earthquake loads, whether full or partial, in addition to concurrent stresses due to volume changes and/or temperature changes of 40°F. with the exception that wind loads and earthquake loads need not be considered simultaneously.
T: Subsystem/Calculation/Structural analysis.

e) R: Provide rigidity against human impact.
C: The deflection of any horizontal part of assembly of this subsystem due to the placement of a 300-pound gravity load at any location, when plotted against the natural frequency of this subsystem, shall fall within the range marked "Acceptable" of the chart following:

GRAPH OF REDUCED HUMAN RESPONSE AFTER LENZEN*



However, in order for an assembly to be considered as meeting this requirement, it shall be demonstrated by means of other tests submitted with this Technical Proposal that bridging action and the proximity of parallel parts are adequate to ensure their cooperative rigidity.

T: Subsystem/Calculation-Physical/Human Impact/PBS-d.6.

*Chart reproduced from "Final Report Vibration of Steel Joist-Concrete Slab Floor Systems" by Kenneth H. Lenzen, The University of Kansas Center for Research in Engineering Science, Lawrence, Kansas. This graph has been modified to show the acceptable displacement to frequency ratio range.

f) R: Control deflections.
C:1)The live load deflection of any horizontal part of this subsystem shall not exceed its span divided by 360, and for cantilevered parts it shall not exceed the overhang divided by 240.
2)The deflection of any horizontal part of this subsystem due to any combination of loads, whether full or partial, in addition to concurrent stresses due to volume changes, including long-term volume changes such as shrinkage and creep, and/or temperature changes of 40°F. shall not exceed its span divided by 240, and for cantilevered parts, it shall not exceed the overhang divided by 240.
3)The horizontal deflection due to wind load of any FCS subsystem assembly in the building shall not exceed the vertical distance between the assemblies divided by 400.
T: Subsystem/Calculation-Physical/Structural analysis.
C:4)This subsystem shall not transmit dead or live loads to any other subsystem.
5)This subsystem, when undergoing deflection due to any combination of specified loads, shall not damage or otherwise impair the performance of any other subsystem.
T: Subsystem-System field/Calculation-Observation/Test Method to be submitted by Offeror with his Technical Proposal.

g) R: Accommodate differential foundation settlement.
C: This subsystem shall sustain loads imposed by differential settlement of the foundations as indicated in the A/E's preliminary designs.
T: Subsystem/Calculation/Structural analysis.

3.24 Durability

3.241 Surface Stability

R: Control cracking.
C:1)Cracks developing in any part of this subsystem, under any combination of stresses due to specified loads and/or volume changes, in use, shall not impair the performance of this or any other subsystem.
T: Subsystem-System field/Calculation-Physical-Observation/Test Method to be submitted by the Offeror with his Technical Proposal.
C:2)Joints and/or surface finish of any part of this subsystem exposed to view in use shall be designed in a way that cracks developing in such an exposed surface under any combination of stresses due

to specified loads and/or volume changes will be consistent with the aesthetic concept of the System design.

T: Subsystem/Physical-Observation/Test Method to be submitted by the Offeror with his Technical Proposal.

3.242 Material Stability

1) Dimensional

R: This subsystem's specified performance shall not be impaired by stresses due to volume change.

T: Subsystem/Calculation-Physical/Structural analysis.

2) Moisture

R: Control water retention.

C: The external surface configuration of all parts of this subsystem in use shall not be capable of containing or retaining water.

T: Subsystem/Physical-Observation.

3) Thermal

R: This subsystem's specified performance shall not be impaired when subject to temperature changes in use of 40°F.

T: Subsystem-System prototype-System field/Calculation-Physical-Observation/Structural analysis.

4) Corrosion

R: Control corrosion

C: Surfaces having corrosion tendencies in the presence of moisture and oxygen shall be treated so that such corrosion shall be prevented or self-limiting.

T: Observation

3.243 Life of Subsystems and Component Parts, Cycles, Hours, Years, etc.

R: Subsystem to have use-life design commensurate with total building system.

C: Subsystem shall have a use life no less than that of the total building system or sixty (60) years.

T: Offeror shall submit evidence of the designed use life of the subsystem for review by the Contracting Officer.

3.25 Transmission

a) R: Control airborne sound transmission.

C:1)This subsystem shall not impair the Speech Privacy Potential, SPP, of no less than 60, for any two zones in any space in the typical Office/Classroom Space Subsystem-System field/Physical/PBS-C.1.
2)This subsystem shall be deemed to meet (1) above if the sum of the speech privacy Noise Isolation Class, NIC, and a compatible NC-Background not exceeding 40 shall be no less than 60.
T: System prototype-System field/Physical/PBS-C.2/NC-Background is defined in the test method.

b) R: Control impact generated sound transmission.
C: This subsystem shall not impair the masking of footstep sounds on finished flooring of contiguous rooms vertically and horizontally by an NC environment of 35.
T: System prototype-System field/Physical/Impact Sound Transmission Test by Footfall Method/IBI-1-I, 1965/Modification: Offeror shall propose modifications to test method for prototype and field application in his Technical Proposal; use male walker with metal tipped heels in addition to specified female walker.

3.26 Dynamic and Operating Characteristics

No requirement.

3.27 Environmental Quality

3.271 Acoustic

R: Control sound generation
C: The measured sound pressure levels transmitted by this subsystem in use, when combined with the measured sound pressure levels produced or transmitted by all other subsystems in use, shall be no greater than those defined by NC35, and all pure tones shall be at least five (5) decibels below the sound pressure level otherwise produced or transmitted by the System in use at the corresponding frequency band.
T: System prototype-System field/Physical/Measurement of Sound/USAS S1.2-1962 and ASHRAE Guide and Data Book, 1969, Chapter 31.

3.272 Illumination

No requirement.

3.273 Air

No requirement.

3.274 Tactile

No requirement.

3.275 Pollutants

No requirement.

3.28 Planning and Visual

R: Appearance of the exposed portions of this subsystem shall be acceptable to the Contracting Officer:
T: Offeror shall submit drawings, samples, etc., for review by Contracting Officer.

3.3 PRACTICAL

3.31 Interface

a) R: Control tolerances.
C:1)All parts of this subsystem exposed to view shall have tolerances on dimensions establishing their location and position with respect to the planned horizontal and the given vertical dimensions, flatness, parallelism, plumbness, irregularity,and surface characteristics consistent with the aesthetic concept of the System's design, and shall not exceed those measured and determined to be acceptable.
T: Subsystem-System field/Observation.
C:2)This subsystem shall fit with and connect to the foundations which will be built within the following tolerances:
a. Elevation--±( ) inch.
b. Plan location--( ) inch maximum.
3)This subsystem's columns and/or hangers, piers, and structural walls, in use, assuming a temperature of 68°F., shall have the following tolerances:
a. Structural Steel--as specified by the Code of Standard Practice for Steel Buildings and Bridges.

b. Concrete and Other Materials--variation from the plumb in the lines and surfaces shall not exceed 1/4 inch per 10 feet and shall never exceed 1 inch.

4)Parts of this subsystem shall fit with and connect to, or shall allow the clear passage of, Out-of-System mechanical, electrical, plumbing, and other built elements, including, but not limited to:
--HVC supply and return ducts
--plumbing stacks
--stairs
--electrical and communication risers.

b) R: Adapt to irregular building configurations.
C:1)This subsystem shall perform as specified in project buildings whose exterior interface boundaries have been altered as indicated in the A/E's preliminary designs within the approved tolerance limits of these specifications. The Offeror will indicate in his Technical Proposal those Out-of-System tolerance limits not specified elsewhere, of normal practice and not requiring proprietary materials and processes for the Out-of-System built elements, and will indicate how this subsystem will fit with and connect to such built elements.
2)This subsystem shall be capable of performing as specified when installed in buildings whose exterior interface boundaries are altered as specified.
T: Subsystem/Calculation-Observation/Structural and Diemensional analysis.

c) R: Control planning reorganization.
C: This subsystem shall require no changes when any other subsystem is changed as specified.
T: Subsystem-System field/Observation.

3.32 Service

1) Accessibility
R: Provide for maintenance procedures.
C: This subsystem shall permit the access required to perform regular custodial maintenance procedures and shall not impair the procedure set forth in the proposed Optional Maintenance Plan.
T: Subsystem-System field/Physical-Observation/Latest applicable edition of the appropriate Handbook.

2) Maintenance Required-Frequency

a) R: Require no maintenance.
C: This subsystem shall require no maintenance for protection against any deterioration of specified performance.
T: Subsystem-System field/Physical-Observation/Offeror shall propose tests in his Technical Proposal.

b) R: Provide protection against damage.
C: This subsystem shall be protected from damage due to maintenance procedures by means of inherent damage resistance or from separation from the effects of the maintenance procedures.
T: Subsystem-System field/Observation-Physical.

3.33 Personnel

No requirement.

interior partitions

1.0	GENERAL
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interior partitions

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE

The interior partition system includes those elements which provide vertical separation of spaces from floor to ceiling inside the building. This includes doors and panels whether they be opaque, transparent, or a combination thereof. Not included herein are those vertical elements which do not go from floor to ceiling and which have been traditionally termed space dividers.

Three different types of partitions will be included:

1) Fixed partitions
Partitions which will be permanently set in place and are not designed to be moved in the future.

2) Demountable Partitions
Partitions which may be moved to a new location with minimal reworking of the partitions themselves or the components to which the partitions are attached.

3) Operable partitions
Partitions which may be moved at will in one direction and which shall have demountable properties in the perpendicular direction.

1.11 Included:

1) Fixed partitions.

2) Relocatable partitions.

3) Accordian type operable partitions.

4) Panel type operable partitions.

5) Interior glazing units.

6) Panels and finishes.

7) Baseboard and trim.

8) Supply and installation of hardware for operable partitions.

9) Installation only of finishing hardware for fixed and relocatable partitions.

10) Doors.

11) Hardware.

12) Service panels.

13) Connection devices between Out-of-System electrical raceways within the service panels to the applicable Electrical Distribution subsystem raceway.

14) Partition intersections and connections with Out-of-System walls, Out-of-System partitions, and all loose connections devices, including but not limited to nuts, bolts, screws, sleeves, shields, gaskets and sealants required to complete such connections.

1.12 Excluded:

1) Electrical elements.

2) Mechanical elements.

3) Plumbing elements.

4) Supply of accessory elements which may be attached to the partitions such as
   a. Bookshelf
   b. Fire extinguishers and cabinets.

5) Space dividers.

6) Load-bearing partitions, exterior walls and sheer walls.

7) Special insulation and shielding.

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY

3.11 Life

3.111 Fire

1) Flame Spread
R: Control Flame Spread
C: Flame spread of the exposed surfaces of this subsystem in use shall not exceed 25.
T: Flame spread, smoke development,and fuel contribution characteristics shall be determined in accordance with ASTM E-84 procedures.

2) Fire Resistance
R: Control Fire
C: Partitions surrounding corridors shall have one hour rating. Non-rated partitions shall be convertible to rated.
T: Fire resistance ratings shall be determined in accordance with ASTM E-119 procedures.

3) Combustibility
R: All elements of this subsystem shall be noncombustible.
C: Any material used in this subsystem, when exposed to a furnace temperature of 1382°F. (750°C.) shall not exhibit a temperature rise in excess of 54°F. (12.22°C.) above the furnace air temperature and shall not flame after an exposure of thirty (30) seconds.
T: ASTM E-136.

4) Smoke Production and Toxic Substances
a) R: Control smoke production
C: This subsystem shall have a maximum smoke development of 50.
T: ASTM E-84.

b) R: Smoke developed by this subsystem shall be nonnoxious and nontoxic.
C: Materials used in constructing the subsystem shall not be toxic or give off toxic vapor or particles under temperatures of up to 600°F.

T: Toxicity as used herein refers to materials so listed by the American Conference of Governmental Industrial Hygienists, at the recommended maximum allowable concentrations.

3.112 Toxicity Characteristics - (Non Fire-Related)

R: The finished surface of this subsystem shall contain no toxic materials or materials which emit toxic fumes under normal use.
C:1)Toxic fumes:
Materials used in constructing the subsystem shall not be toxic or give off toxic vapor or particles under normal conditions.
2)Toxic Surface:
Materials shall not be toxic to touch.
T: Toxicity as used herein refers to materials so listed by the American Conference of Governmental Industrial Hygienists, at the recommended maximum allowable concentrations.

3.113 Radiation Characteristics

No requirement.

3.114 Azoic Characteristics

a) R: This subsystem in use shall not be subject to verminal or organic deterioration, or provide life support for any organisms.
T: Subsystem/Offeror shall propose tests in his technical proposal.

b) R: Joints and intersections must be sealed, rounded, or in some other way be designed to prevent the accumulation of media for any organic growth.
T: Observation; Offerer may be required to propose tests if alternate means of accommodating this requirement are designed.

3.115 Electrical Characteristics

R: Provide electrical safety.
C: This subsystem's service panels shall conform to the requirements of the National Electrical Code.
T: Subsystem/Observation/National Electrical Code.

3.116 Hazardousness

a) R: Provide anthropometric fit.

C: This subsystem, properly installed and in use, shall,present no hazard to building occupant or maintenance personnel, as might result from construction details or structural inadequacy.
T: Observation

b) R: Provide accessibility to, and usability by, the physically handicapped.
C: This subsystem shall not impair each building's compliance with ASA A117.1-1961 "American Standard Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped," and in particular shall comply with paragraphs 3, 5.3,and 5.5 of that specification.
T: Subsystem/Observation.

3.12 Property

3.121 Fire

1) Endurance
See: 3.111 "Fire Resistance" above.

3.122 Theft Security

No requirement.

3.123 Vandalism Security

R: Reasonable resistance to vandalism shall be provided.

3.124 Resistance to Misuse

R: Reasonable resistance to inadvertent misuse shall be provided. See also Section 3.23, Strength.

3.13 Specific Code Restrictions

R:1)The system should comply with all applicable National codes.
2)All codes and tests referred to herein are the latest published version of said document.
3)(Note any local codes have special jurisdiction.)

3.2 FUNCTIONAL

3.21 General Functional Performance Characteristics

a) R: This subsystem shall comprise all floor to ceiling interior non-load bearing partitions. Partitions shall be fixed, operable, and relocatable types, and may attach to floor and/or ceiling. Partitions shall be designed to provide visual and acoustical barriers between spaces and must have provisions to allow them to provide fire-resistive smoke barriers.

b) R: Door sets complete with frames shall be included as a part of this subsystem.

c) R: Interior glazed units and vision panels shall be included as part of this subsystem.

d) R: Support and fittings for wall hung casework shall be provided in this subsystem.

e) R: Subsystem shall be completely finished in accordance with the other provisions of this Specification.

3.22 Size, Weight, Dimensional

1) Plumbness
C: Plumb to within tolerances of 1/4" over height of partition.
T: Subsystem/Measurement.

2) Dimensions
a) R: Fit within available space.
C:1)Vertical dimensions of subsystem shall be designed to be compatible with the proposed systems vertical modular dimensions.
2)Subsystem in use shall not exceed ( ) in thickness.
3)Thickness of partition at foot and head shall not exceed ( ) in thickness.
T: Observation/Measurement.

b) R: Exposed joints, if applicable, shall be recessed and shall not protrude beyond the plane of the partition.
T: Observation

c) R: Door widths shall be available in no less than ( ) sizes from ( ) feet to ( ) feet.
T: Observation
(The maximum size single leaf which may be permitted is to be determined in accordance with the door slam test.)

d) R: Glazed panels shall have transparent and solid panels in a size and configuration compatible with the proposed systems.
T: Observation

3) Flatness
C: The surface of this partition shall not deviate from a flat plane by more than 1/360 of the vertical dimension of the partition, and shall exhibit no sharp transitions in surface within these limits.
T: Prototype/Measurement/Observation.

4) Weight
a) R: The weight of this subsystem shall not exceed the allowable floor loads of the structural subsystem.
C: The subsystem shall not add more than 25 psf to the live load in the building.
T: Calculation.

b) R: The weight of the elements shall not inhibit the relocatability of this subsystem if applicable.
C: Unless special lifting devices are included as an integral part of the subsystem offering, no single panel, door panel or glazed panel shall weigh in excess of 250 lbs.
T: Weigh: if special relocation hardware is included, the Offeror may be required to propose tests to demonstrate its use.
E: The intent is to permit two men to manipulate individual elements of the subsystem, either with or without mechanical aids.

3.23 Strength

1) Dead Load
R: Subsystem shall have sufficient strength to support its own dead load without any additional attachments.
T: Observation.

2) Superimposed Load
R: Provide support for attached loads.
C:1)This subsystem's partitions, in use, shall support a vertical load

of four (4) bookshelves spaced 12 inches on center starting 30 inches above the floor at 40 pounds per linear foot per shelf with load center at 6 inches from face of partition without damage to the surface except damage, caused by simple attachment, that can be repaired without impairing the specified performance of the System at a cost not to exceed 5 percent of the original cost of this subsystem's panel affected, or other parts of this or any other subsystem, and without a displacement of the surface of this subsystem exceeding the measured tolerance limits for this subsystem.

2) This subsystem's service panels in both the not-abutting-a-door and free-standing categories, shall be capable of supporting a vertical load of a TV set of 150 pounds resting on an Out-of-System shelf projecting 24 inches from the face of the service panel, located between 24 inches and 96 inches from the finished flooring, except at locations of clocks and loudspeakers, without damage to the surface or other parts of this or any other subsystem, and without displacement of the surface of this subsystem exceeding the measured tolerance limits for this subsystem.

T: Install shelf brackets to the subsystem as proposed.

E: Failure loading to be at least 3 times design load.

3) Lateral Loads

C: 1) Subsystem shall be capable of resisting a lateral load of 10 psf.

2) Subsystem shall be capable of resisting a lateral load of 5 psf with a maximum deflection of 1/360 of the height of the partition.

3) The subsystem in use shall resist a concentrated horizontal load of 150 lbs applied at its apparent weakest point with no damage to the surface or other parts of this or any other subsystem.

T: Prototype/Strength Tests of Panels/ASTM E-72, Sections 10 and 11.

4) Dynamic

a) R: Provide resistance to door-slam impact.

C: No part of this subsystem or any other subsystem shall be damaged or have a displacement measured during and immediately after each door slam exceeding the accepted tolerance limits (Section 3.31) for this subsystem.

T: Prototype/PBS - d.1.

b) R: Provide resistance to impact.

C: This subsystem in use shall resist an impact of 60 ft-lbs with no damage to the surface or other part of this or any other subsystem

with a displacement of the surface of this subsystem measured 24 hours after impact not exceeding the accepted tolerance limits (Section 3.31) for that subsystem.
T: Prototype/Strength Test of Panels/ASTM E-72

5) Temporary (Transit)
R: Design the subsystem so as to resist any temporary loadings to be encountered in the course of transporting the subsystem to the site, installing,and relocating it.
T: Offeror shall propose tests to demonstrate this strength.

3.24 Durability

3.241 Surface Stability

1) Impact
R: Provide resistance to point impact.
C: Any component part of this subsystem, one surface of which is exposed to view, shall withstand 9 inch-pounds of impact on its exposed surface without any indentation greater than 1/16 inch measured twenty-four (24) hours after impact, and without any splitting or other permanent damage.
T: Subsystem/Physical/Falling Ball Impact/Fed. Test Method Std. No. 406, Method 1074/Modification: use 1/2 pound ball at 6 inch increments up to 42 inches.

2) Cracking, Crazing, Splitting, Spalling, Blistering, and Delamination
C:1)When compared with the reference samples and with any other specimen subjected to this test, the exposed surface of this subsystem in use shall not differ in color beyond the color tolerance limits established for it in the prototype, or by more than one NBS unit, whichever is greater, and when compared with the specimen prior to test, shall not exhibit a change in color or more than one NBS unit. Variegated, irregular, or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by the Contracting Officer.
2)The exposed surface of this subsystem in use shall not exhibit any form of cracking, crazing, splitting, spalling, blistering, delamination, breaks, discontinuities, or any other form of surface deterioration when evaluated visually subject to review by the Contracting Officer.
T: Subsystem/Colorfastness to Light/Federal Standard No. 501a, Method 5421.

3) Abrasion Resistance

R: Provide resistance to abrasion.

C: The exposed surfaces of this subsystem shall lose no more than 800 mg per 1000 revolutions in "normal use areas" and no more than 250 mg per 1000 revolutions in "hard use areas."

T: Subsystem/Abrasion Wear. For surfaces over 1/16" thick, Federal Test Method No. 406, Method 1091; for surfaces 1/16" thick or less, Federal Test Method 141a, Method 6192.

4) Scratch Resistance

R: Provide resistance to scratching.

C: The exposed surface of this subsystem shall have a 2H rating in "normal use areas" and a 3H rating in "hard use areas."

T: Subsystem/Wilkenson Pencil Hardness Method as modified by Smith/ Official Digest of the Federation of Societies for Paint Technology, 23-232-7, March 1956.

5) Cleanability and Scrubbability

C:1) The exposed surface of this subsystem in use when compared with the reference samples with any other specimen subject to this test shall not differ in color beyond the color tolerance limits established for the subsystem in the Prototype or by more than 3 NBS units, whichever is greater, and when compared with a specimen prior to test, shall not exhibit a change in color of more than 3 NBS units. Variegated, irregular, or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by the Contracting Officer.

2) The exposed surface of this subsystem in use shall not exhibit a change in gloss value of more than 5 NBS units.

3) The exposed surface of this subsystem in use shall not exhibit any form of cracking, splitting, spalling, blistering, delamination, breaks, discontinuities, or other form of deterioration when evaluated visually, subject to review by the Contracting Officer.

4) The component parts of this subsystem, the surface of which is exposed in use, shall not change in dimension sufficiently to impair the specified performance of the subsystem in use.

T:1) Subsystem/Physical Washability of Paints/Federal Test Method Standard No. 141a, Method 6141.

2) Subsystem/Physical/Scrub Resistance Test/Federal Test Method Standard No. 141a, Method 6142.

6) Stain Resistance

R: Provide stain resistance.

C: Stain site on the exposed surface of this subsystem shall not be evident when evaluated visually, subject to review by the Project Manager upon removal of the following stains:

pencil or graphite dust	orange juice
coffee	tea
milk	cold drinks and carbonated beverages
residue of cigarette (snuffed out rapidly)	chalk
grease pencil	permanent inks
ball point inks	alcohol-based marker inks (magic markers)
lipstick	
nail polish	

T: Subsystem/PBS-F.2. For normal use areas, dip rag once into mound of trisodium phosphate before stain removal. (Owner-User may substitute Test Ref. #8).

3.242 Material Stability

1) Moisture

a) R: Remain stable in presence of moisture.

C: Construct partition so that effects of water and water vapor will not cause permanent deterioration of its performance.

T: A disk of paper filter board 1" in diameter, saturated with distilled water, shall be placed in the specimen, covered with a watchglass and left for one hour. The disk shall then be removed and any water left on the specimen mopped up.

E: The test shall show no marking after a period of 24 hours.

b) R: Control Water Retention

C: This subsystem's external surface configuration in use shall not be capable of containing water.

T: Observation.

2) Thermal

R: Resist Thermal Degradation.

C: Any partition and the parts of which it is composed shall be capable of complying with the performance requirements and criteria stated elsewhere in this document when subjected to variations in thermal conditions within the limits specified below.

T: This requirement should be combined with moisture performance and any stated limits for permissible movement shall be construed as being limits for the total movement, whether caused by variations in temperature, humidity, or both. The requirements shall apply under conditions of dry-bulb temperature, varying from 40°F. to 90°F. The two extreme temperature levels may occur on opposite sides of the partition. Offeror should state the amount of movement anticipated and the effects of such movement.

E: Permissible movement in any part of the partition shall depend on the manner in which the resulting information affects other properties: for example, general appearance of the partition, requirements relating to objects in contact with this face, etc.

3) Chemical

R: Provide Chemical Resistance.

C:1) The exposed surface of this subsystem in use when compared with the reference samples and with any other specimen, subjected to this test, shall not differ in color beyond the color tolerance limits established for this subsystem in the Prototype, or by more than 3 NBS units, whichever is greater, and when compared with the specimen prior to test, shall not exhibit a change in color of more than 3 NBS units. Variegated, irregular, or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by Contracting Officer.

2) The exposed surface of this subsystem in use shall not exhibit any form of cracking, crazing, splitting, spalling, blistering, delamination, breaking, or discontinuities, or any other form of surface deterioration when evaluated visually, subject to review by the Contracting Officer.

3) The component parts of this subsystem, the surface of which is exposed in use shall not change in dimension sufficiently to impair the specified performance of the subsystem in use.

T: Subsystem/Physical/Spotting Resistant Federal Test Method Standard No. 141a, Method 6081. Modified: Use 60 minutes exposure time and use the following reagents:

distilled water	sodium hydroxide
detergent solution	soap solution

Cleaning agents specified in the current VA Custodial Management Standards:

10% phosphoric acid	5% nitric acid
5% acetic acid	5% hydrochloric acid
28% ammonium hydroxide	

4) Cohesiveness-Adhesiveness

R: Provide cohesion/adhesion of surface coatings.

C: All coatings on exposed surfaces of this subsystem under .005-inches thick shall not delaminate and shall be rated no less than 3 on scratch test.

T: Surface Adhesion Test (Test References No. 1).

5) Brittleness

C: Surface shall not show any fracture or break from an 8 oz. 1-1/2" outside diameter steel ball dropped from a height of 24".

T: In accordance with MIL-T-1717A. (Ships)

3.243 Life of Subsystem and Component Parts

R: All major components of this system--panels, glazing panels, and door panels shall have an average use-life of 40 years, or eight relocations, whichever occurs first.

3.25 Transmission

1) Sound

a) R: *Control airborne transmission of sound.*

C: This subsystem shall not impair the STC values as shown below:

Function Between Rooms	STC
office/classroom to office/classroom	40-50
office/classroom to other spaces	50

All elements of this subsystem, including doors and glazed panels, shall be designed to maintain this level of performance. Necessary seals shall be provided at ceiling, floor, and exterior wall intersections to eliminate flanking transmission paths which might impair this performance.

T: ASTM E-90.

b) R: Control impact generated sound transmission.

C:1) This subsystem shall not impair the masking of footstep sounds on finished flooring of contiguous rooms vertically and horizontally by an NC environment of 35.

T: System prototype--System field/Physical/Impact Sound Transmission Test by Footfall Method/IBI-1-I, 1965/Modification: Offeror shall propose modifications to test method for prototype and field application in his Technical Proposal; use male walker with metal tipped heels in addition to specified female walker.

2) Door slam sounds in this subsystem, transmitted to Rooms contiguous vertically and horizontally with the Rooms separated by the door being tested (not in rooms in which the door occurs) shall be masked by an NC environment of 40.
T: System prototype--System field/Physical/Offeror shall submit test in his Technical Proposal.

2) Transmission of Light
R: Control light transmission by glazed panels.
C: Clear, colorless glazed panels shall transmit greater than 85 percent of clear solar light without materially obstruction vision. Tinted or translucent glazed panels shall transmit no less than 50 percent clear solar light.
T: Sample and Subsystem/Observe and Measure.

3) Transmission of Heat
No requirement except as incidental to the requirements that rated partitions must have heat transfer characteristics in accordance with one-hour fire rating.

4) Transmission of Air and Gases
No requirement, except as pertains to one-hour rated partitions.

5) Transmission of Moisture and Liquids
R: Subsystem in use shall not transmit liquids across its thickness when subjected to washing and/or spills.
T: Offeror shall propose tests acceptable to the Contracting Officer to demonstrate compliance with this requirement.

3.26 Dynamic and Operating Characteristics

1) Methods of Operation
R: Door modules shall offer the following modes of operation:
--left-hand and right-hand swing
--single and multiple leaf
--removable transom panels

3.27 Environmental Quality

3.271 Acoustic

R: Sound Generation--Construct subsystem so as to be free from rattles and squeaks.

C: The measured sound pressure levels produced or transmitted by this subystem in use when combined with the measured sound pressure levels produced or transmitted by all other subsystems in use shall be no greater than those defined by NC 35, except that sounds produced by expansion and contraction of this subsystem, by operation of the doors in any but the immediate space, and all pure tones shall be at least five (5) decibels below the sound pressure level otherwise produced or transmitted by this system at the corresponding frequency band.
T: Measurement of Sound/USAS S1.2-1962 and ASHRAE Data Guide and Book, 1967, Chapter 31.

3.272 Illumination

1) Reflection
R: The exposed surfaces of this subsystem shall have an average reflectance of no less than 60 percent.

3.273 Air

1) Odor
R: The materials in this subsystem shall not release odors deemed to be objectionable by the Contracting Officer in any concentration reasonably predictable.

3.274 Tactile

No requirement.

3.275 Pollutants

No requirement.

3.28 Planning and Visual

1) Modularity
R: Relocatable partitions with exposed joints shall be so designed that the joints shall fall on a regular module of no less than 2 feet and no more than 5 feet.
T: System Observation.

2) Uniformity/Variety
R: All exposed surfaces of this subsystem shall have a uniform coordinated surface texture.
T: Observation.

3) Variety of Colors
a) R: The exposed surfaces of this subsystem shall be available in at least 5 visually compatible colors, subject to review by the Contracting Officer.
T: Observation.

b) R: All trim pieces, base pieces, relief angles, etc., shall be available in colors and services visually compatible with the subsystem panels, subject to review by the Contracting Officer.
T: Observation.

4) Color/Surface Coordination of Door and Glazed Panels
R: Door and glazed panels in this subsystem shall be available in colors and surfaces visually compatible with the wall surface panels of this subsystem, subject to review by the Contracting Officer.
T: Observation.

3.3 PRACTICAL

3.31 Interface

1) Fit
a) R: Control fit at partition base.
C: Accommodate with floor. Partitions shall be designed so as to accommodate to tolerances in floor system as specified elsewhere, and provide adequate seal for acoustic and/or fire-rating purposes.
T: Subsystem/Detail/Observation.

b) R: Control fit at junction between partition and at ceiling:
C:1)Accommodate with ceiling to provide seal with ceiling in accordance with acoustic and fire requirements if applicable.
2)Head-relief moulding, if applicable, shall be designed to accommodate to ceiling tolerances as specified elsewhere.
T: Detail/System Prototype Observation.

c) R: Subsystem shall be designed to provide a seal when butted against out-of-system exterior wall elements. Seal shall be adequate to

achieve acoustic performance and fire-rating performance if applicable.
T: Observation.

d) R: Trim pieces, if applicable, shall be designed to accommodate to tolerances of out-of-system partitions and out-of-system exterior walls.
T: Detail/Prototype/Observation.

e) R: Provide capability to accommodate Out-of-System built elements.
C:1)This subsystem's partition surfaces shall be capable of accepting the following Out-of-System applied finishes:
--high-density thermoplastic or thermo-setting plastic.
--thin sheet wall coverings, including but not limited to: fabric backed wall coverings, wall paper, metal foil, or plastic sheeting.
--sprayed on epoxy polyester, or urethane high 90 percent plus solid content glazed type finishes.
--paint conforming to Federal Standard No. 595.
2)Partitions shall be capable of either accepting on their surfaces or replacing their component parts whose surfaces are exposed to view with the following Out-of-System finishes:
--plywood up to and including 1/4-inch thick.
--chalk board up to and including 1/2-inch thick.
--tack board up to and including 1/2-inch thick of resilient material or magnetic material perceived as different from the partition's exposed surface.
3)Doors in type A partitions shall be capable or accepting cylinder locks of type 86E or 161B. Federal Specification FF-H-00106b.
4)All subsystem doors shall be capable of accepting closers, with and without hold-open mechanism, surface mounted and concealed either in the door or in the head or jamb frame.
T: Subsystem/Observation.

2) Attachment
R: Attach subsystem at floor and ceiling. Subsystem shall be designed to be attached to building structure at floor and/or at ceiling. No other attachments shall be used.
T: Detail/Prototype/Observation.

3) Tolerances
R: At floor and ceiling, subsystem shall be designed to be installed against floors and ceilings with tolerances as specified below.

C: Subsystem shall contain provisions for leveling all door modules and glazed modules within the tolerance of the overall structural system.

Standards:

In 10 ft	1/4"
Bay-20 ft max.	3/8"
In 40 ft or more	3/4"

T: Subsystem/Physical/Measurement

4) Relocatability

R: Every part of this subsystem shall be removable without damage to other subsystems, except for minor repairable damage to finished floor and ceiling.

5) Sequence of Erection

System shall be designed to be installed in a substantially complete raw space after mechanical and toilet modules have been installed. Installation of this subsystem shall not delay the progress of finishing of the space, except inasmuch as provided for in the GENERAL CONDITIONS for the project.

3.32 Service

1) Repairability and Replacability

R: Any elements of this subsystem, partition panels, door panels, glazed panels, shall be able to be repaired or replaced with no more than 4 manhours of labor--without requiring the use of special materials--at the use location.

T: Offeror/Demonstration.

2) Interchangability

R: Panels, door panels, and glazed panels shall be designed to be interchangeable one with the other.

T: Offeror/Demonstration.

3) Disturbance to Other Systems and Occupants

R: Changes and relocations in this subsystem shall not require work in any room or space otherwise unaffected by the planning change in order to achieve the specified performance after the planning change.

T: Observation.

4) Modifiability in Space

a) R: Provide means of upgrading performance of system surface.
C: System shall be designed to either meet higher standards of performance in terms of washability, wash resistance, etc., or shall accept special surfaces applied over basic system surface, such as ceramic tile and/or special coatings.
T: Offeror shall demonstrate such capability.

b) R: Any nonrated partition must be designed so as to be able to be converted to a one-hour rated partition.
T: Offeror shall demonstrate such capability.

3.33 Personnel

1) Required Education Trainability of Maintenance and Repair Personnel
R: Offeror shall provide means and facilities for educating and training the normal building maintenance personnel of the contracting agency so that they may install, relocate, remove, and repair all elements of this subsystem.
T: Offeror Guaranty/Warranty.

heating, ventilating, and cooling

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heating, ventilating and cooling

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE

This section covers the furnishing and installation of Heating, Ventilating and Cooling (HVC) system for the projected buildings; and includes any plumbing and electrical control-wiring which forms a part of the above installation. Electrical power requirements are to be coordinated with the mechanical systems to be considered.

1.11 Included:

1) A complete air-conditioning system consisting of an air distribution system and a means of overcoming heat gains and losses in the space with thermostatic and other controls to regulate within defined limits, temperature, air changes, air movement, air cleanliness, air pressure and relative humidity.

2) Outside air intakes (including weather louvers not located in walls), dampers, filters, coils and ductwork.

3) All thermal insulation and covering required for the elements of the Subsystems.

4) All electrical equipment which forms part of the installation including:
   a. All electrical heaters, if any, contactors, controls and wiring.
   b. Motors, starters, controls and wiring.

5) All plumbing which forms part of the above installation.

6) Control wiring shall include all line and low voltage wiring and conduit for control and interlocks between power source, sensing and controlling elements except line voltage distribution to power panels, motor starters and mechanical equipment.

Motor starters shall be supplied and installed by this Contractor; power wiring will be connected thereto by others. This Contractor shall furnish disconnect switch at equipment including on-off switch.

7) Acoustical treatment to achieve noise criteria. Vibration and/or sound control of fan units, ducts, pumps, pipes.

8) Special exhaust systems such as fume hoods, appliance hoods, kitchen exhaust, etc.

9) Sleeves, Hangers, Counter Flashing and Weatherproofing.

10) This Subsystem shall easily accommodate future changes in the subdivision of interior space on an incremental basis for similar use requirements.

1.12 Excluded:

1) Electrical work which is not included in this Subsystem:

2) Service Entrance equipment and metering facilities.

3) Power distribution system, including switchboard, panel boards, distribution transformers if necessary, feeders and branch circuit wiring.

4) Air supply, return and exhaust orifices, if these form a part of Lighting/Ceiling Subsystem (the responsibility for specifications and approval thereof remains with HVC Subsystem Contractor).

5) Primary fuel supply to within 5'-0" of the building.

6) Plumbing work which is not included in this Subsystem:

7) Basic building supply and distribution systems, including site work for water.

8) Sanitary waste and vent system.

9) Storm waste system.

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY

3.11 Life

3.111 Fire

1) Flame Spread
R: Control flame spread.
C: Flame spread of the exposed surfaces of this subsystem shall not exceed 25.
T: ASTM E-84.

2) Fire Resistance
R: Control Fire
C: If fire stops are provided as part of the system, as specified for the finished ceiling subsystem, any penetration of such fire stops shall be provided with either a 24-gage transfer duct with a 90° elbow on one side of the fire stop or 24-gage baffle plate aligned with penetration and installed not more than 6 inches away from the fire stop. The baffle dimensions are to exceed the penetration dimensions by a minimum of three inches on all sides.
T: Subsystem-System Prototype-System field/Observation.

3) Fuel Contribution
a) R: No air distribution means of this subsystem over 50 mils in thickness shall have a potential heat of more than 5,000 BTU per pound.

b) R: No air distribution means of this subsystem shall have a potential heat of more than 2,000 BTU per square foot of its surface.
T: Subsystem/Physical/Potential Heat/Proceedings of ASTM Vol. 61, 1961, pp. 1336-1347.

4) Smoke Production
a) R: Control smoke production and toxic substances.
C:1)Shall not produce smoke with a specific optical density of more than 150 for all exposed materials, with nonflaming burning conditions.
T: ASTM Stp. No. 422.

b) R: Smoke developed by this system shall be nonnoxious and nontoxic.

5) Fire Generation

R: Design all parts of subsystem, including electrical and mechanical, to avoid generating fire either in normal use or malfunction.

3.112 Toxicity Characteristics

R: Materials used shall not be toxic nor give off toxic vapors or particles which could in any way come in contact with any person or find its way into the environmental air under normal operating conditions or at temperatures up to 450°F.

T: Toxicity as used herein refers to materials so listed by the American Conference of Governmental Industrial Hygienists, at the recommended maximum allowable concentrations.

3.113 Radiation Characteristics

No requirement.

3.114 Azoic Characteristics

R: This subsystem in use shall not produce or retain odors, be subject to verminal or organic deterioration, nor provide life support for any organic media.

T: Subsystem/Physical/Offeror shall propose tests in the Technical Proposal.

3.115 Electrical Characteristics

R: Shall be safe from electrical hazard.

C:1) All electrical conductors and terminals shall be protected from direct contact or insulated by materials having a resistance of 10 megohms or more.

2) All electrical conducting materials which are not used specifically as conductors and which might in any way due to use, misuse, or accident come in contact with a conductor, shall be grounded.

T: National Electric Code

3.116 Hazardousness

a) R: All rotating parts including drives, belts, pulleys, etc., shall be equipped with guards to prevent harm to maintenance personnel.

b) R: Safety Controls shall interrupt the operation of the supply fan upon sensing conditions above or below their settings.

c) R: Each coil section shall have a low temperature controller with manual reset switch upstream of cooling coil.

d) R: Duct firestats shall have manual reset switch downstream of primary filter and in the return air duct ahead of any fire, smoke or control dampers. (In accordance with NFPA Bulletin 90A--"Controls" Duct type ionization smoke detectors may be used in lieu of duct firestats.)

e) R: If supply fan is interrupted by any of the above devices, the device reset switch shall be manually reset before the fan can be restarted.

f) R: Provide accessibility to, and usability by, the physically handicapped.
C: This subsystem shall not impair each building's compliance with ASA A117.1-1961 "American Standard Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped.
T: Subsystem/Observation.

g) R: Provide anthropometric fit.
C: This subsystem in use shall not cause personal injury directly nor indirectly through other subsystems.
T: Subsystem-System prototype-System field/Observation.

3.12 Property

3.121 Fire

R: The HVC Satellite Core shall be constructed of materials that are resistant to damage by fire.

3.122 Theft Security

No requirement.

3.123 Vandalism Security

No requirement.

3.124 Resistance to Misuse

R: All safety devices fitted shall be factory-adjusted and shall be arranged to prevent inadvertent resetting to dangerous levels by the user. The devices shall be fail-safe in operation so that their removal or failure will prevent the controlled component from working.

R: Clear instructions on the proper use and loading limits of each piece of equipment shall be indelibly printed on the outside casing of each major component.

3.13 Specific Code Restrictions

R: Conform to codes and standards.

C: This subsystem shall meet the appropriate requirements of all Federal and National codes and standards, and other standards quoted specifically herein, including but not limited to NEPA 90A, ASHRAE Guide and Data Book, SMACNA Manuals.

T: Subsystem-System prototype-System field/Physical-Observation/NFPA 90A, ASHRAE Guide and Data Book, SMACNA Manuals.

3.2 FUNCTIONAL

3.21 General Functional Performance Characteristics

a) R: This subsystem shall be factory-fabricated as much as possible, fabricated and installed as to be easily removable.

b) R: The HVC subsystem distribution ductwork will be sized to accommodate the ultimate maximum air flow capacity of ( ) cfm ( ) cfm/sq ft) and HVC capacities shall be designed to meet ( ) cfm per sq ft minimum to ( ) cfm per sq ft maximum.

c) R: The air handling units shall have connections to the Fresh Air Intake, the HVC subsystem supply air distribution, the HVC return air, and exhaust air.

3.22 Size, Weight, Dimensional

1) Dimensions

a) R: Shall fit within available space.

C: Floor area including access space for operating, maintenance,

modifying, and removing parts or whole unit is ('),x ('). Height is ('). These dimensions must allow space to accommodate the header duct which is sized for the maximum air flow (cfm) and connections to all other inputs and outputs.

T: Measure, Observe

b) R: Shall fit through openings in mechanical room walls for initial installation and for later replacement, if required, to alter capacity with revised space use.

T: Measure

2.23 Strength

1) Static

a) R: Provide subsystem support.

C: This subsystem shall be supported in the floor/ceiling space with a factor of safety of five (5) against the dead load of this subsystem and any other subsystem supported by this subsystem.

T: Subsystem/Calculation/Structural analysis.

b) R: The air handling components of this subsystem shall have sufficient strength to support their own combined dead load without any additional attachments to the structural subsystem.

T: Subsystem/Calculation/Structural analysis

2) Dynamic

a) R: Shall resist impacts on exposed surfaces normally occurring during operation and maintenance of the equipment without downgrading the performance of its functions.

C:1)Shall resist impact load of 60 ft pounds at any place.

2)Shall resist a load of 150 lbs over a square inch area at any location.

3)Shall resist a load of 300 lbs on a 7 square inch area on any horizontal surface on which it would be possible for a person to stop.

T: ASTM E-72.

b) R: Provide resistance to earthquake loads.

C:1)No part of this subsystem, and any other subsystem supported by this subsystem, shall separate from its supports, fail or cause failure in a manner that will endanger occupants, when subjected

to a seismic force as specified in the GSA Handbook "Structural Engineering" and when located in zones 2 and 3 to vertical accelerations equal to one-half that of gravity.

2)This subystem in addition to resisting seismic forces as specified above in the project buildings shall be capable of resisting seismic forces similarly at any location in the fifty states as specified in the above Handbook.

T: Subsystem/Calculation/Structural analysis/Modification: The coefficient "Z" shall be 1.5 instead of 1.0 for the project building located in earthquake zone 3.

c) R: Control steady-state vibration.

C:1)The subsystem connections shall not fail during the service life of the structure as a result of dynamic loads caused by the vibration of this subsystem in service.

2)Steady-state vibrations induced by this subsystem in service into the finished floor subsystem shall not cause vertical accelerations in the finished floor subsystem in excess of 0.004 g.rms.

T: Subsystem-System field/Calculation Physical/Measurement of accelerations over a minimum 20-minute period.

3) Thermal

R: Provide stability under extreme temperature and humidity.

C: This subsystem shall not exhibit any form of cracking, crazing, splitting, spalling, blisters, delamination, breaks, discontinuities, or other form of deterioration when submitted to a test designed to stimulate the effect and duration of extremes of temperature and humidity, beyond the range of normal operation, but which could possibly be encountered by the subsystem in emergency start-up and breakdown situations.

T: Physical/Deformation and Deterioration at High Temperature and Humidity: FHA Technical Studies Bulletin, No. 954, Test Procedures to Determine Suitability of Ducts for Use in Residential Warm Air Heating and Air Conditioning Systems, Section X, pages 11-12 or WL 181 for duct systems other than standard sheet metal.

3.24 Durability

3.241 Surface Stability

a) R: Exterior surfaces shall be cleanable with a minimum of crevices and small spaces which would make it difficult to clean.

b) R: Components with which the environmental air comes in contact with shall be cleanable either by removing them or making them accessible in place.

c) R: Parts of this, or any other, subsystem exposed to moving air shall not break away, flake off, or show evidence of delamination or continued erosion.
T: Subsystem/Physical/Erosion/U.L. Standard for Safety, Air Ducts, UL181-1970, paragraphs 97-106/Modification: Offeror shall propose tests in his Technical Proposal for parts exposed to moving air in plenums.

d) R: Exterior surfaces shall not require refinishing over the life of the subsystem.

3.242 Material Stability

1) Corrosion
a) R: All materials shall be resistant to corrosion, protected to prevent corrosion, or treated to make such corrosion self-limiting.

b) R: All materials which might come in contact with moisture shall be moisture-resistant.

2) Dimensional
R: Provide dimensional stability.
C: Dimensional changes in this subsystem in use shall not impair its performance.
T: Subsystem/Physical-Calculation/Test method to be submitted by Offeror with his Technical Proposal.

3) Moisture
a) R: Control water permeability.
C: Any component part of this subsystem, one surface of which is exposed to the FCS in use, shall not absorb or transfer water through the surface exposed to the FCS.
T: Subsystem/Physical/PBS-d.3/Modification: Use flat representative samples of subsystem materials.

b) R: Control water retention.
C: The external surface configuration of all parts of this subsystem

exposed to the office space and/or the FCS in use shall not be capable of containing water.
T: Subsystem/Observation.

4) Thermal
R: Provide stability under extreme temperature and humidity.
C: This subystem shall not exhibit any form of cracking, crazing, splitting, spalling, blisters, delamination, breaks, discontinuities, or other form of deterioration when submitted to a test designed to simulate the effect and duration of extremes of temperature and humidity, beyond the range of normal operation, but which could possibly be encountered by the subsystem in emergency start-up and breakdown situations.
T: Physical/Deformation and Deterioration at High Temperature and Humidity: FHA Technical Studies Bulletin, No. 954, Test Procedures to Determine Suitability of Ducts for Use in Residential Warm Air Heating and Air Conditioning Systems, Section X, pages 11-12 or WL 181 for duct systems other than standard sheet metal.

3.243 Life of Subsystem and Parts

R: All subsystem components with the exception of filters and drive belts shall have a minimum average life of 20 years.

3.25 Transmission

1) Heat
a) R: The subsystem and any connections to the energy supplies and returns and any ductwork included as part of the subsystem shall be insulated to minimize the heat loss or gain to the subsystem.

b) R: Control heat emission.
C: This subsystem shall remove all heat delivered by the Lighting/Ceiling Subsystem to the Floor/Ceiling Space and to the Typical Office/Classroom Space.
T: Subsystem/Calculation.

2) Air and Gases
R: The subsystem and its associated ductwork and piping shall be so constructed that there is a minimum loss of air and the piping shall be so constructed, arranged and installed so that there shall be no loss of gases or water.

3) Moisture

R: This subsystem shall not cause condensation in any part of this or any other subsystem when it is operated continuously for a period of four (4) hours under the following conditions: Room: 80°F. D.B., 69°F. W.B.; Supply Air: 54°F. D.B., 53°F. W.B.

3.26 Dynamic and Operating Characteristics

1) Methods of Operation

a) R: The operation of the subsystem shall be standard practice as experienced nationally for this type of equipment.

b) R: All control devices shall have adjustable ranges or differentials. Control valves and dampers shall operate in response to their control signal.

c) R: The supply fan shall be manually started, with the return air-exhaust air fan interlocked so that both fans operate in unison, safety controls permitting.

d) R: Provide means to permit use of outdoor air for atmospheric cooling, if appropriate, unless outdoor air dew point temperature requires minimum outdoor air volume for system.

e) R: When the supply fan is inoperative, the outdoor and exhaust air dampers shall close, and return air damper shall open.

f) R: Dampers shall modulate between selected minimum position and full open position.

g) R: Provide for each coil section the means to maintain the desired temperature settings.

h) R: Each heating coil section shall be provided with a sectional low limit temperature discharge controller to maintain the desired minimum leaving air temperature.

i) R: Units not for use with remote terminal reheat coils or mixing boxes shall be provided with a remotely located space thermostat.

j) R: Provide a return air duct type humidistat to automatically maintain the desired humidity conditions whenever the supply fan is in operation.

k) R: Provide means to permit operating personnel to visually observe system operation and to make necessary control point adjustments.

l) R: This subsystem shall be controllable so that typical office/classroom spaces may be divided into ( ) control zones, provided that these zones are simple shapes, that no zone differs in areas from any other zone on that floor by more than twenty-five percent (25%) and that no Room or Space smaller than ( ) square feet be in more than one (1) zone.

m) R: This subsystem after installation shall be capable of accommodating changes in the size of any of the original control zones on any story, provided that no zone will differ in area from any other zone on the floor by more than twenty-five percent (25%).

n) R: This subsystem's thermostat(s) shall be located in the typical office space so that the temperature of the controlled zone can be selected and adjusted manually.

o) R: All "in system" air moving equipment and terminal devices shall be sized with a ten percent excess capacity. Manual air volume dampers shall be installed at all branch takeoffs.

2) Cycle Time and Speed of Operation
R: The response time in reacting to changing the environmental requirements shall not exceed 5 seconds.

3.27 Environmental Quality

3.271 Acoustic

1) Sound Generation
a) R: Sound generated by the subsystem shall not disturb adjoining spaces.
C:1)The subsystem shall be mounted and the moving parts balanced such that sound generated by the subsystem and transmitted by the structure will not raise the level in other rooms above NC35. All enclosing walls of the mechanical room will be rated for STC 55.
2)The sound generated by the subsystem which can be transmitted through the ducts shall not raise the level in the rooms it

serves above NC35. Distribution ducts will be fiberglass lined for sound absorption.
T: On site sound pressure metering.

b) R: Control airborne sound
C:1)This subsystem shall not impair the Speech Privacy Potential, SPP, of no less than 60, for any two zones in any space in the typical office/classroom space.
T: Systemfield/Physical/PBS-C.1.
C:2)This subsystem shall be deemed to meet (1) above if the sum of the speech privacy Noise Isolation Class, NIC, and a compatible NC-Background not exceeding 40 shall be no less than 60.
T: Systemfield/Physical/PBS-C.2/NC-Background is defined in the test method.
C:3)If this subsystem is a flat plane, it shall be deemed to meet (1) above if the Functional Specular Reflection Loss exceeds 6db.
T: Subsystem/Physical/PBS-C.3.

c) R: Control impact generated sound
C: This subsystem shall not impair the masking of footstep sounds on finished flooring of contiguous rooms vertically and horizontally by an NC environment of 35.
T: System field/Physical/Impact Sound Transmission Test by Footfall Method/IBI-1-I, 1965/Modification: Offeror shall propose modifications to test method for prototype and field application in his Technical Proposal; use male walker with metal tipped heels in addition to specified female walker.

2) Reverberation Time
R: Control resonance.
C: This subsystem in use shall generate no 1/3 octave band sound pressure level more than 5 decibels higher than the adjacent band levels between 20 HZ and 20,000 HZ.
T: System prototype-System field/Physical/Measurement of Sound/USAS S1.2-1962/Sound Pressure levels shall be measured with the microphone at least 30 inches from any reflecting surface.

3.272 Illumination

No requirement.

3.273 Air

1) Temperature

a) R: Control temperature gradients.

C:1)This subsystem in use shall distribute air to all Rooms and Spaces of any control zone as specified in this subsystem's planning requirements, such that the average temperature within the occupied zone shall not vary more than ±2°F. from that at the location of the thermostat.

2)This subsystem in use shall distribute air to all Rooms and Spaces of any control zone such that the average temperature of the air entering any return intake shall be no more than 2°F. below the average temperature at the location of the thermostat.

3)This subsystem in use shall distribute air to all Rooms and Spaces of any control zone as specified in this subsystem's planning requirements, such that the temperature at any location in the occupied zone shall not differ by more than 5°F. from that at the location of the thermostat.

T: Subsystem-System field/Physical/Temperature measurement/Air Diffusion Council Equipment Test Code 1062 R2/Modification: System Contractor shall propose location of thermostat.

b) R: Control Dry-Bulb Temperature.

C:1)This subsystem in use shall provide the following thermal environment:

2)The dry-bulb temperature shall be between (°F.) and (°F.) at any point within the occupied zone, and at any time, when MRT is approximately equal to the dry-bulb temperature.

3)The dry-bulb temperature may exceed the range given if necessary to provide compensation of MRT deviations as specified in (c) below.

4)The rate of change of dry-bulb temperature at any point in the occupied zone shall not exceed ( ) deg/hr if the peak to peak variation in the temperature cycle is two degrees or greater within the limits of (°F.) and (°F.).

T: Subsystem-System Field/Calculation-Physical/Temperature Measurement.

These temperatures shall be maintained as specified under the following conditions of heat generation in the Typical Office/Classroom Space.

1)Typical Office/Classroom Space from 0.0 BTUH per square foot to ( ) BTUH per square foot and heat delivered by the Luminaires subsystem.

2)Typical Office/Classroom Space beneath the roof or penthouse floor shall be the same as the typical office/classroom space plus a summer external gain through the roof of 11 BTUH per square foot and a winter loss of 11 BTUH per square foot through the roof.
3)Office/Classroom Space latent heat loads shall be based on one person per ( ) square feet of space at two hundred fifty BTUH per person.

c) R: Control Mean Radiant Temperature.
C:1)When the mean radiant temperature in the occupied zone differs from the dry-bulb temperature, the dry-bulb temperature shall be reduced 1.4°F. for each 1.0°F. mean radiant temperature elevation above air temperature and vice versa.
2)The MRT correction shall be considered applicable only for mean radiant temperatures between 70° and 80°F.

3)When excessive local radiant effects are present from surfaces which are considerably above or below the room temperature, compensation shall be provided.
4)The rate of change of mean radiant temperature at any point in the occupied zone shall not exceed 3 deg/hr if the peak to peak variation of the MRT cycle is 1.5°F., or more, within the limits stated.
T: Subsystem-System Field/Calculation-Physical/Air Diffusion Council Test Code 1062 R2/Modification and test and instrumentation information as contained in ASHRAE Guide and Data Books and Standards.

2) Humidity
R: Control Relative Humidity.
C:1)This subsystem in use shall provide the following thermal environment: The relative humidity shall not exceed ( ) percent at any point in the occupied zone nor shall it fall below ( ) percent.
2)The rate of change of relative humidity at any point in the occupied zone shall not exceed ( ) percent/hr if the peak to peak variation of the humidity cycle is ( ) percent or more within the limits stated herein.
T: Subsystem-System Field/Calculations-Physical/Relative Humidity Measurement.

3) Velocity
R: Control air motion.

C: This subsystem in use shall distribute air to Rooms and Spaces such that air motion in the occupied zone shall be no less than 20 FPM nor more than 50 FPM.
T: Subsystem-System Field/Physical/Air Velocity Measurement/Air Diffusion Council Equipment Test Code 1062 R2.

4) Cleanliness
R: Control air cleanliness.
C: The subsystems shall contain some means of removing airborne contaminants equivalent to a system containing filter media having an efficiency of 40 percent based on NBS dust spot method using atmospheric dust.
T: Subsystem/Observation.

5) Freshness
a) R: Control fresh air quantity.
C: This subsystem in use shall supply not less than .2 CFM per square foot of outdoor air to the typical office space. Not less than .2 CFM per square foot of typical office space shall be exhausted from this subsystem.
T: Subsystem-System Field/Calculation-Physical/Air Quantity Measurement.

b) R: Control air mixture.
C: This subsystem in use shall supply to and remove from the typical office space not less than .6 CFM per square foot.
T: Subsystem-System Field/Calculation-Physical/Air Quantity Measurement.

6) Odors
R: The subsystem shall impart no detectable odor to the environmental air.

3.274 Tactile

R: The subsystem shall be designed to have a minimum of vibration in operation and shall have mountings to isolate any vibration from the structure.

3.275 Pollutants

R: Control dust collection

C: The configuration of surfaces of this subsystem exposed to moving air in use, shall not trap dirt or impair regular custodial maintenance.

T: Subsystem/Observation

3.28 Planning and Visual

1) Relationship of Functions
R: Subsystems shall be arranged so that connections to fresh air inlet, supply ducts, return ducts, exhaust ducts, and energy source are logically made.

2) Uniformity/Variety
R: The subsystem shall be designed to require a minimum of variety of units to satisfy all of the conditions.

3.3 PRACTICAL

3.31 Interface

1) Fit
a) R: Provide capability to accommodate Out-of-System hardware.
C: This subsystem shall not impair the installation of Out-of-System smoke detectors conforming to NFPA Standards and ASHRAE Guide and Data Book.
T: Subsystem/Observation.

b) R: Adapt to irregular building configurations.
C: This subsystem shall perform as specified in project buildings whose exterior interface boundaries have been altered as indicated in the A-E's preliminary design.
T: Subsystem/Observation.

2) Tolerances
a) R: Control Tolerances
C: All parts of this subsystem exposed to view shall have tolerances on dimensions establishing their location and position with respect to the planning Grid and the given vertical dimensions, flatness, parallelism, plumbness, regularity, surface characteristics, and color consistent with the aesthetic concept of the System's design,

and shall not be less nor greater than those measured in the System prototype and determined to be acceptable.

T: Subsystem-System Field/Observation.

b) R: Control planning change.

C: Rebalancing of this subsystem's air outlets, if required by a relocation of any part of the Space Dividers subsystem, shall be achievable from the face of the outlet and shall require no special tools.

T: Subsystem-System Field/Observation.

3.32 Service

R: The subsystem shall be furnished with access doors at all points required for cleaning and maintenance. These access doors shall provide for easy maintenance of all components.
Maintenance required shall be minimal for the subsystem. The Offeror shall supply the Contracting Officers with 6 sets of maintenance manuals and recommendations for the equipment.
All portions of the subsystem shall be accessible for repair and/or for replacement.

3.33 Personnel

3.331 Availability of Maintenance and Repair Personnel

R: Shall demonstrate that he has adequate maintenance and repair personnel on facilities within a 100 mile radius of the project building. Repair personnel shall be available for 24-hour emergency service as well as for regular maintenance.

lighting/ceiling

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lighting/ceiling

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE

The complete Lighting-Ceiling Subsystem includes the finished acoustical and light reflecting surfaces and lighting units, acoustical control, air supply and return devices, provisions to accommodate concealed element such as additional lighting, speakers, bells and horns, ceiling members, provision for passage of mechanical, structural, electrical and other building elements; and provision to receive Interior Partitions, as well as transfer partition loads through the lighting-ceiling system to the structural system.

1.11 Included:

1) All lighting elements and lamps.

2) All ceilings including finished acoustical and light reflecting surfaces.

3) Lenses, diffusers, louver, and/or other light control elements.

4) Acoustic control.

5) Suspension systems.

6) Ballasts and ballast wiring.

7) Trim, clips, spacers, etc.

8) Fireproofing, if required for Structure Subsystem.

9) Air handling orifices which are integral with the Lighting-Ceiling Subsystem as required by the Atmosphere Subsystem.

10) Provisions to accommodate concealed elements such as P.A. speakers, bells, horns, etc. as required by Electric-Electronic Subsystem.

11) Provision for passage of mechanical, structural, electrical and other building elements.

12) Closure devices between ceiling plane and partitions Openings required to accommodate fire protection sprinklers.

13) Provision to accommodate connectors for Electric-Electronic Subsystem.

14) Closure panels above the ceiling over partitions, as required for light, acoustical, or fire separation.

15) Baffles, fillers, closures, etc. to ensure that the sound transmission class requirement is met.

1.12 Excluded:

1) Switching.

2) Hook-up of lighting fixtures.

3) Switchboards and panelboards.
Junction boxes.

4) Supply Feeders to Junction Boxes.

5) Receptacles.

6) Special Lighting.

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY

3.11 Life

3.111 Fire

1) Flame Spread
R: Control Flame Spread
C:1)Any surface of any component part of this subsystem exposed in the typical office/classroom space except Luminaire diffusers complying

with U.L. Standard No. 57-1969 and occupying no more than 30 percent of the total horizontal projection of the ceiling shall have a maximum flame spread of twenty-five (25).

2)If a fully automatic fire protection sprinkler system is provided as a part of the System, as specified in the Structure Subsystem, the flame spread rating shall not exceed two hundred (200).

T: Subsystem/Physical/ASTM E-84, "Surface Burning Characteristics of Building Materials," or ASTM E-162 "Surface Flammability of Materials"/Modification: use flat representative samples of subsystem materials.

2) Fire Resistance

R: Control Fire

C:1)If this subsystem is part of a fire-resistive assembly required to meet the Structure subsystem's fire safety requirements, and is installed with continuous space above it in the Floor/Ceiling Space, then such space shall be provided with fire stops made of a noncombustible material equivalent to at least 24-gauge steel at intervals not exceeding 100 feet in any direction, and enclosing areas of not more than 1,500 square feet.

2)If this subsystem is not part of a fire-resistive assembly, and is installed with continuous space above it in the Floor/Ceiling Space, such space shall be provided with fire stops between HVC control zones without regard to area enclosed or to distance between fire stops.

3)Criteria (1) and (2) above need not be met if a fully automatic fire protection sprinkler system is provided as a part of the System, as specified in the Structure Subsystem.

T: Subsystem-System field/Observation.

3) Fuel Contribution

R: All elements of this subsystem shall be noncombustible.

C:1)No part of this subsystem shall have a potential heat of more than 5,000 BTU per pound.

2)All parts of this subsystem shall not have a potential heat of more than 2,000 BTU per square foot of projected area of this subsystem.

T: Subsystem/Physical/Potential Heat/Proceedings of ASTM, Vol. 61, 1961, pp 1336-1347.

4) Smoke Production

R: Control smoke production

C: The smoke generating properties of all parts of this subsystem

shall be such that the maximum specific optical density does not exceed one hundred fifty (150) when tested under both flaming and nonflaming conditions of burning.
T: Subsystem/Physical/Proposed Tentative Method. Interlaboratory evaluation of smoke density chamber, National Bureau of Standards Technical Note 708.

3.112 Toxicity Characteristics

No requirement.

3.113 Radiation Characteristics

No requirement.

3.114 Azoic Characteristics

R: Provide azoic properties.
C: This subsystem in use shall not produce or retain odors, be subject to verminal or organic deterioration, or provide life support for any organic media.
T: Subsystem/Physical/Offeror shall propose tests in his Technical Proposal.

3.115 Electrical Characteristics

a) R: Control electrical safety.
C:1)This subsystem in use shall have a continuous grounding in accordance with the National Electrical Code.
T: Subsystem/Observation/Code.
C:2)This subsystem shall conform to the requirements of all applicable codes as cited in Section 3.13.
T: Subsystem/Observation/Code.

3.116 Hazardousness

R: Provide anthropometric fit.
C: This subsystem in use shall not in itself effect, or cause other subsystems to effect, personal injury.
T: Subsystem-System Prototype-System field/Observation.

3.12 Property

3.121 Fire

See Section 3.111 above.

3.122 Theft Security

No requirement.

3.123 Vandalism Security

No requirement.

3.124 Resistance to Misuse

No requirement.

3.13 Specific Code Restrictions

R: Conform to codes and standards.
C: This subsystem shall meet the appropriate requirements for all Federal and national codes and standards including but not limited to the *National Electrical Code*, U.L. Standards, I.E.S. Standards and N.E.M.A. Standards.
T: Subsystem/Calculation-Physical-Observation/National Electrical Code, I.E.S. Handbook, N.E.M.A. Standards, U.L. Standards.

3.2 FUNCTIONAL

3.21 General Functional Performance Requirements

(See General Requirements)

3.22 Size, Weight, Dimensional

1) Plumbness, Levelness, Flatness
C: All part of this subsystem exposed to view shall have tolerances on dimensions establishing their location and position with respect to planned horizontal and vertical dimensions, flatness, parallelism, plumbness, irregularity, surface characteristics, and color consistent with the aesthetic concept of the system's design, and determined to be acceptable.
T: Subsystem/System-Field Measure

2) R: Control Weight
C: This subsystem shall add no more dead load to the structural subsystem than ( ) psf.
T: Subsystem/Calculation/Measurement.

3.23 Strength

1) Static
R: Provide subsystem support.
C: This subsystem shall be supported in the Floor/Ceiling Space with a factor of safety of five (5) against the dead load of this subsystem and any other subsystem supported by this subsystem.
T: Subsystem/Calculation/Structural analysis.

2) Dynamic
a) R: Provide resistance to earthquake loads.
C:1) No part of this subsystem, and any other subsystem supported by this subsystem, shall separate from its supports, fail or cause failure in a manner that will endanger occupants, when subjected to seismic forces as specified in the General Services Administration handbook, "Structural Engineering," and when located in Zones 2 or 3, to vertical acceleration equal to one-half that of gravity.
2) If this subsystem is part of a fire resistive assembly required to meet the Structural Subsystem's fire safety requirements, its fire resistance shall not be substantially impaired when subjected to seismic forces as specified in General Services Administration handbook, "Structural Engineering."
T: Subsystem/Calculation/Structural analysis/Modification--the coefficient "Z" shall be 1.5 instead of 1.0 for the project buildings located in earthquake Zone 3.

b) R: Provide resistance to ascending forces.
C:1) No part of this subsystem shall be damaged or have a displacement observed and when measured during and immediately after conclusion of the Door Slam test.
T: Subsystem/Physical/Door Slam/PBS-d.1/Modification: slam door with force of 17 foot-pounds inward fifty (50) times toward a Room of ten (10) feet by ten (10) feet.
C:2) No part of this subsystem shall be damaged or have a displacement exceeding the accepted tolerance limits for this subsystem when subjected to any ascending forces imposed by the Space Dividers subsystem in use.

T: Subsystem-System field/Observation.
C:3)No part of this subsystem shall be damaged, lifted, fluttered, vibrated or be otherwise displaced, when the HVC Subsystem is delivering air over the full range of quantities specified.
T: Subsystem-System field/Physical/Offeror shall propose tests in his Technical Proposal.

3.24 Durability

3.241 Surface Stability

1) Cleanability
R: Provide washable surface.
C:1)The exposed surface of this subsystem in use, when compared with the reference samples and with any other specimen subjected to this test, shall not differ in color beyond the color tolerance limits established for this subsystem, or by more than three (3) NBS units, whichever is greater, and when compared with the specimen prior to test shall not exhibit a change in color of more than three (3) NBS units. Variegated, irregular or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by the Project Manager.
2)The exposed surface of this subsystem in use shall not exhibit a change in gloss value of more than five (5) units.
T: Subsystem/Physical/Washability of Paints/Fed. Test Method Std. No. 141a, Method 6141/Modifications: perform test for two hundred (200) strokes; substitute representative sample of Luminaire parts in place of specially painted panel; pour 250 ml. of water on the sponge; subject both sides of light transmitting elements to test; colorimetric evaluation shall be by Fed. Test Method Std. No. 141a, Method 6123; gloss evaluation shall be by Fed. Test Method Std. 141a, Method 6101; all visual evaluations shall be made from a distance of thirty-six (36) inches, at any angle, with the sample illuminated as in use.

2) Scratch Resistance
R: Provide resistance to scratching.
C: Exposed surfaces of this subsystem, except light transmitting elements, lamps, and lamp holders, subject to contact with any part of the internal partition subsystem shall have a 2H rating; except for exposed grid members of a metal suspension system meeting

the requirements of ASTM Specifications for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings, ASTM C-635.

T: Subsystem/Physical/Wilkinson Pencil Hardness Method as Modified by Smith/Official Digest of the Federation of Societies for Paint Technology, 28-232-7, March 1956.

3) Abrasion Resistance

R: Provide resistance to abrasion.

C: Exposed surfaces of this subsystem subject to contact with any part of the Space Dividers subsystem shall lose no more than an average of 800 milligrams per 1,000 revolutions.

T: Subsystem/Physical/Abrasion Wear/for surfaces over 1/16 inch thick, Fed. Test Method Std. No. 406, Method 1091/Modification: use CS ten (10) wheel; paragraph 4.5 does not apply; run test for 5,000 revolutions using more than one (1) specimen if necessary. For surfaces 1/16 inch thick or less, Fed. Test Method Std. 141a, Method 6192/Modification: use CS ten (10) wheel, 1,000-gram load and 1,000 revolutions.

4) Impact Resistance

R: Provide resistance to point impact.

C:1) Any component part of this subsystem, one (1) surface of which is exposed to view, except lamps, shall withstand three (3) inch-pounds of impact on its exposed surface without any indentation greater than 1/16 inch, measured twenty-four (24) hours after impact, and without any splitting or other permanent damage.

T: Subsystem/Physical/Falling Ball Impact/Fed. Test Method Std. No. 406, Method 1075 for light transmitting elements and 1074 for all other parts/Modification: use 1/2-pound ball, at drops of 1, 3, 6, and 9 inches.

C:2) Any component part of this subsystem, one (1) surface of which is exposed to view, subject to contact with any part of the Space Dividers subsystem shall withstand 18 inch-pounds of impact on its exposed surface without any indentation greater than 1/16 inch, measured twenty-four (24) hours after impact, and without any splitting or other permanent damage.

T: Subsystem/Physical/Falling Ball Impact/Fed. Test Method Std. No. 406, Method 1075 for light transmitting elements and Method 1074 for all other parts/Modification: use 1/2 pound ball, at drops of 1, 3, 6, and 9 inches.

5) Cracking, Crazing, Spalling, Blisters, Delamination

R: Control surface deterioration.

C: The exposed surface of this subsystem in use shall not exhibit any form of cracking, crazing, splitting, spalling, blisters, delamination, breaks, discontinuities, or other form of surface deterioration when evaluated visually, subject to review by the Project Manager.

T: Subsystem/System-Observation.

6) Fade

R: Control surface color stability.

C: The exposed surface of this subsystem in use, when compared with the reference samples and with any other specimen subjected to this test, shall not differ in color beyond the color tolerance limits established for this subsystem, or by more than one (1) NBS unit, whichever is greater, and when compared with the specimen prior to test shall not exhibit a change in color of more than one (1) NBS unit. Variegated, irregular, or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by the Project Manager.

T: Subsystem/Physical/Colorfastness to Light/Fed. Test Method Std. No. 501a, Method 5421/Modification: exposure time for opaque elements shall be three hundred (300) standard fading hours, and for light transmitting elements shall be one thousand (1,000) standard fading hours; sample shall include joints, if applicable; three (3) samples shall be used; colorimetric evaluation shall be by Fed. Test Method Std. 141a, Method 6123; all visual evaluations shall be made from a distance of thirty-six (36) inches with the sample illuminated as in use.

3.242 Material Stability

1) Friability

R: Control friability.

C: Any component part of this subsystem, one (1) surface of which is exposed to view in use, composed of any materials except metal or sheet glass, shall not lose more than fifty percent (50%) in weight in ten (10) minutes.

T: Subsystem/Physical/Strength Properties of Acoustical Materials/ ASTM C-367 paragraphs 7-12/Modification: four (4) of the specimens shall be edge pieces; ten (10) minute test only.

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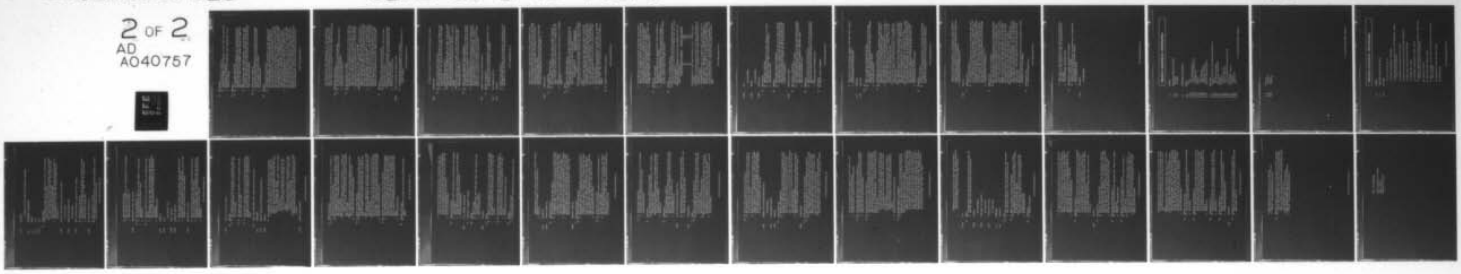

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2) Dimensional
R: Provide dimensional stability.
C: Dimensional changes in this subsystem, in use, shall not impair the performance of the System.
T: Subsystem/Physical-Calculation/Offeror shall propose test in his Technical Proposal.

3) Moisture
a) R: Control water permeability.
C: Any component part of this subsystem, one (1) surface of which is exposed to the Floor/Ceiling Space in use, shall not absorb more than five (5) times its own weight of water through its upper surface.
T: Subsystem/Physical/PBS-d.3/Modification: place specimen in dual tray device with upper surface upward use quantity of water equal to ten (10) times the weight of the specimen; test both surfaces of light transmitting elements.

b) R: Control water retention.
C: The external surface configuration of all parts of this subsystem exposed to the office space and/or the Floor/Ceiling Space shall not be capable of containing water.
T: Subsystem/Observation.

4) Chemical
R: Provide chemical resistance.
C: The exposed surface of this subsystem in use when compared with the reference samples and with any other specimen subjected to this test, shall not differ in color beyond the color tolerance limits established for this subsystem in the prototype, or by more than three (3) NBS units, whichever is greater, and when compared with the specimen prior to test shall not exhibit a change in color of more than three (3) NBS units. Variegated, irregular, or translucent finishes shall be evaluated for acceptability of color change only visually, subject to review by the Project Manager.
T: Subsystem/Physical/Spotting Resistance/Fed. Test Method Std. No. 141a, Method 6081/Modifications: use 40 inch x 40 inch test area; use sixty (60) minutes exposure time; use joints, if applicable; use the following reagents (ASTM D-543-67); Distilled Water (15), Detergent Solution (12), Sodium Hydroxide 1 percent (43), Soap Solution (37) and any additional cleaning agent required for normal custodial maintenance; colorimetric evaluation shall be by Fed.

Test Method Std. No. 141a, Method 6123; all visual evaluations shall be made from a distance of thirty-six (36) inches, at any angle, with the sample illuminated as in use. Approval by the Project Manager will be required if specific reagents cause failure.

5) Cohesiveness/Adhesiveness

a) R: Provide cohesion/adhesion of surface coatings.
C: All coatings on exposed surfaces of this subsystem under 0.005 inches thick shall not delaminate.
T: Subsystem/Physical/PBS-d.4.

b) R: Provide cohesive strength.
C:1)Any component part of this subsystem, one (1) surface of which is exposed to view, shall withstand a tensile pull equal to five (5) times its own weight per square inch, applied normal to its exposed surface, with no delamination, except for surface membranes.
T: Subsystem/Physical/PBS-d.2./Modification: use 12 inch x 12 inch hardwood blocks on 12 inch x 12 inch specimen.
C:2)Any component part of this subsystem, one (1) surface of which is exposed to view, which is adhered to any other part of this subsystem or any other subsystem, shall not delaminate from that other part when subjected to a tensile pull equal to five (5) times its own weight per square inch, applied normal to its exposed surface.
T: Subsystem/Physical/PBS-d.2/Modification: use substrate representative of the substrate material in use; use 12 inch x 12 inch hardwood blocks on 12 inch x 12 inch specimen; repeat this test on a specimen immediately after it has been totally immersed in water together with its adhered substrate for twenty-four (24) hours.

6) Corrosion
R: All metallic parts shall resist corrosion.
C:1)Avoid contact of dissimilar metals which are likely to produce elecytrolytic corrosion.
2)Surfaces having corrosion tendencies in the presence of moisture and oxygen shall be treated so that such corrosion shall be prevented or be self-limiting.
T: ASTM Corrosion Resistance Test.

3.243 Life of Subsystem and Component Parts

R: The subsystem shall be designed for a life of :
1)Light-transmitting elements, ceiling finishes/acoustic surfaces, 15 years.

2)Suspension systems, lighting/electrical elements, 40 years.

3.25 Transmission

a) R: Control airborne sound transmission.
C:1)This subsystem shall not impair the Speech Privacy Potential, SPP of no less than 60, for any two zones in any space in the typical office space.
T: System field/Physical/PBS-C.1.
C:2)This subsystem shall be deemed to meet (1) above if the sum of the speech privacy Noise Isolation Class, NIC', and a compatible NC-Background not exceeding 40 shall be no less than 60.
T: System field/Physical/PBS-C2/NC-Background is defined in the test method.
C:3)If this subsystem is a flat plane, it shall be deemed to meet (1) above if the Functional Specular Reflection Loss exceeds 6db.
T: Subsystem/Physical/PBS-C.3.

b) R: Control impact generated sound transmission.
C: This subsystem shall not impair the masking of footstep sounds on *finished flooring of contiguous* rooms vertically and horizontally by an NC environment of 35.
T: System prototype-System field/Physical/Impact Sound Transmission Test by Footfall Method/IBI-1-I, 1965/Modification: Offeror shall propose modifications to test method for prototype and field application in his Technical Proposal; use male walker with metal tipped heels in addition to specified female walker.

3.26 Dynamic and Operating Characteristics

1) Methods of Operation
R: The operation of this subsystem shall be standard practice as experienced nationally for this type of equipment.

3.27 Environmental Quality

3.271 Acoustic

R: Control sound generation.
C: The measured sound pressure levels produced or transmitted by this subsystem in use, when combined with the measured sound pressure

levels produced or transmitted by all other subsystems in use, shall be no greater than those defined by NC35, and all pure tones shall be at least five (5) decibels below the sound pressure level otherwise produced or transmitted by the System in use at the corresponding frequency band.

T: System prototype-System field/Physical/Measurement of Sound/USAS S1.2-1962 and ASHRAE Guide and Data Book, Chapter 31.

3.272 Illumination

1) Color Rendition

R: Control illumination color.

C: This subsystem's illumination color shall be white lamp color. Color index shall be between 0.25 and 0.44 on the x scale and between 0.25 and 0.45 on the y scale of the C.I.E. chromaticity diagram.

T: Subsystem/Physical/Color Appearance of Light Source/I.E.S. Handbook pages 4-14.

2) Level

a) R: Control illumination quantity.

C:1)This subsystem shall provide an average illumination level in effective lumens per square foot of floor area measured at 30" above the floor or not less than the following:

Room Function/Size (List)	Effective Lumens/Sq Ft (Quantity of Lumens/sq ft)

2)All rooms permitted by the planning criteria shall have an average illumination level of not less than 100 effective lumens per square foot.

3)Effective lumens shall be actual lamp lumens measured after 100 burning hours multiplied by the maintenance factor. The maintenance factor shall be 0.81 times the lamp lumen depreciation (LLD). For I.E.S. category V.I. and 0.85 times the lamp lumen depreciation (LLD) for I.E.S Categories I through V. Lamp lumen depreciation shall be considered as occurring at the published mean lumen rating of the lamp.

T: System Prototype-System field/Physical-Calculation/I E.S. Handbook pages 4-20 through 4-23/Modification: use 20' x 30' room for physical test. Use I.E.S. Section 9 for calculation of remaining spaces.

b) R: Control illumination uniformity.

C: This subsystem's maximum and minimum illumination levels within rooms 20' x 30' and larger shall be not more than 1/6 above or below the average illumination level measured on a horizontal plane 30 inches above the floor for all portions of the Room except those within 3 feet of ceiling high walls and column faces.

T: System prototype-System field/Physical/I.E.S. Handbook, pages 4-20 through 4-23. Use 20' x 30' room for physical test.

3) Reflection

R: Control reflectance.

C: The exposed surfaces of this subsystem shall have an average reflectance of no less than 75 percent.

T: Subsystem/Physical/Measurement of Reflectance/ASTM E-97/Modification: determine reflectance for each surface and compute average by using relative areas as weighing factors.

4) Quality

R: Control illumination quality.

C:1) The ratio of maximum to average luminaire luminance shall not exceed five to one at 45, 55, 67, 75, and 85 degrees from nadir crosswise and lengthwise.

2) Maximum luminaire luminances crosswise and lengthwise shall not exceed the following:

Angle Above Nadir (Degrees)	Maximum Foot-Lamberts
45	2250
55	1605
65	1125
75	750
85	495

3) The luminaire, in use, shall conform to I.E.S. "scissors curve" criteria.

4) Criteria in (1) above need not be met if the total installation of luminaires, in use, provides a visual comfort probability (V.C.P.) of 70 or greater.

T: Subsystem/Calculation I.E.S. Handbook pages 2-20 through 2-21 for scissors criteria. RQQ Report No. 2, Illuminating Engineering, October 1966, for V.C.P./Modification/based on representative room sizes from a minimum of 10 x 15 ft up to a maximum of 100 x 100 ft at room subsystem average illumination level and arrangement. Tabulated calculations from a recognized testing agency are acceptable.

3.273 Air

No requirement.

3.274 Tactile

No requirement.

3.275 Pollutants

1) Particulates
R: Control dust collection.
C: The exposed surface configuration of this subsystem in use shall not trap dirt or impair regular custodial maintenance.
T: Subsystem/Observation.

2) Energies
R: Control heat output of Luminaires.
C: This subsystem shall not deliver more heat to the typical office/classroom space than is removed from the typical office/classroom space by the HVC Subsystem and shall not deliver more heat to the floor/ceiling space than is removed from the floor/ceiling space by the HVC Subsystem.

3.28 Planning and Visual

1) Relationship of Functions
R: Provide Luminaire control zoning.
C: This subsystem together with the Electrical Distribution subsystem shall from Luminaire control zones as specified in the Electrical Distribution subsystems illumination requirements above.
T: Subsystem-System/Observation.

2) Modularity
R: Control relation to the Planning Grid.
C: Those parts of this subsystem exposed to view shall have a regular geometric relationship to planned dimensions as established by the A/E.
T: Subsystem-System field/Observation

3) Uniformity
R: Control visual arrangement.

C: Those parts of this subsystem exposed to view shall have a regular geometric relationship to one another.
T: Subsystem-System field/Observation.

3.3 PRACTICAL

3.31 Interface

1) Fit

a) R: Adapt to irregular building configuration.
C: This subsystem shall perform as specified in project buildings whose exterior interface boundaries have been altered as indicated in the A/E's preliminary design.
T: Subsystem/Observation.

b) R: Accommodate Out-of-System hardware.
C:1)This subsystem shall not impair the installation of Out-of-System luminaires such as two (2) surface mounted or recessed fixtures with a maximum plan size of 12 inches by 12 inches.
2)This subsystem shall not impair the penetrations for and installation of Out-of-System ducts in the interstitial space. The penetration shall have a maximum area of ( ) square inches in any regular shape, as established by the A/E.
3)This subsystem shall not impair the installation of a smoke detection system and/or a heat detection system in accordance with NFPA Standards.
4)This subsystem shall not impair the installation of Out-of-System doors and glass panels, in any combination whose aggregate dimension shall be any increment from (ft/in.) to (ft/in.) and any multiple of the planning module as determined by the A/E.
5)This subsystem shall be capable of providing access, without damage to this or any other subsystem, to Out-of-System built elements in the interstitial space in the typical office space at all points where maintenance adjustment or planning change of those built elements may be required.
T: Subsystem-System field/Observation.

2) Tolerances
R: Control tolerances.
C: All parts of this subsystem exposed to view shall have tolerances on dimensions establishing their location and position with respect to the Planning Grid and the given vertical dimensions,

flatness, parallelism, plumbness, irregularity, surface characteristics, and color consistent with the aesthetic concept of the System's design, and shall not exceed those measured in the System prototype and determined to be acceptable.
T: Subsystem-System field/Observation.

3.32 Service

1) Accessibility
R: Provide accessibility.
C: This subsystem shall provide access to the interstitial space and to all subsystems in the Floor/Ceiling Space, if applicable, at all points where maintenance, adjustment, or planning change of those subsystems may be required. All parts of this subsystem which must be removed to provide such access shall withstand twenty (20) sequential removals and replacements without impairing the performance specified for this or any other subsystem, and with no change in appearance when evaluated visually.
T: Subsystem-System field/Physical.

2) Repairability
R: Allow for service or subsystem.
C:1) This subsystem and its component parts shall be installed so that they may be removed and disconnected from the subsystem and the Out-of-System electrical conductors for total replacement with another part without permanently impairing the performance of the System. It shall be possible to do the above, including repairs of damage to this or other subsystems resulting from the above work, within a period of forty-five (45) minutes by one (1) man within the respective Space or an equivalent period of forty-five (45) man-minutes by two (2) men within the respective space.
2) The Luminaires shall provide accessibility for replacement of lamps independent of any other subsystem. It shall be possible to replace lamps of a Luminaire and restore it to its in-use condition within a period of five (5) minutes by one (1) man within the respective Space. The stated time shall be for actual work on this subsystem only.
T: Subsystem-System/Physical/Operations shall be performed by a person specified by the Project Manager.

3) Interchangeability
R: Provide interchangeability.

C: Those parts of this subsystem of equal dimension and orientation with respect to the Planning Grid shall be interchangeable with each other.
T: Subsystem-System field/Observation.

4) Disturbance to Other Subsystems and Occupants
R: Control planning changes.
C: Changes in this subsystem shall not require work in Rooms otherwise unaffected by the planning change.
T: Subsystem/Observation.

3.33 Personnel

No requirement.

electric/electronic distribution

1.0	GENERAL
1.1	SUBSYSTEM DEFINITION AND SCOPE
1.11	Included
1.12	Excluded
3.0	PERFORMANCE REQUIREMENTS
3.1	SAFETY
3.11	Life
3.111	Fire
3.114	Azoic Characteristics
3.115	Electrical Characteristics
3.116	Hazardousness
3.12	Property
3.121	Fire
3.122	Theft Security
3.123	Vandalism Security
3.124	Resistance to Misuse.
3.13	Specific Code Restrictions
3.2	FUNCTIONAL
3.21	General Functional Performance Characteristics
3.211	General
3.212	Specific Requirements
3.22	Size, Weight, Dimensional
3.23	Strength
3.24	Durability
3.241	Surface Stability
3.242	Material Stability
3.243	Life of Subsystem and Component Parts
3.25	Transmission
3.27	Environmental Quality
3.271	Acoustic
3.272	Illumination
3.273	Air

3.3 PRACTICAL
3.31 Interface
3.32 Service
3.33 Personnel

electric/electronic distribution

1.0 GENERAL

1.1 SUBSYSTEM DEFINITION AND SCOPE

1.11 Included:

1) Main building service.

2) Primary transformers, switchgear.

3) All power and communication wiring and connections, except those of the HVC Subsystem.

4) Lighting and receptacle service panels.

5) General purpose duplex wall-mounted power receptacles.

6) Power and/or switching service stations.

7) Standby power source.

8) Integrated communications control center.

9) Speakers, communication connectors, clock outlets, manual fire alarm stations, automatic fire detectors.

10) Intercom stations.

11) Empty telephone raceway system.

12) Means of support in the Floor/Ceiling Space for all parts of this subsystem.

13) Communication trunk and branch wiring.

14) AM/FM antenna.

1.12 Excluded:

1) Power wiring and conduit for Atmosphere Subsystem.

3.0 PERFORMANCE REQUIREMENTS

3.1 SAFETY

3.11 Life

3.111 Fire

1) Flame Spread

C:1)All exposed surfaces of this subsystem shall have a maximum flame spread rating of two hundred (200).

2)If a fully automatic fire protection sprinkler system is provided as a part of the Floor/Ceiling System, the flame spread rating shall not exceed four hundred (400).

T: Subsystem/Physical/ASTM E-84 "Surface Burning Characteristics of Building Materials," or ASTM E-162 "Surface Flammability of Materials."

3.112 Toxicity Characteristics (not fire related)

No requirement.

3.113 Radiation Characteristics

No requirement.

3.114 Azoic Characteristics (undesirable life support)

R: Provide azoic properties.

C: This subsystem in use shall not be subject to verminal or organic deterioration, or provide life support for any organic media.

T: Offeror shall propose test.

3.115 Electrical Characteristics

R: Control electrical safety.

C:1)This subsystem in use shall have a continuous grounding in accordance with the National Electrical Code.

T: Subsystem/Observation/Code.
C:2)This subsystem shall conform to the requirements of all applicable codes as cited in Section 3.13.
T: Subsystem/Observation/Code.

3.116 Hazardousness (other than above)

a) R: Provide anthropometric fit.
C: This subsystem in use shall not in itself effect, or cause other subsystems to effect, personal injury.
T: Observation.

b) R: Provide accessibility to, and usability by, the physically handicapped.
C: This subsystem shall not impair each building's compliance with ASA A117.1-1961 "American Standard Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped."
T: Subsystem/Observation.

3.12 Property

3.121 Fire

See Section 3.111

3.122 Theft Security

3.123 Vandalism Security

R: Design service fittings, access panels, and all exposed portions of the system so as to resist theft and vandalism.
T: Observation: Contracting Officer may require special tests of the elements of this system as he deems necessary.

3.124 Resistance to Misuse

R: Design the service fittings, access covers, and other exposed portions of this subsystem to resist misuse.
C: Connections for power, signal, and telephone shall be clearly distinguished one from the other, and incorrect connections shall be prevented by the inherent design.
T: Observation.

3.13 Specific Code Restrictions

1) National

a) R: All raceway portions of this subsystem, if applicable, shall conform to the requirements of the National Electrical Code for conduit and raceway.

b) R: The electrical distribution portions of this subsystem with the National Electrical Code.

c) R: Floor outlets and means of access to the electrical distribution subsystem, if applicable, shall conform to the requirements of the National Electrical Code and the Underwriters' Laboratories Standards.

2) Local (Any applicable local codes should be cited here.)

3.2 FUNCTIONAL

3.21 General Functional Performance Characteristics

3.211 General

R: This subsystem shall perform the following basic requirements:

1) Providing a means which will distribute power, signal, and telephone to all portions of the typical office/classroom space, as specified in the Performance Criteria for this specification. These means may include:
   a) A system of conductors, raceways, and/or transmission media of some form.
   b) Service fittings as required for the connection of standard electrical and/or communications equipment to the system.
   c) Connections and/or terminations for connection of the subsystem to the project electrical, telephone, and/or signal subsystems at the core interface.
2) Power distribution functions of this subsystem shall serve both office/classroom equipment and luminaires including means of control.

3.212 Specific Requirements

1) Power Distribution

a) R: Provide adequate electrical power distribution to all portions of the typical office/classroom space.

C:1)Provide method which will distribute power, in raceways if necessary, between the primary power source and any electrical outlets, and service panels in the typical office/classroom space and any specified locations.

2)The subsystem shall provide capacity to allow for ( ) outlets per ( ) square feet of office/classroom space with a maximum of five (5) outlets per circuit. Each circuit shall contain two conductors and one ground.

3)This subsystem shall provide electrical equipment power distribution capability as indicated in the preliminary designs.

T: (1-4) Observation/Calculation/Measurement.

b) R: Control Pulling Distance.

C:1)This subsystem's equipment power distribution raceway and signal distribution raceway shall be arranged such that the maximum installed length of Out-of-System conductors does not exceed 200 feet.

2)This subsystem's communications raceway shall be arranged such that the maximum installed length of Out-of-System conductors does not exceed 150 feet.

3)The measured distances shall be from the point of termination at the circuit panel to the furthest possible location in the typical office space. Cumulative cross sectional areas specified for these systems shall be based on the maximum area served by the foregoing.

T: Subsystem-Calculation/Observation.

c) R: Control Interconnection of Distribution System.

C: This subsystem's electrical equipment power distribution raceway, signal distribution raceway and communications power distribution raceway shall be arranged such that the Out-of-System conductors may be installed from any termination point to any outlet in the typical office/classroom space specified. This requirement shall not be subject to the maximum pulling distances specified in b)1) above.

T: Subsystem-Observation.

2) Outlets and Access

R: Control location of outlets and electrical distribution access panels.

C: Electrical distribution access panels, if applicable, shall be usable at any of their specified locations, shall not interfere with or be interfered with by interior partitions located anywhere on the A/E's established horizontal grid, and shall not impair the specified performance of the partitions.
T: Observation/Measurement.

3) Signal Distribution
R: Provide adequate signal distribution to all portions of the typical office space.
C: Provide method by which signal distribution system may be effected between the typical office/classroom spaces.
T: Observation/Measurement.

3.22 Size, Weight, Dimensional

1) Levelness, Plumbness, Flatness

2) Weight
R: Control weight.
C: This subsystem shall add no more dead load to the structural subsystem than ( ) psf.
T: Observation/Measurement.

3.23 Strength

1) Static
a) R: Nonflush floor outlets shall resist a horizontal load of 500 pounds with a physical displacement of no more than 1/16 inch and without any damage to outlets or to adjoining parts of this or other subsystems.

b) R: Electrical distribution shall be supported in the floor/ceiling space with a factor of safety of five (5) against the dead load of this subsystem and any other subsystem supported by this subsystem.
T: Subsystem/Calculation/Structural analysis.

2) Dynamic
a) R: Resist seismic forces.
C:1)This subsystem shall provide stability for each part of this

subsystem against a seismic force as specified in the Gen. Services Administration Handbook, "Structural Engineering."
T: Analysis.

3.24 Durability

3.241 Surface Stability

1) Impact Resistance
R: Provide resistance to point impact.
C: Any component part of this subsystem in use, one (1) surface which is exposed to view, if applicable, shall withstand seventy-two (72) inch-pounds of impact on its exposed surface without any indentation greater than 1/16 inch measured twenty-four (24) hours after impact, and without any splitting or other permanent damage.
T: Subsystem/Falling Ball Impact/Fed. Test Method Std. No. 406 Method 1074/Modification: Use one (1) pound ball at six (6) inch increments to eighty-four (84) inches; perform this test on specimens which have been subjected to test specified in 3.242 (1) (a).

3.242 Material Stability

1) Moisture Resistance
a) R: Control water permeability.
C: Any component part of this subsystem, one (1) surface of which is exposed to view in use, including floor outlets, electrical distribution access panels, if applicable, or those parts plus other parts of this or any other subsystem which may be necessary to attain permeability resistance by this test, and a flat sheet sample of more than fifteen percent (15%) by weight of water and shall not transfer any water for at least three (3) hours.
T: Subsystem/Physical/Calculation.

b) R: Control water absorption.
C: No part of this subsystem exposed to the floor/ceiling space in use shall absorb water.
T: Subsystem/Physical/Water Absorption of Plastics/Fed. Test Method Std. No. 406, Method 7031/Modification: use procedure A; test specimens shall be of a size, shape and preparation representative of the subsystem in use.

c) R: Control water retention.
C: The external surface configuration of all parts of this subsystem in use shall not be capable of containing water.
T: Subsystem/Observation.

2) Corrosion
R: All metallic parts shall resist corrosion.
C:1)Avoid contact of dissimilar metals which are likely to produce electrolytic corrosion.
2)Surfaces having corrosion tendencies in the presence of moisture and oxygen shall be treated so that such corrosion shall be prevented or be self-limiting.
T: Observation.

3) Dimensional
R: Control dimensional stability
C: The component parts of this subsystem, the surface of which is exposed in use, shall not change in dimension sufficiently to impair the performance of the system in use.
T: Subsystem/Observation.

3.243 Life of Subsystem and Component Parts

R: Design subsystem and its components for use-lives as follows:
C: Electrical distribution portions of the subsystem shall have a use-life of no less than twenty (20) years.

3.25 Transmission

1) Sound
a) R: Control airborne sound transmission.
C:1)This subsystem shall not impair the Speech Privacy Potential, SPP, of no less than 60, for any two zones in any space in the typical office/classroom space.
T: Subsystem/System field/Physical/PBS-C.1.
C:2)This subsystem shall be deemed to meet (a) above if the sum of the speech privacy Noise Isolation Class, NIC', and a compatible NC-Background not exceeding 40 shall be no less than 60.
T: Subsystem-System field/Physical/PBS-C.2/NC-Background is defined in the test method.

b) R: Control impact generated sound transmission.
C: This subsystem shall not impair the masking of footstep sounds on finished flooring of contiguous rooms vertically and horizontally by and NC environment of 35.
T: Subsystem-System field/Physical/Impact Sound Transmission Test by Footfall Method/IBI-1-I, 1965/Modification: Offeror shall propose modifications to test method for prototype and field application in his Technical Proposal; use male walker with metal tipped heels in addition to specified female walker.

3.26 Dynamic and Operating Characteristics

No requirement.

3.27 Environmental Quality

3.271 Acoustic

1) Sound Generation
R: Control sound generation.
C: The measured sound pressure levels produced or transmitted by this subsystem in use, when combined with the measured sound pressure levels produced or transmitted by all other subsystems in use, shall be not greater than those defined by NC35, and all pure tones, shall be at least five (5) decibels below the sound pressure level otherwise produced or transmitted by the System at the corresponding frequency band.
T: Subsystem-System field/Physical-Calculation/Measurement of Sound/USAS S1.2-1962 and ASHRAE Guide and Data Book 1967, Chapter 31.

3.272 Illumination

1) Other Quality: Distribution of Illumination
a) R: Provide wiring capacity for power distribution to luminaires.
C:1)This subsystem shall provide luminaire power distribution in raceways if necessary, between primary access panels and the typical office/classroom spaces capable of maintaining a lighting level of no less than 75 foot candles uniformly distributed on a plane parallel to and 2'6" above the floor surface.
2)This subsystem shall provide luminaire control raceway from luminaire power distribution raceway to the control point located

at the interior partitions Subsystem's service panels, as indicated in the A/E's preliminary designs.

T: Subsystem-System prototype/Calculation-Observation.

b) R: Provide wiring capacity for control of luminaires.

C: This subsystem shall provide luminaire control capability between luminaires and the interior partition subsystem's service panels.

T: Subsystem-System prototype/Observation.

c) R: Provide luminaire control zoning.

C: Those parts of this subsystem providing luminaire power distribution and luminaire control distribution shall form single control zones (groups of luminaires controlled by a single Out-of-System switch), as indicated on the A/E's Preliminary Designs and working drawings for the project building. These control zones may be any of the following:

a) A single control zone in any Room or Space controlled by and Out-of-System switch or switches located in the interior partitions subsystem's service panels within the Room or Space as specified;

b) A single control zone consisting of any group of Rooms or Spaces, controlled by and Out-of-System switch or switches located on the typical classroom space side of corridor partitions.

T: Subsystem-System prototype/Observation.

d) R: Provide luminaire conductors.

C:1) At the option of the Offeror, this subsystem <u>may include</u> certain conductors for supply and control of the luminaires. Conductors shall be of two groups installed as follows:

a) Conductors shall be installed to supply and control luminaires within the control zones specified. Conductors shall terminate at and connect to the terminal points in the electrical closets as indicated in the A/E's preliminary designs and working drawings. Where extension of the control raceway to the Out-of-System switch(s) at the service panel(s) occurs, the conductors to be connected to the Out-of-System conductors shall be terminated and provided with approved terminal adapters acceptable for connection between the conductors. Out-of-System conductors will be 60°C copper wire (Type TW or THW).

b)Conductors shall be installed to supply selected luminaires from separate night lighting circuits. The selected luminaires shall be as indicated in the A/E's preliminary designs.

3.273 Air

1) Odors
R: The subsystem in use shall not produce or retain odors in type and quantity judged to be offensive by the Contracting Officer.

3.274 Tactile

No requirement.

3.275 Pollutants (by-products)

No requirement.

3.28 Planning and Visual

No requirement.

3.3 PRACTICAL

3.31 Interface

1) Fit
a) R:1)This subsystem shall not impair the installation of out-of-system doors and glass panels on lines established by the A/E.

b) R: Adapt to irregular building configuration.
C:1)This subsystem shall perform as specified in project buildings whose exterior interface boundaries have been altered as indicated in the A/E's preliminary designs.
2)This subsystem shall be capable of performing as specified when installed in buildings whose exterior interface boundaries are altered as specified.
T: Subsystem/Observation.

2) Tolerances
R: Control tolerances.

C: All parts of this subsystem exposed to view shall have tolerances on dimensions establishing their location and position with respect to the planned horizontal and the given vertical dimensions, flatness, parallelism, plumbness, irregularity, surface characteristics, and color consistent with the aesthetic concept of the System's design, and which shall not exceed those measured in the System prototype and determined to be acceptable.
T: Subsystem-System field/Observation.

3) Sequence of Erection
R: Control sequence of erection so that installation of this subsystem does not delay or affect the installation of any other subsystem or out-of-system element except as provided for in (specifier select appropriate conditions) schedule and/or network for total building system as (specified in General Conditions) (specified by total building system proposal).
T: Offeror shall propose test to demonstrate compliance with this criterion.

3.32 Service

1) Accessibility
R: Control change accessibility
C: During a planning change involving the installation or removal of Out-of-System electrical conductors in this subsystem, such change shall not require access to pullboxes, if applicable, at more than three (3) locations, in the typical office/classroom space.
T: Offeror shall demonstrate compliance with these criteria.

2) Maintenance Required-Frequency
R: The electrical portions of this subsystem shall require no regular maintenance.
T: Offeror: Guaranty/Warranty.

3) Disturbance to Other Systems and Occupants.
R: Changes to this subsystem in use will not affect functions of adjacent spaces.
C:1) Changes in this subsystem shall not require work in rooms or spaces otherwise unaffected by the planning change except for the installation or removal of out-of-system electrical conductors.
2) Change involving any part of this subsystem shall not in itself damage any other subsystem.

3)No planning change involving the installation or removal of out-of-system electrical conductors shall require continuous disruption of this subsystem in any access way, thereby blocking its use.

4)Change in any part of this subsystem shall not in itself impair the performance and integrity of any other subsystem.

5)This subsystem's electrical equipment signal and communication power distribution raceway shall be installed such that access to it, for the installation of floor outlets, can be achieved within fifteen (15) minutes from the time all supplies and equipment are available and set up at the work site until the System is ready for the pulling of Out-of-System electrical conductors.

T: Observation/Demonstration.

4) Modifiability in Place

R: This subsystem shall not impair planning changes involving changes in the "use" characteristics of any area.

T: Observation.

5) Repairability/Replaceability

C: Floor outlets and/or service fittings shall be capable of being removed and either replaced with a cover plate which shall be flush with the finished flooring and have the same attributes as flush floor outlets, or leave the finished floor in a flush, unmarred state without otherwise impairing the specified performance of the system.

T: Observation.

6) Interchangeability

R: Design service fittings, outlets, access panels, if applicable, terminating devices, etc. to be interchangeable one with the other.

T: Observation

7) Future Extendability

R: Design this subsystem to allow extension of power/communications/signal circuits without modifying existing subsystem.

T: Offeror/Prototype/Demonstration.

3.33 Personnel

1) Availability of maintenance and repair personnel and facilities.

R: Offeror shall demonstrate that he can provide personnel for maintenance and/or repair of:

C:1)Any electronic components of this subsystem.
2)Any exposed hardware components of this subsystem.
T: Offeror: Warranty/Guaranty/Demonstration.

2) Required Education, Trainability of Maintenance and Repair Personnel
R: Offeror shall demonstrate that he can and will at no additional cost in lieu of 3.33 (1) at the option of the Contracting Officer, train the regular maintenance personnel of the Owner-User to perform maintenance and repairs on:
C:1)Any electronic components of this subsystem.
2)Any exposed hardware components of this subsystem.
T: Offeror: Warranty/Guaranty/Demonstration.

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