VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

DESIGN AND CONSTRUCTION

STANDARDS

Revised
August, 2006

Notes for the December 10, 2004 revision:

Only a few changes have been made to the February 16, 2004 version. These primarily address energy conservation issues and include: a statement in design philosophy; a new section for energy conservation general issues; targets for energy consumption rates, requirements for Low-E glazing, variable speed motor drives, premium efficiency motor requirements, and a few others. Also, a new reference for the VT Fire Alarm Design Standards, and a new section on construction site fencing has been added.

Revisions – January, 2006:

Deleted CAD Standards text and incorporated by reference/Appendix
Added OUA Sustainable Space and Finish recommendations
Revised Elevator, Plumbing, Mechanical and Electrical sections
Cabling Standards issued by CNS and BAS Standards issued by Siemens incorporated by reference/Appendix
Revised Division 4. Masonry recommendations and incorporated by reference
Added in Division 1, General Commissioning Requirements (revised 080305)
Added in Division 15, Mechanical Systems Commissioning
Added in Division 16, Electrical Systems Commissioning
Added in Division 17, Building Automation Commissioning

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DESIGN PHILOSOPHY

General

It is the University's intent to maximize the design potential of each campus building project in terms of accommodating the programs to be served, fostering collegiality on the campus, and contributing to the public realm that defines the Virginia Tech campus as a unique place.

In order to achieve the programmatic goals of each project, the design must cost-effectively overlay the specific, user-generated objectives for the project with the University objectives of institutional identity, durability, longevity, flexibility, and adaptability.

In order to foster collegiality, each project must create environments, which encourage interaction and discourse among students, faculty and staff. This potential shall be recognized in the development of interior and exterior environments.

While a major responsibility of programmatic accommodation is to the development of the "insides" of the project, every project also has a responsibility to the greater whole of the campus. This responsibility to the public realm recognizes the importance of the architectural and planning traditions at Virginia Tech and strives to contribute to the further development of the campus as a highly imaginable, unique, and inspiring place.

To achieve these goals, it is incumbent upon the project design team to invest in an understanding not only of immediate program goals but also of the history of planning and architecture on the campus, of the goals and objectives of the current campus master plan, and particularly of the immediate context (precinct and site) for the project.

Further elaboration of many of these points can be found in the **OUA Campus Master Plan** on the web.

Accessible Design

It is the University's policy to create learning & working environment which fosters participation by all persons who visit, attend and work for Virginia Tech. Design of new and renovated space which allows inclusion of all persons is a top priority. Accessibility is something that shall be included in the initial planning of all new facilities, not an after thought in a code review of a design that is complete. Universal design that incorporates access for all persons shall be a primary planning criterion. In new construction, there is no need to segregate access for persons with disabilities from that for the general population.

Energy Efficiency

The University is committed to the principles of energy conservation. All designs shall strive to maximize energy efficiency , and comply with the energy conservation

requirements contained in these standards and Campus Energy Policy no. 5505.

Sustainability

In order to incorporate sustainable design solutions in new construction and renovation projects, Virginia Tech has joined the US Green Building Council (USGBC) and fully supports the principles of the *LEED (Leadership in Energy and Environmental Design) Building Rating System.* The pursuit of high performance green buildings that are energy efficient and environmentally sensitive will help to lower operating and energy costs, improve employee productivity, promote improved learning, and enhance the health, and well being of the students, faculty and staff at Virginia Tech. All projects shall address sustainability as it relates to site issues, water, energy efficiency, materials and resources and indoor air quality.

In the early stages of design, the A/E shall strive to meet or exceed the minimum number of points needed for LEED certification under the rating system appropriate for the project. The A/E shall determine the most cost effective means of achieving these points, and shall take full credit for points achieved through compliance with other university standards that address sustainability issues, such as building commissioning. The A/E shall submit for the university's review and approval a LEED Project Checklist, identifying the specific measures proposed to be incorporated into the project to achieve the target number of points.

The university recognizes that the cost of achieving the total number of LEED points needed for certification may not be affordable within the authorized budget for every project, and that this will be addressed on case-by-case basis. If the point level for LEED certification cannot be reached for a given project, then as many features as can be afforded shall be maintained in the design.

****END OF DESIGN PHILOSOPHY****

SPACE STANDARDS

Space planning for new university facilities shall generally follow the guidelines in Chapter 9, Section 901.2 of the Commonwealth of Virginia *Construction and Professional Services Manual*. In addition to those guidelines the following space guidelines are recommended.

VIRGINIA TECH SPACE GUIDELINES		
FACULTY / STAFF OFFICE SPACE	***SPACE TYPE***	***NASF***
Vice Presidents; Deans	P	256
Associate VP; Associate Dean	P	192
Assistant VP; Assistant Dean	P	192
Directors reporting to Pres, VP or Dean	P	192
Department Head	P	168
Associate or Assistant Dept Head	P	144
Faculty / PI Office	P	120
Professional / Technical	P	120
Professional / Technical	SP or WS	96
Technical / Clerical	SP or WS	64
Graduate / Teaching Assistant	SP or WS	50-64
Unassigned Shared Workstation	SP or WS	25-50
SUPPORT SPACE		
Reception (Capacity: 8 @ 10 SF each)	O	80
Copy / Work (One room per floor, typical)	E	100
Kitchen / Break Area (One room per floor, typical)	E	100
File Room (Capacity: Six 5-drawer lateral files, 18”x 42”)	E or O	120
ERENCE / MEETING SPACE		
Large Conference (Capacity: 30 @ 20-25 SF ea.)	E	600-750
Medium Conference (Capacity: 15 @ 20-25 SF ea.)	E	300-400
Small Conference (Capacity: 8 @ 20-25 SF ea.)	E	160-200
Video Teleconference (Capacity: 20 @ 20-25 SF ea.)	E	500
Team/Interview (Capacity: 6 @ 20 SF ea.)	E	120
CLASSROOMS		
Lecture Hall (150 fixed seats @ 10-12 SF each)	E	1500-1800
Large Classroom (100 fixed seats @ 15 SF each)	E	1500
Medium Classroom (50 @ 20 SF each seated at tables)	E	1000
Small Seminar (30 @ 20 SF each seated at tables)	E	600
KEY		
P = Private SP = Semiprivate WS = Work Station O = Open Area E = Enclosed		

The Architect/Engineer shall document specific space allocations based on these guidelines and the requirements of the project in design during the programming and schematic design phases for review and acceptance by the Office of the University Architect and the Building Subcommittee. These space allocations will become the basis for the development of the project design.

Other Space Requirements:

Classroom Space Requirements in New and Renovation Construction

The design of new classrooms or the renovation of existing classrooms on campus requires the review and inclusion of criteria from the following sources:

- Construction & Professional Services Manual, Revision 1, 2004
- Performance/Design Standard for Learning Environments, 2000 accessed at: http://www.cdcd.vt.edu/ClassStd/standards_frame.htm
- The approved facility program document.

As emerging technologies and furnishings become available alternate classroom designs will be reviewed and approved on a case by case basis.

Other Space Requirements in New Construction

1. Lactation Room: Provide one room; minimum 9' X 6' or equivalent space in each building. Include the following:
   - 1.1. Solid core wood door, no lites, with key pad outside; automatic lock upon closing.
   - 1.2. Connection to the building's HVAC for climate control
   - 1.3. Ceiling mounted lighting with dimmer control or other approved indirect lighting
   - 1.4. Three receptacles, including one GFI receptacle centered over countertop
   - 1.5. Accommodate mothers with disabilities, including those using wheelchairs
   - 1.6. Built in casework with 6' x 2' x 30" high countertop; allow for seating at counter or future under counter refrigerator; include small sink with soap dispenser and paper towel dispenser
   - 1.7. One 18" wide base cabinet below counter positioned at opposite end of sink; continuous wall cabinets above with fluorescent mounted lighting
   - 1.8. Floor Covering: Carpet tiles
   - 1.9. Room color: Calm, neutral color
   - 1.10. Full length mirror located on wall opposite counter
   - 1.11. Coat hook on wall or door

Incorporate the following spaces into the design of new buildings to allow Physical Plant to provide adequate custodial and preventive maintenance services to the building occupants:

2. Housekeeping Supply; Provide one 100 square foot supply closet located adjacent to service entrance or loading dock. Include the following:

   2.1. Door hinged to swing out, not into the room.
   2.2. Minimum of three 24" deep adjustable steel or sealed wood shelves on two walls. Mount bottom shelf 24" above floor.
   2.3. Minimum one duplex receptacle, 120 VAC, located near door.
   2.4. Fluorescent lighting
   2.5. Adequate ventilation
   2.6. Sealed concrete floor with sloped floor drain in center of room
   2.7. Walls painted off-white to enhance light reflectance
   2.8. No roof access, serviceable building electrical or mechanical equipment such as electrical panels, motors, etc. in this space

3. Housekeeping Closet; Provide a minimum of one 60 square foot closet on each floor but not within proximity of Housekeeping Supply; two closets on floors exceeding 18,000 square feet. Include the following:

   3.1. Door hinged to swing out, not into room
   3.2. One floor mounted sink located in corner. Sink not to exceed 8" in height.
   3.3. One mop holder over sink to hold three mops
   3.4. Minimum of three 18" deep adjustable sealed wood or steel shelves on longest wall mounted with heavy duty brackets; bottom shelf 24" above floor.
   3.5. Fluorescent lighting
   3.6. Do not include any
   3.7. Sealed concrete floor with sloped floor drain in center of room
   3.8. Adequate ventilation
   3.9. Door hinged to swing out, not into the closet
   3.10. Walls painted off-white to enhance light reflectance
   3.11. No roof access, serviceable building electrical or mechanical equipment such as electrical panels, motors, etc. in this space

4. Housekeeping Supervisor; Provide one 100 square foot office; include the following:

   4.1. One duplex receptacle on each wall; one data outlet on wall opposite door.
   4.2. Solid core wood door reinforced to discourage unauthorized entry
   4.3. Suspended acoustical ceiling with recessed fluorescent lighting
   4.4. Resilient floor or carpet tiles
   4.5. Connection to the building's HVAC for climate control
   4.6. One wall mounted key cabinet, minimum 20 gauge steel, gray baked enamel finish, concealed hinges, key type lock, minimum size 12" x 12" x 2"
   4.7. No roof access, serviceable building electrical or mechanical equipment such as electrical panels, motors, etc. in this space.

5. Preventative Maintenance Office; Provide one 100 square foot office on the ground floor of each building, in close proximity to the loading dock. Include the following:

   5.1. One duplex receptacle on each wall; one data outlet on wall opposite door.
   5.2. Suspended acoustical ceiling with recessed fluorescent lighting.
   5.3. Resilient floor or carpet tiles
   5.4. Connection to the building's HVAC for climate control.
   5.5. No roof access, serviceable building electrical or mechanical equipment such as electrical panels, motors, etc. in this space.

The following recycling related office space and equipment requirements shall be incorporated into the design of new buildings to facilitate waste stream separation and removal:

1. Offices; Provide desktop space for double-compartmented paper collector (10"W x 9-1/2"D x 11"H) or floor space for desk side three compartmented trash and paper collector (10-3/8"W x 19-3/8"D x 13-5/8"H).

2. Copy Rooms; Provide floor space for one 30 gallon rectangular paper collector (21-3/4"W x 15-5/8"D x 27-5/8"H) for every two copiers (collector to be emptied once a week).

   2.1. Note: For rooms with multiple high speed copiers, provide floor space for one 30 gallon rectangular paper collector (21-3/4"W x 15-5/8"D x 27-5/8"H) for each copier (collector to be emptied daily).

3. Lounges/Mail Rooms; Provide floor space, or alcove, for three rectangular 30 gallon collectors for aluminum cans, newspapers, office paper (21-3/4"W x 15-5/8"D x 27-5/8"H).

4. Corridors:

   4.1. Provide floor space, or alcove, for two rectangular 30gallon paper collectors (21-3/4"W x 15-5/8"D x 27-5/8"H) for every ten (10) office workers (collectors to be emptied once a week).

   4.2. Provide floor space, or alcove, for one rectangular 30 gallon aluminum can collector (21-3/4"W x 15-5/8"D x 27-5/8"H) for each soda vending machine.

5. PC Labs; Provide floor space, or alcove for one 30 gallon paper collector 21-3/4"W x 15-5/8"D x 27-5/8"H) for each printer (collector to be emptied once a week during normal periods, 2-3 times per week during peak periods).

6. Loading Docks:

6.1. Loading dock shall be an “L” shaped design. Provide floor space along the long leg for multiple storage containers (37-1/2”W x 30-1/2”D x 43”H), one per recyclable.

6.2. Provide bumpers and dock leveler at each loading dock.

6.3. Exterior loading dock area shall be enclosed with an overhead door, or at a minimum, sheltered from the elements by an overhanging roof.

6.4. Locate loading dock near the mid-section of the building, rather than at either end.

6.5. Loading dock shall be directly accessible by a service elevator having a 2500 lb. usable capacity.

6.6. Provide a 60” cardboard bailer in close proximity to each loading dock area if facility generates more than six cubic yards of cardboard per week and does not have an open hopper with cardboard compartment.

****END OF SPACE STANDARDS****

ROOM NUMBERING STANDARDS

Goals: (in priority order)

1. Identify rooms for visitors to the building so they may be easily located in a systematic way.
2. Identify rooms for building occupants.
3. Identify rooms for administrative identification (CNS, Physical Plant, 911, etc.) and databases.

Guidelines:

1. The same room numbering sequence shall be used on all floors of the same building with lower room numbers at one end of the building and higher room numbers at the other end of the building. Also, even room numbers shall be on one side of the primary hallway and odd room numbers on the other side in so far as possible.

2. Rooms in similar locations on different floors shall have similar room numbers so that room numbers are coordinated on a vertical basis as well as a horizontal basis in the entire building. For example, rooms 115, 215, and 315 shall all be located directly above or below each other or as close as possible.

3. Reasonably allow for renovation changes. Rooms shall be numbered in such a manner that, shall renovations occur in the future, intervening numbers will be available for room assignments (especially where larger rooms are built that may be subdivided into smaller rooms at some time in the future).

4. All accessible spaces must be assigned a room number. If an area of a room has a different use function or is not clearly delineated by walls and doors (ex. an area off of a corridor is used for a work area), dashed lines shall be added to the floor plan to clearly identify the space and it shall be identified by a room number.

5. All assignable rooms (including offices, labs, classrooms, conference rooms) shall have their room number begin with a numeric character; the first digit specifies the floor number.

6. All non-assignable rooms (including bathrooms, corridors, stairs, elevators, janitor closets, mechanical and electrical rooms) shall have their room number begin with a alphabetic character followed by a numeric room number; the first character specifies the floor number with “A” being the first floor, “B” being the second floor, etc.

7. Try to use 3-digit room numbers unless there are too many rooms on a floor.

8. All interior rooms accessed from a primary room have an alphabetic character (ex. “A”, “B”, etc.) following the primary room number. A secondary interior room shall have a single digit (ex. “1”, “2”, etc.) following the alphabetic character of the first level interior room (ex. Room “101A1” is accessed from room “101A” that is accessed from room “101”).

Delivery Requirements:

1. A separate AutoCAD (version 2000 or earlier) drawing file (.dwg) must be provided for each floor of the building and must be self-contained (i.e., no overlays, Xrefs, etc.) and use standard AutoCAD fonts (typically the simplex font). The name of the drawing file shall indicate which floor it represents.
2. Each drawing shall have only the following layers:
   - 2.1. FLOOR
   - 2.2. DOOR
   - 2.3. WINDOW
   - 2.4. TEXT
   - 2.5. ROOM
3. The FLOOR layer (white) shall contain all walls, elevators, and stair entities
4. The DOOR layer (red) shall contain only door entities
5. The WINDOW layer (blue) shall contain only window entities (both interior and exterior panes)
6. The TEXT layer (magenta) shall contain, for each identified space, two or more lines of text centered above/below each other. The top text line(s) shall give the room name or use (ex. “OFFICE”, “JAN.”, “WOMEN”, “STORAGE”,”FRUIT RESEARCH LAB”, etc.). The bottom line of text shall contain the room number. All text shall be set at 1’3” in height and be oriented so that it fits within the room or space without be obstructed in so far as possible. Also included on this layer are the stair and ramp directional arrows.
7. The ROOM layer (green) shall contain a polyline outlining each space in the building. The polyline shall follow the inside wall surface of each room or space. It is used to calculate room areas and is required for our facilities management system.
8. Bathroom fixtures, cabinetry, furniture, etc., are not to be included on any drawings.
9. No overlaid drawing entities shall exist. That is, a line or other entity on the drawing shall not be stacked with multiple entities. Also, any single line on the drawing shall consist of one line and not multiple line segments.

10. The drawings shall be kept as simple and clean as possible as they are used and modified by many people in many functions across the university.

11. A sample drawing of a building floor may be obtained for reference.

SIGNAGE STANDARDS

All proposed signs (for both on-campus and off-campus applications) must be reviewed and approved by the Office of the University Architect. Virginia Tech typically utilizes its own resources for the design, fabrication and installation of signage. For capital building projects, the cost of the interior and exterior signage is a part of the overall project cost, but separate from the "design to" construction budget.

Virginia Tech uses standardized signage and standard applications. This information is provided for reference only. Standard signage incorporates:

1. Non-Illuminated Interior Signage
   - 1.1. Secondary Directional Signs
   - 1.2. Area Identification Signs
   - 1.3. Room Identification Signs
   - 1.4. Regulatory and Control Signs
   - 1.5. Mechanical, Instrumentation Sign
   - 1.6. Main Building Directories
   - 1.7. Department Directories

2. Illuminated Exterior Signage
   - 2.1. Primary Identification Signs (Buildings)

3. Non-Illuminated Exterior Signage
   - 3.1. Secondary Identification Signs
   - 3.2. Vehicular Directional Signs

4. Dedicatory Plaques

5. Street Signage
   - 5.1. Street Names
   - 5.2. Regulatory and Control

6. Construction Signage

Site planning concepts shall include suggested exterior signage locations. Typically, no signage is attached directly to the exterior of a building, in conformance to the Campus Master Plan. A construction sign cannot be a requirement of the contract documents. Shall the contractor choose to have a construction sign, the sign must conform to the requirements set forth by the university.

The A/E must submit an electronic version of the floor plans to the Office of the University Architect 6 months prior to substantial completion of construction in order to begin interior signage planning. Planning for dedicatory plaques and exterior regulatory and control interior signage requires consultation with the Office of the University Architect.

****END OF SIGNAGE STANDARDS****

ENERGY CONSERVATION STANDARDS

General

1. Buildings must be energy efficient and shall strive to achieve a maximum energy consumption rate of 100,000 BTU's per square foot per year.
2. Lighting wattage should not exceed 1 Watt per square foot total.
3. Landscape design shall reduce energy consumption in the building through the use of wind breaks and deciduous tree Placement while respecting the strategies outlined in the Master Plan guidelines.
4. Primary entry doors shall include a vestibule to minimize infiltration.
5. Virginia Tech Campus Energy and Water Policy No. 5505 applies to these standards.

****END OF ENERGY CONSERVATION STANDARDS****

DRAWING (CAD) STANDARDS

General

The VT CAD Standards are maintained in a separate document at the following link – VT CAD Standards

****END OF DRAWING (CAD) STANDARDS****

UNIVERSITY MASTER PLAN - GENERAL RECOMMENDATIONS

Design Character

1. Buildings shall extend and enhance the underlying planning and architectural strengths of the campus.
2. New buildings shall balance individual expression with contextual sensitivity.
3. New buildings shall reflect the character of Virginia Tech as an institution with a rich past, vibrant present, and promising future.
4. Program, site, and budget parameters shall all be addressed in an integrated fashion.

Planning

1. Buildings shall be sited to reinforce and enhance the spatial structure of the campus and its circulation patterns.
2. Building entries shall be clear and coordinated with circulation patterns and landscaping elements.
3. Ground level uses shall consider the harmony of interior and exterior activities.

Massing

1. Massing shall be simple.
2. Buildings should primarily range from two to four stories appropriate in scale with the adjacent outdoor spaces.
3. Bays, porches, towers, and other minor adjustments to massing are encouraged.

Roof Forms, Roof Lines and Silhouette

1. Well-developed and articulated rooflines are encouraged.
2. Sloped roofs and flat roofs are both acceptable
3. Sloped roofs shall be of high quality self finished metal or slate.
4. Flat roofs shall have carefully selected aggregate or pavers if visible. Visible Roofscapes must be as carefully designed as any other exterior surface of the building.
5. It will be necessary for designers to explain all aspects of their design selection including material, color, patterning, and other details.
6. Parapets shall be well articulated and trimmed with cut stone. Profiles, scuppers,

and other ornamental devices are acceptable and encouraged.

7. Dormers and pediments are also acceptable and encouraged as are cupolas, chimneys, and other traditional roofing embellishments. Their intersection with the main roof must be well detailed and will receive careful scrutiny. These elements shall not be viewed purely as ornamental elements without functional attributes.

Facades

1. Facades shall be simple and well ordered.
2. General fenestration patterns shall be regular. Some vertical hierarchy is appropriate. Where affordable, cut stone window surrounds are preferred to precast concrete. Window openings shall be subdivided to create a vertical proportion where they form horizontal groupings.
3. The use of bays, giant order elements, or special accents to provide a large overall order is acceptable and encouraged.
4. Special detailing ornament and materials at significant locations are acceptable and encouraged.
5. Window frames and glass shall be set back approximately 6". Sills and heads shall be detailed to shed water and alleviate the possibility of unattractive weathering patterns.

Architectural Details

1. Buttresses, coping, string courses, and other traditional architectural details are acceptable and encouraged.
2. The joining of dissimilar materials must be resolved carefully and will be rigorously reviewed.
3. Where possible, caulk joints shall be placed in less visible locations such as inside corners or reveals.
4. Extreme care and experienced oversight shall be given to details designed to prevent water infiltration.

Ornament

1. The campus currently has minimal ornament reflective of its lengthy history. Future buildings shall have well-developed ornamental programs appropriate to a University with such a broad contemporary mission.
2. Heraldry, plant, animal, and geometric motifs are all acceptable and encouraged in a coordinated program.
3. Building identification integrated into building facades are key elements of an ornamental program.

4. The use of new technologies to economically produce ornamental elements is acceptable and encouraged.
5. The creative use of masonry patterning is also acceptable as an ornamental strategy.

Masonry

1. Material selection shall be made to reinforce existing campus patterns.
2. Hokie stone with split face random units and natural color mortar shall be used in buildings within the quadrangles surrounding the Drill Field. The drill marks these stones contain shall also be retained as a design element. Cut limestone trim shall be utilized. Outside this inner core, a mix of Hokie Stone and reddish brick, or brick with limestone trim may be considered.
3. Masonry design must comprehensively consider unit size, texture, color, hording pattern, mortar, and striking. These design choices will be rigorously reviewed.
4. Precast concrete, cast-in-place concrete, and cast stone may be proposed as alternatives to limestone trim.

Exterior Doors

1. Wood, metal, and glass doors are all acceptable.
2. Doors shall have a quality and character appropriate to the overall façade.
3. Vision panels, reveals, and carving are appropriate and encouraged.

Exterior Finishes

1. Color choices for exterior masonry must be coordinated with the existing campus and reinforce the overall campus design.
2. Paint colors on campus are currently subdued. More contrast and hue are encouraged.
3. Colors shall help accentuate the various tones in the Hokie stone and plant materials on campus.

****END OF MASTER PLAN RECOMMENDATIONS****

BIDDING REQUIREMENTS

The Bidding Requirements of all specifications for Virginia Tech projects shall be arranged in the following manner, using the samples enclosed herein and the referenced Capital Outlay Forms. Electronic copies of all forms can be downloaded from the Department of General Services (DGS) website – http://forms.dgs.virginia.gov. Projects with federal funding may have additions or revisions to this list. Specific questions concerning any of the items shall be directed to the Project Manager.

1. **Sample Advertisement**
   Include a Notice of Invitation to Bid in the specifications. Contact the Project Manager to determine the dates to be inserted.

2. **Instructions to Bidders (CO-7a)**
   Insert current copy of form DGS-30-055.

3. **Sample Bid Form**
   The sample bid form shown herein shall be used as a basis to construct a bid form for the project. As each project is unique, contact the Project Manager concerning any special requirements.

4. **General Conditions of the Construction Contract (CO-7)**
   Insert current copy of form DGS-30-054 - CO-7, General Conditions of the Construction Contract.

5. **Supplemental General Conditions**
   Insert current copy of form DGS-30-377 - Supplemental General Conditions. If liquidated damages are to be specified insert current copy of DGS-30-376, contact the Project Manager concerning the dates and amounts to be used.

6. **VUSBC Special Inspections – State Owned Buildings (CO-6b)**
   Insert current copy of form DGS-30-052.

7. **Contract between Owner and Contractor (CO-9)**
   Insert current copy of form DGS–30–064. Contract will be prepared by the Owner and sent to the contractor for signature.

8. **Commonwealth of Virginia Standard Worker's Compensation (CO-9a)**
   Insert current copy of form DGS–30–076.

9. **Commonwealth of Virginia Standard Performance Bond (CO-10)**
   Insert current copy of form DGS–30–084. Contractor will prepare and distribute directly to the owner.

10. **Commonwealth of Virginia Standard Labor and Material Payment Bond (CO-10.1)**
Insert current copy of form DGS–30–088. Contractor will prepare and distribute directly to the owner.

11. **Schedule of Values and Certificate for Payment (CO-12)**
Insert current copy of form DGS–30–104.

12. **Contract Change Order (CO-11)**
Insert current copy of form DGS–30–092.

13. **General Contractor Estimate for Change Order (GC-1)**
Insert current copy of form DGS–30–200.

14. **Subcontractor Estimate for Change Order (SC-1)**
Insert current copy of form DGS–30–204.

15. **Sub-Subcontractor Estimate for Change Order (SS-1)**
Insert current copy of form DGS–30–208.

16. **Commonwealth of Virginia Affidavit of Payment of Claims (CO-13)**
Insert current copy of form DGS–30–108.

17. **Certificate of Completion by A/E or Project Manager (CO-13.1)**
Insert current copy of form DGS-30-112

18. **Certificate of Substantial Completion by A/E (CO-13.1a)**
Insert current copy of form DGS-30-116

19. **Final Report of Structural & Special Inspections (CO-13.1b)**
Insert current copy of form DGS-30-120

20. **Certificate of Partial or Substantial Completion by Contractor (CO-13.2a)**
Insert current copy of form DGS-30-140.

21. **Certificate of Completion by Contractor (CO-13.2)**
Insert current copy of form DGS–30-136.

22. **Checklist for Occupancy (CO-13.3b)**
Insert current copy of form DGS–30-152.

DIVISION 1 – GENERAL REQUIREMENTS

Summary of Work

Work by Owner may include, but not necessarily be limited to, the following:

Virginia Tech Electric Service (VTES) shall provide and install all exterior light standards, cobra heads and "Hokie" lights. The Contractor shall install the light standard bases (anchor bolt template provided by VTES), connecting conduit and pull rope. Conductors and lighting controls will be installed by VTES. Lighting controls shall be located outside of the building or in a VTES vault within the building.

Payment Procedures

1. Sections 19 and 36 of the General Conditions of the Construction Contract (CO-7) apply to this section.
2. Three days prior to the Monthly Pay Meeting, the Contractor shall submit a "draft copy" of the Schedule of Values and Certificate for Payment (Form CO-12) and Monthly Project Report (Section 19d) to the A/E, the Owner's Project Manager and the Owner's Field Engineer.
3. The A/E, Project Manager and Field Engineer will endeavor to review the submittals and return comments/changes to Contractor the following day.
4. The Contractor shall bring 5 copies of the "revised" and signed CO-12 and approved Monthly Project Report to the Monthly Pay Meeting.
5. At the conclusion of the Monthly Pay Meeting, the A/E and Field Engineer shall sign and certify the CO-12 for payment.

Project Management and Coordination

1. Sections 17 and 50 of the General Conditions of the Construction Contract (CO-7) apply to this section.
2. Staffing Plan - It is a requirement of the construction contract that the project be adequately and appropriately managed by the Contractor to ensure both the timeliness and quality of all construction activities. The Contractor shall provide a Staffing Plan that lists all assigned personnel, their anticipated responsibilities and their work history and experience to the Owner and A/E for their review and approval prior to the Preconstruction meeting. Once approved, any proposed changes to the Staffing Plan must be submitted in writing to the Owner and A/E for approval. The Staffing Plan shall include, but not necessarily be limited to, the Project Manager(s), Project Engineer, General Superintendent and Assistant Superintendent(s).

3. Preconstruction Meeting – A preconstruction meeting will be held in accordance with Section 50 of the General Conditions of the Construction Contract (CO-7). The meeting is to be scheduled and conducted by the A/E. An agenda based on appropriate sections of the General Conditions of the Construction Contract and Division 1 of the Project Manual shall be prepared by the A/E and approved by the Owner in advance of the meeting.

4. Construction Progress and Pay Meetings – Monthly Progress and Pay Meetings will be held in accordance with Section 50 of the General Conditions of the Construction Contract (CO-7). The meetings are to be scheduled and conducted by the A/E. The agenda for the meetings shall be in accordance with Paragraph M. of the A/E Contract – Memorandum of Understanding and shall be indicated in this section of the Project Manual.

5. Pre-installation Meetings – The contract shall require pre-installation meetings to ensure both the quality and timeliness of various construction activities. The Contractor and appropriate Subcontractors shall schedule and conduct the pre-installation meetings in accordance with the requirements of the Project Manual. Given their knowledge of the project design documents, the A/E shall identify in this section, as a minimum, specific construction activities requiring a pre-installation meeting.

Construction Progress Documentation

General:

1. Sections 19 and 36 of the General Conditions of the Construction Contract (CO-7) apply to this section.

2. Upon issuance of the Notice of Award and prior to submitting the preliminary schedule, the Contractor shall arrange to meet with the Owner and A/E to discuss the Contractor's plan to construct the project.

3. Contractor to provide printed copies of the schedule submittal(s) to the Owner and A/E for review. Once approved, record copies of the fully complete Project schedule and any approved revisions shall be submitted to the Owner and A/E electronically.

4. The Monthly Project Reports to be submitted with each pay request (Section 19d) shall consist of the approved construction schedule (or latest approved revision) that has been updated to indicate actual progress at the time of the submittal. The "as of" date (data date) for the update shall be no earlier than one week before the pay request meeting. If there are construction activities whose actual progress is less than what is indicated on the approved schedule, a narrative report must also be submitted which lists the delayed activities and, where necessary, indicates how these activities will be expedited to avoid delaying the overall project completion date. A printed copy of the updated schedule and, if required, the narrative report must be submitted with each pay request. Review and approval of the Monthly Project Report is a prerequisite to the review and approval of the monthly pay

request (Section 36a). Once approved, electronic record copies of Monthly Project Report shall be provided to the Owner.

Schedule Activity Content:

All CPM schedule activities shall be coded to allow for sorting by Phase, Trade and Building Location. The construction schedule shall include, but not necessarily be limited to, the following Schedule Activities as they apply to this project:

1. Construction tasks (maximum duration for any activity is 20 days)
2. Submittal and approval of required shop drawings
3. Submittal and approval of required coordination drawings
4. Ordering, fabrication and delivery of major materials and equipment
5. Check-out, start up and test/balance of major equipment
6. Submittal and approval of O & M Manuals
7. Clean up and punch list
8. Interim (i.e. pre-ceiling installation), Substantial Completion and Final Completion inspections
9. Owner occupancy

Vehicular Access and Parking Areas

1. Sections 25 and 31 of the General Conditions of the Construction Contract (CO-7) apply to this section.

2. Parking on the Virginia Tech campus is regulated for all vehicles. Virginia Tech Parking Services strictly enforce parking regulations (regulations at: www.parking.vt.edu). Violations of parking regulations could result in parking tickets, wheel booting, or vehicle towing. Contractor parking on campus is managed with the following requirements:

   2.1. Parking <u>within</u> the construction fencing of a capital project is allowed without restriction. Company and private vehicles may be parked inside the fence without a permit. All efforts shall be made to keep contractor parking within the fenced area. Parking on site after the project is deemed substantially complete and the construction fence is removed requires written approval by the Owner and/or an appropriate parking (turf) permit.

   2.2. Prior coordination with Parking Services (540/231-3200) is required shall the need arise for additional contractor parking. The university will designate a parking lot on campus for use by contractors. The designated contractor lot will be the <u>only</u> lot on campus in which contractor parking is allowed. The university, at its discretion, reserves the right to change the designated contractor lot to any other lot on campus during the term of the contract. Parking in the designated contractor lot on campus during the term of the

contract. Parking in the designated contractor lot requires the purchase of a vendor/business/contractor permit from Parking Services for both company and privately owned vehicles. These rates may change on an annual basis at the discretion of Parking Services.

2.3. The hours of use of the designated contractor lot are generally reserved for normal daytime hours of work (7 am to 5 pm, Monday-Friday). The potential need for occasional night work is recognized and accepted, providing the lot is not used for overnight storage of vehicles. At no time will the lot be used to store equipment or industrial vehicles. Also, there will be occasions, typically on weekends, when the lot must be completely vacated for special activities such as graduation or football game parking. Parking Services will inform the Capital Design and Construction department in advance of the special events dates and notices will be posted at the entrance to the lot. Vehicles left in the lot on these occasions are subject to being towed at the owners' expense.

3. Contractors will abide by all traffic regulations at Virginia Tech. Construction sites must make consideration for the flow of pedestrian traffic around the site. Coordination for vehicle and pedestrian traffic must be made with the Office of Transportation (540/231-7641) prior to occupation of the site. Large deliveries that cannot be accommodated within the staging area may be briefly off-loaded in the roadway ONLY with prior coordination with Virginia Tech Police Department (540/231-6411) at least five working days in advanced. No significant activities should be planned at the construction site during home football games or university graduations.

Temporary Barriers and Enclosures

Construction Site Fence

GENERAL

1. Prior to initiating any on-site construction activities, the General Contractor shall erect a temporary construction fence as indicated in the contract documents. The contractor will meet with the owner and A/E prior to the start of the installation to discuss timing, work conditions and pedestrian routing.
2. The contractor shall call Miss Utility before driving any posts for the fencing.
3. Signs shall not be posted on the fence system except: "No Trespassing" signs may be installed at 50 foot intervals; safety related signs required by OSHA; and visitor site entry rules as required by the contractor. Advertising signage is strictly prohibited.
4. The contractor shall keep plant growth from around the base of the fence by either trimming or chemical treatment.
5. Fence shall be maintained for the duration of the project, and shall not be removed without the owner's permission.

TREE PROTECTION FENCING (TREE PROTECTION ZONES)

1. Tree protection fencing must be installed around all existing trees noted to remain on plans within the fenced staging area. Fencing shall extend a distance from the trunk of 1.25 feet per each inch of trunk diameter or 6', whichever is greater. For example, a tree with a 12" trunk diameter shall be fenced 15' from the trunk (30' diameter)
2. Fencing must be installed prior to any equipment arrival on the site. Work may not begin until fencing is installed.
3. Fencing shall be galvanized chain link as specified below, 4' minimum height.. Plastic fencing and wood stakes, or snow fencing are NOT acceptable.
4. Fence shall be maintained for the duration of the project, and shall not be removed without the owner's permission.
5. No material storage, vehicles or any other activity shall occur at any time within tree protection fencing.
6. Contractor may be required to pay tree replacement and/ or soil compaction remediation costs if there is any incursion in to tree protection zones.

FENCE DESIGN AND MATERIALS

1. The minimum height for all temporary fencing shall be 6 feet.
2. The fencing shall be of galvanized 11-1/2 ga. chain-link construction with a minimum of 1-5/8" O.D. tubular steel posts and top rails.
3. Surface mounted fence panels may be used with the approval of the owner and are to be adequately braced to resist wind and ice loading and shall be continuously connected to prevent access by the public.
4. Privacy netting to screen construction activities shall be used on all "core campus" (bounded by Perry Street, Washington Street, West Campus Drive and Kent/Stanger Streets) projects, or as specified in the contract documents.
5. Privacy screen material shall be green, equal to the weave of US Netting's Windscreen, polyethylene netting.
6. Barbed wire shall not be used.

GATES

1. Limit entrance/exit to no more than two locations, unless otherwise approved by the owner.
2. Gates shall be a minimum of 12 feet in width to allow access for emergency vehicles.
3. Where other transportation authorities need to review gate locations and operation, communication with those authorities will be coordinated through the owner.
4. Gates shall be closed and locked at all times the site is not occupied, unless otherwise directed by the owner where emergency vehicle passage through the site is needed to access existing occupied buildings.

Protecting Installed Construction

1. Roof Protection – Before working over or moving equipment, materials or personnel over a new or existing roof, the General Contractor and any of their agents and/or subcontractors must thoroughly and completely protect the roof system from

damage and excessive wear during and following the roofing work. Construction activities over or the movement of equipment, materials or personnel over a new or existing roof without approved roof protection shall be cause for the Owner and/or A/E to stop work until the protection is provided and any damage to the roof system is corrected.

2. The contractor shall protect all utilities and structures installed in this contract whether by them or other contracts from construction operations at all times during the work. Means and methods of protection shall be submitted to the A/E for review and approval prior to work being performed.

3. The owner will have the right to access the work for post installation testing of roofs, utilities and structures or any other installed systems for construction damage, forwarding the findings to the A/E for development of strategies for correction by the contractor.

Close Out Submittals

General

1. Close out submittals, including as-built drawings, Operation & Maintenance manuals and required product manuals must be submitted to and approved by the A/E prior to achieving Substantial Completion.

Operations & Maintenance O&M manuals:

1. Prior to the demonstration of equipment, the Contractor shall submit operations and maintenance manuals to the A/E for approval.

2. Two complete sets of O&M manuals shall be provided in individually bound volumes as indicated below:

2.1.	Division 1-13 Architectural	
2.2.	Division 14	Vertical Transportation
2.3.	Division 15	Heating, Ventilating, Cooling
2.4.	Division 15	Plumbing
2.5.	Division 15	Building Automation System
2.6.	Division 16	Electrical

3. Manual binders shall accommodate 8 ½ X 11 inch pages, be heavy-duty three-ring type with the project name lettered on the spine.

4. All pages shall by 8½ X 11 inches. Larger pages, if used, shall be neatly folded to 8½ X 11 inches and be used as pullouts or foldouts.

5. As appropriate, each manual shall include:

   5.1. Names, addresses and trades of all subcontractors, Manufacturers, and

suppliers who participated in the construction or who furnished materials and equipment.

5.2. Complete maintenance instructions from the manufacturer's local representative for each item of operable equipment as well as the name, address, and telephone number of the installing Subcontractor.

5.3. Catalog data on all items submitted and other pertinent data such as mortar colors, bricks selected, and color selected for all finished materials and fabrics.

5.4. Catalog data on all plumbing fixtures, valves, water heaters, heating equipment, temperature controls, fans, electrical panels, service entrance equipment, light fixtures, similar equipment and systems. Manufacturer's advertising or promotional literature will not be acceptable.

5.5. Manufacturer's name, model number, service manual, spare parts lists, and descriptive literature for all components.

5.6. Preventive maintenance instructions and schedules for all major equipment.

5.7. List of most frequently encountered breakdowns and repairs.

5.8. Instructions for starting and operating the actual system as installed.

5.9. Detailed one-line, color-coded wiring diagrams.

Warranties & Guarantees

1. Two copies of all warranties and guarantees shall be drawn in the name of The Board of Visitors of Virginia Tech and be bound into a single, heavy duty, three ring binder to accommodate 8 ½ X 11 inch pages. Include a table of contents and separate each warranty section with a marked tab in the order of the specifications.

Spare Parts & Materials

1. Spare parts and maintenance materials, where specified, shall be turned over to the Owner's Field Engineer prior to Substantial Completion.

General Commissioning Requirements

1. Definition of Commissioning – Commissioning as used in these Design Guidelines, is the systematic process of review, documentation, inspection and performance testing implemented starting with design and extending through construction and occupancy of the facility, utilized to assure that the facility and systems meet the Owner's Requirements. The "Commissioning Authority" shall ideally be an independent, third-party consultant hired by the university, responsible for the conduct of the commissioning scope of work. In some cases, the Contractor will be required to hire the Commissioning Authority and conduct the commissioning scope of work.

2. Objectives of Commissioning – The objective of commissioning of Virginia Tech facilities is to insure proper, reliable and safe operation of HVAC, plumbing, piping, electrical power and communications systems upon occupancy of each facility.

Commissioning may also be utilized to assure the proper selection, installation and operation of other building systems, such as architectural systems, at the discretion of the university.

3. General Requirements – For most projects, Virginia Tech will hire an independent, third-party Commissioning Authority to provide the scope of commissioning services defined herein. These sections are intended to illustrate the scope of commissioning for which the Contractor will be responsible to cooperate and facilitate within the Project Documents. On some smaller projects, Virginia Tech will determine that commissioning services shall be included within the Contractor's scope of work. In these cases, the project specifications shall require the Contractor to appoint or hire the Commissioning Authority and include in their bid. On all projects unless otherwise approved, the contract documents shall include specifications which require the contractor to cooperate, provide labor, assistance, materials, supplies and information, and otherwise facilitate the work of a third-party, independent "Commissioning Authority" (or to provide for and coordinate with the commissioning authority for commissioning services, where "contractor commissioning" is specified.) Where third-party commissioning is used, the independent Commissioning Authority will normally develop the "Commissioning Specifications" sections for inclusion in the Project Documents by the A/E of record. Where "contractor commissioning" is utilized, the A/E will be responsible for developing the appropriate commissioning specifications sections. Virginia Tech shall be consulted on each project to determine the applicability and appropriateness of third-party commissioning (vs. contractor commissioning) to the project scope, and to identify the specific systems to be commissioned for the particular project.

4. Systems to be Commissioned – On most typical projects the following systems are to be commissioned, as applicable:
   - 4.1. Air Handling Units
   - 4.2. Terminal Boxes
   - 4.3. Airflow Control Valves
   - 4.4. Exhaust and Supply Fans
   - 4.5. Sound Attenuation and Control Systems
   - 4.6. Fume Exhaust Fans
   - 4.7. Heating Units
   - 4.8. Steam and Hydronic Systems
   - 4.9. Hot Water Heaters and Converters
   - 4.10. Pumps
   - 4.11. Variable Frequency Drives
   - 4.12. Space Airflow and Temperature Control
   - 4.13. Chillers, Cooling Towers and Condenser Water
   - 4.14. Heat Recovery Systems
   - 4.15. Fume Hoods and Controls
   - 4.16. Laboratory Pressurization Controls
   - 4.17. Building Automation and Controls

4.18. Emergency Generators and Transfer Switches
4.19. UPS and Backup Electrical Power Systems
4.20. Other Special Systems, as Required

5. Commissioning Team Members – On most projects the Commissioning Team shall consist of the following members:
   5.1. Owners Representative (Capital Design and Construction)
   5.2. Third Party Commissioning Authority or Agent
   5.3. Architect and Engineer of Record
   5.4. Mechanical Contractor
   5.5. Electrical Contractor
   5.6. General Contractor
   5.7. Contractor's Commissioning Authority (where applicable)
   5.8. Test and Balance Subcontractor
   5.9. Controls Contractor
   5.10. Other Installers or Suppliers, as needed

6. Responsibilities of Team Members – Each team member shall have specific responsibilities in support of the commissioning process clearly defined in the project specifications, and made a part of the Contract Documents and Requirements.

7. Commissioning Scope of Work – Most projects shall include the following minimum scope of commissioning work in the Specifications, which obligates the Contractor and the Contractor's subcontractors to participate and cooperate with the Commissioning Authority:
   7.1. Provide Submittals and other documents for Review
   7.2. Completion of Installation Verification Checklists
   7.3. Cooperate with Pre-Functional Testing of Systems
   7.4. Participate in Scheduled Commissioning Meetings
   7.5. Respond to Commissioning Issues and Field Reports
   7.6. Provide Other Commissioning-Related Information, as Requested
   7.7. Assist in Conduct of Functional Systems Performance Testing
   7.8. Submit O&M Manual Documentation for Review
   7.9. Assist in Development and Conduct of Owner Training
   7.10. Provide all other reasonable and requested assistance to the Commissioning Authority

8. Contractor Responsibility – The Contract Documents shall require the General Contractor and subcontractors to cooperate, provide labor, materials, supplies and information where required to facilitate (or conduct, in the case of "contractor commissioning") the specified scope of commissioning work. The Contractor shall provide all specified assistance in a timely manner, at no extra cost to the Owner, and shall incorporate all commissioning activities and milestones into the overall Project Construction Schedule. Satisfactory completion and acceptance of all commissioning tests and reports shall be a condition for granting Final Completion of the project. Ideally, all functional performance testing shall be completed in order to

grant Substantial Completion of the project.

9. Project Closeout – Project closeout requirements shall include the review and recommendation of approval by the Commissioning Authority of O&M Manuals and Warranty Information. Project closeout requirements shall include the completion of all testing and submission of all commissioning-related reports, certifications and manuals.

10. Owner Training – Contract documents shall require the Contractor to provide assistance, materials and services required to conduct training of Owner's personnel in the operation and maintenance of all major equipment and controls, and to cooperate with the Commissioning Authority in developing the training agenda and methods.

11. Related Commissioning Specifications Sections:
12. Division 15, Mechanical Systems Commissioning
13. Division 16, Electrical Equipment/Systems Commissioning
14. Division 17, Building Automation Systems Commissioning

Construction Waste Management

1. General**:** Responsible, thoughtful design can greatly reduce the amount of construction waste through use of standard sizes for construction materials, minimization of applied finishes and careful consideration of manufacturing methods.

2. Sustainable Considerations: The diversion of waste materials shall be accomplished through salvage, reuse and recycling as defined in the project specifications with diversion goals set in keeping with LEED standards.

3. Products:

    3.1. Materials to be considered may include:
        3.1.1. Land -clearing debris
        3.1.2. Clean wood, pallet wood
        3.1.3. Plywood, OSB, particle board
        3.1.4. Concrete
        3.1.5. Hokie Stone
        3.1.6. CMU, brick
        3.1.7. Cardboard, paper: VTR can provide scheduled, on-site collection of clean corrugated cardboard packing boxes, and bins for collection by Contractor of sorted office paper, glossy magazines, catalogs, and newspapers.
        3.1.8. Packaging
        3.1.9. Metals: VTR can provide commercial size roll-offs for collection of ferrous and non-ferrous scrap metals, provided jobsite has room. Contractor is responsible for ensuring roll-offs are used for scrap metals only. VTR can provide bins for collection by Contractor of

commingled containers (glass bottles, aluminum cans, plastic bottles #1&#2)

3.1.10. Unpainted gypsum drywall
3.1.11. Paint
3.1.12. Glass
3.1.13. Plastic
3.1.14. Carpet
3.1.15. Acoustical ceiling tile

****END OF DIVISION 1****

DIVISION 2 – SITEWORK

General

The University has developed **Site Development Specifications and Details** which expands upon the requirements of this section. Contact Site and Infrastructure Development to obtain a copy of this information.

Demolition

1. The contractor shall be responsible for satisfying any and all erosion control and storm water management requirements for any land disturbing activities, including but not limited to on-site or off-site borrow, on-site or off-site stockpiling or disposal of waste materials.
2. The contractor shall be responsible for obtaining rights of way to any waste disposal areas for all material not to be salvaged. Contractor shall be responsible for all tipping fees when materials are disposed in a location not provided by the university.

Protection of Existing Structures and Utilities

1. The contract documents shall include language and specific instructions to enumerate all existing structures and utilities within the project limits and the protection and support by the contractor thereof.
2. Where the A/E identifies structures and utilities such as utility tunnels, duct banks, underground piping, etc. be vulnerable to construction traffic, the A/E shall design in plan and crossectional views, detailed protection requirements for the contractor to implement prior to start of construction activities.
3. These details are to be reviewed with and approved by the Utilities Group Department and the Site and Infrastructure Division.
4. The A/E shall design any underpinning or sheet wall retaining solutions, required to support any structures and utilities for insertion into the contract documents.

Site-Preparation

1. Remove all tree stumps, trees, limbs, and rubbish from construction area. Controlled burning shall not be permitted. Stockpile topsoil in an approved area for later use during final grading and restoration.
2. All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths and delivered to the university.
3. The contractor shall remove topsoil from the existing site prior to construction activities to reduce the potential for soil compaction and contamination. Topsoil

shall be stockpiled in areas approved by the university.

Subsoil Preparation

1. Subsoil must be mechanically loosened prior to a minimum depth of 12” prior to topsoil spreading.
2. Remove all extraneous debris from subsoil prior to topsoil spreading.

Pavement Marking

1. Provide paint specifically formulated for use as pavement marking in automobile traffic areas. Parking spaces, crosswalks, and handicap spaces shall be painted white. No yellow or blue paint shall be used on the pavement or curbing.
2. Pavement markings in parking areas shall be 4 inches in width. Pavement markings on streets shall be 6 inches in width, or as otherwise specified on the plans. Lines shall stop 6 inches short of curb and sidewalk edge.

Piping and Fittings

1. Upon completion of the work, the contractor shall provide two sets of record drawings to the university clearly illustrating the as-built elevations of all grades, structures, and pipes installed as part of the construction. The record drawings shall be prepared by and sealed by a land surveyor or professional engineer licensed in the State of Virginia.
2. PVC water main 4” and larger shall be SDR-18, Class 150.
3. Water laterals 3” or smaller shall be ductile iron.
4. PVC sewer pipe shall be PVC SDR 35 or PVC Schedule 40.
5. Plastic marking tape with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep.
6. Tapping sleeves shall be Mueller Mechanical Joint Tapping Sleeves, catalog number H-615, provided by the University and installed by the Contractor.

Valves and Cocks

1. Shop drawings shall include manufactures names, class of materials, pressure rating, catalog, and engineering data showing compliance with the specified requirements.
2. Submit Corrective and preventive maintenance instructions, including recommended spare parts.
3. Gate valves shall have right-hand threads.

Water Systems

1. Domestic water shall be metered with valve assembly to by-pass to meter. Meter shall be furnished by the university and installed by contractor.
2. Backflow Preventors shall be installed at all building service meters and all outside hydrants/sprinklers outlet.
3. Post indicator valve shall be installed on all buildings that are fully sprinkled.
4. #12 Covered Insulated Tracing Wire w/URD, shall be installed/taped to al PVC pipe (domestic and chilled water lines), the length of the pipe, from top of valve box to the building.
5. Anchorage for water lines shall be protected against joint pulling or thrust damage by suitable mechanical joint restraint devices at all joints, fittings and other critical points.

Topsoil Spreading and Seeding

1. Spread topsoil to 4" minimum depth after subsoil preparation
2. Compact topsoil to 80% Standard Proctor
3. Contact Campus Landscape Architect for additional topsoil preparation and seeding specifications or to review acceptability of consultant's topsoil and seeding specifications.

Landscape Design

1. Project architect shall retain a Landscape Architect to provide the university with a complete landscape plan, details, and specifications to be included in the project bid documents, as well as a cost estimate. The Landscape Architect must consult with the Campus Landscape Architect throughout the landscape planning process and as follows:
   - 1.1. Coordinate plant selection with Campus Arboretum Committee.
   - 1.2. Coordinate landscape planning with building stake holders with assistance from the Campus Landscape Architect if required.
   - 1.3. Review landscape specifications with Campus Landscape Architect.
2. Landscape Architect shall consult the **OUA Campus Master Plan** Part Two: Design Guidelines, for discussion of Landscape Guidelines prior to meeting with the Campus Landscape Architect.
3. Landscape Architect must conduct a preconstruction meeting with the landscape

subcontractor. Also provide, at a minimum, one or more inspections during landscape installation and a final landscape installation inspection/ punch list to the contractor and Campus Landscape Architect. Final landscape installation acceptance shall be by the Landscape Architect.

4. The "design to" construction budget will be reduced in accordance with the estimate for landscaping.

Exterior Site Furnishings

1. Trash receptacle - place one receptacle at all major building entrances. Receptacle shall be equal to model ES-142 manufactured by Victor Stanley, Inc. of Dunkirk Maryland (800) 368-2583. Color- dark bronze.
2. Ash urn - place one urn at all major building entrances. Urn shall be equal to model S-20 manufactured by Victor Stanley, Inc. of Dunkirk Maryland (800) 368-2583. Color- dark bronze.
3. Steel Bench - place on 4' x 8' concrete slabs along walks or on plaza areas. Bench shall be equal to model RB-28 manufactured by Victor Stanley, Inc. of Dunkirk Maryland (800) 368-2583. Length- 6'. Color- dark bronze.
4. Bike Loops - place loop groupings in close proximity to off site bike circulation paths and building entrances. Bike loop shall be equal to model BL-36 Bike Loop manufactured by Wabash Valley Inc. of Silver Lake Indiana. (800) 253-8619. Color- dark bronze. For slab sizing and installation details, see **Site Development Specifications and Details** available from Site and Infrastructure Development.

****END OF DIVISION 2****

DIVISION 3 – CONCRETE

Concrete (Cast in Place)

1. Interior and/or exterior structural concrete surfaces shall not be scheduled to receive a sandblasted finish unless specifically approved by the university.

2. Building interior structural concrete painted surfaces shall not be scheduled to receive a rubbed finish. If a smooth plaster-like finish is desired, specify a thin coat of veneer plaster over the concrete substrate.

3. Building exterior expressed concrete structural frame shall be detailed (incorporating insulation and finish systems) to prevent thermal loss or gain.

4. Exposed interior concrete floors shall be sealed. A hardener shall be required where the floor surface is subject to heavy, impact, and/or rolling loads.

5. A sample panel of exterior exposed “Architectural” concrete shall be provided to establish an acceptable standard of workmanship/quality concerning finishing, texture of formed material, etc. The concrete used in the sample panel shall be furnished by the project concrete supplier, and shall represent the approved mix for strength and texture.

6. Exterior concrete flatwork shall be six inches nominal thickness, 3000 PSI air-entrained concrete, reinforced with welded wire fabric located two inches below the top surface. The flatwork shall be placed over a six inch aggregate stone base, and where intermittent vehicular traffic is anticipated, be a minimum of nine feet wide. The top surface shall be broom finished with sawn or tooled joints at a maximum of six feet on-center.

7. All defects, form irregularities or honeycomb shall be repaired immediately upon form removal.

****END OF DIVISION 3****

DIVISION 4 – MASONRY

Hokie Stone

A fully detailed description of these requirements can be found in the Hokie Stone Standards

**** END OF DIVISION 4 ****

DIVISION 6 – WOOD AND PLASTIC

Rough Carpentry

1. General: This section includes but is not limited to dimensional lumber, engineered wood products, plywood, medium density fiberboard, particleboard, and rot and insect resistant wood.
2. Design Considerations: Avoid over harvesting, poor forestry practices and toxic treatment by specifying products from sustainable sources, such as FSC Certified Wood or regionally manufactured from abundant species. Products shall be free of urea-formaldehyde binders, copper or arsenic.

Finish Carpentry / Cabinets / Countertops

1. General: This section includes, but is not limited to interior millwork, paneling, caseworks and countertops.
2. Design Considerations: Avoid depletion of natural resources by specifying wood species from sustainable sources, such as FSC Certified Wood or regionally harvested wood from abundant species. Avoid use of exported or exotic species such as mahogany that are limited in supply or not sustainably harvested. Products shall be free of urea-formaldehyde binders, copper or arsenic.
3. Countertops may include non-wood products such as recycled glass cast concrete, recycled content synthetic cast slabs, regionally quarried stone, biobased materials, recycled plastic solid surfacing or plastic laminates.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Building Insulation

1. Fiberglass batt insulation shall be installed to minimize exposed fiberglass in areas needing to be accessed for inspections, maintenance, etc. Designs shall encapsulate fiberglass using foil or pre-applied backing, plastic or gypsum board covering.
2. Roof insulation shall achieve a minimum of an R-30 rating, for both flat and sloped roofs.
3. Sustainable considerations: Maximize insulation value to conserve energy; avoid insulation containing formaldehyde or ammonium sulfate or foams expanded with hydrochlorofluorocarbons (HCFC's); consider insulation with recycled content

Roofing

1. Flat roofs shall be white in color and have a minimum solar reflectance of 50%.
2. Single-ply roofing systems (60 Mil) shall be specified for low slope (less than 4 in 12 pitch) applications. Fully adhered systems are preferred. Ballasted systems must be approved in advance by the university. Mechanically fastened systems are not acceptable.
3. Ballast (if approved) shall be clean, river washed gravel meeting ASTM-C-136.
4. Specify service walkways (minimum 2'0" wide) appropriately located to service all roof top equipment from the roof access.
5. Flashing between parapet and capstone shall be as specified in the Hokie Stone Standards
6. Gutters and downspouts shall be (minimum) 16 oz/sf copper.
7. Downspouts shall tie directly to underground storm drainage system.
8. Slate shingles, where appropriate, shall be a minimum of ¼ inch thick, weighing not less than 900 pounds per square. Natural slate shall be Buckingham black slate or equal. Synthetic slate may be considered as an alternative. Materials shall be reviewed and approved by Virginia Tech.
9. Provide snow guards over entrances on all roofs with a slope of 6 in 12 or greater.
10. Specify roof hatches that are insulated and lockable.
11. Rating of complete roof assemblies shall be a minimum Class I-60 designed in accordance with FM P7825 (and I-90 rating is preferable). When approved, loose laid ballasted applications shall be designed to withstand wind uplift in accordance with requirements of FM Tech Advisory Bulletin I-29.

**** END OF DIVISION 7 ****

DIVISION 8 - DOORS AND WINDOWS

Exterior Doors

1. All primary entry doors shall be power operated. Operators shall be Electro-Mechanical equal to Stanley Magic Access with power assist option or equal with approval by Virginia Tech. Both doors in a vestibule configuration shall be power operated. If only one door in each pair of doors is operated, then the left hand leaf as viewed from the exterior, shall be power operated. Power operated egress doors shall have electronic strike or latch to allow power operation during times when building is locked. Radio controlled remote actuators shall be wall or post mounted. Post mounting shall manufacturer's standard unit unless otherwise directed by Virginia Tech.
2. Power operators shall have auxiliary contacts to allow for card reader and proximity reader activation of the openers.

Interior Doors

1. Standard **,** 3'-0" x 7'-0" x 1-3/4" birch, stain grade, solid core.
2. All doors in new construction shall have lever handles that comply with ADAAG requirements. When renovation work requires changing door hardware or which hardware change is requested for functional change, all replacement hardware shall include ADAAG compliant lever handles.

Locksets

1. Cylindrical Locksets; Series 4000, Grade 1 (ANSI A156.2), 93K Lever handle with through bolted trim, Round rose - varying in size between 2-9/16" to 3-3/8" or largest available size. Lockset shall be complete with a combinated core and must accept a Best 7-pin interchangeable core. NO SUBSTITUTES.
2. The University Keyshop personnel shall accomplish the final keying and installation of cores. Construction cores may be installed by the Contractor during construction, but must be removed prior to beneficial occupancy.
3. Closers; Equal to Super Smoothy LCN-4040 Regular or Super Smoothy LCN-4041 Handicapped.
4. Panic Exit Devices; Equal to Sargent 9800 Rim type or Sargent 9898 Non-handed. Trim pack determines function. For lever handle application -- Sargent 8800 series with ET outside trim.

Glazing

1. All exterior glass sheeting (tempered or otherwise) shall be “Low E” or “Comfort E.”

Restrooms

1. Mirror Glass/Standard; 18" x 24", vandal proof, with stainless steel frame.

2. Mirror Glass/Handicapped; 18" x 36", vandal proof, with stainless steel frame.

**** END OF DIVISION 8 ****

DIVISION 9 – FINISHES

General

1. General: The preliminary selection of interior finish materials shall take place during the schematic design phase. Informal discussions of finish materials appropriate to the intended project use shall precede a formal *Interior Design Presentation* of interior finish boards by the A/E consultant's interior designer with design input and approval from the Office of the University Architect (OUA). Virginia Tech must then approve the color selections of all finishes.

2. The interior finish boards shall include representative samples of adequate size to visualize colors and patterns. Particular attention shall be given to finishes in public spaces. The finish boards shall be labeled and keyed sufficient to cross reference to a floor plan presentation and finish legend for easy reference.

3. Interior finish selections shall be high quality, durable materials that are manufactured regionally, with a strong preference for Virginia based manufacturers. Specialty or higher end finishes may be acceptable for public spaces as deemed appropriate during the informal discussions during schematic design. Avoid the use of imported materials.

4. Extravagant, costly and/or high maintenance finishes shall be avoided. Finishes or detailing that have minimal tolerances and place unrealistic expectations on the installing contractor(s) shall be avoided.

Paints and Coatings

1. General; Products used in interior spaces shall be top quality coatings with characteristics of scrubbability, hiding power and washability. Do not use flat paint for walls. Avoid the use of deeply saturated colors for walls; accent walls shall be from mid-tone ranges unless otherwise approved in the *Interior Design Presentation.* For walls, ceilings, doors, metal door frames, railings, wood features that require painting water borne paint shall be used.
2. Design Considerations: The use of lighter colors enhances reflectivity and reduces the need for electrical lighting. The selection of zero or low VOC products will help to eliminate problems associated with off-gassing. Provide adequate ventilation during the application and curing of paint. Complete all painting prior to the installation of furniture or other soft surfaces which may absorb off-gassing VOCs. High quality, durable paint products will last longer, extending the future repainting schedule. Specifications shall call for shop drawing submittals to include Technical Data Sheets (TDS) and Material Safety Data Sheets (MSDS) for compliance review for each paint product to be used.
3. Volatile Organic Compounds (VOCs); Products used shall not emit VOCs as defined

by the US Environmental Protection Agency (EPA), measured by weight in grams/liter and listed herein.

3.1. Semi-gloss and gloss -0 to 50 VOC- Low VOC Paint

3.2. Eggshell - 0 to 5 VOC – Zero VOC Paint.

4. Exceptions; Specialty items may require an alternate paint that exceeds the required VOC levels. These items must receive explicit approval from the OUA prior to inclusion in written specifications. When alternate paints are approved, VOC content shall not exceed:

4.1. Oil-Based or soy-based- 0 to 380 VOC
4.2. Waterborne epoxy – 0 to 200 VOC
4.3. Water based polyurethane – 0 to 170 VOC

5. Formulation/ do not use products that contain formaldehyde, halogenated solvents, aromatic solvents or heavy metals.

6. Acceptable Manufacturers: Meeting the above specifications may include but are not limited to Benjamin Moore & Co., Duron Paints and Wallcoverings, PPG Architectural Finishes, Inc., and The Sherwin-Williams Company

Tile

1. General; The use of ceramic tile shall be limited to high profile/high use public areas, restrooms, shower, and locker rooms or other such utilitarian spaces where a durable, aesthetically pleasing floor or wall material is deemed appropriate.

2. Design Considerations: High quality ceramic tile is a long lasting, durable product that is easy to maintain over its lifetime. The use of tiles with high recycled post-consumer and/or post-industrial content is encouraged. The selection of zero or low VOC mortars, grout and sealants will help to eliminate indoor air quality problems.

3. Products: Products used in interior spaces shall be top quality with characteristics of smooth texture, minimum porosity, low absorption, cleanability and slip resistance. All floors and wet walls with ceramic tile shall receive epoxy grout to be waterproof, stain proof, durable and easy to maintain. Floor tile and grout color selections shall minimize the showing of dust and/or footprints. Avoid dark colors, extremely light colors and white or light colored floor grout. Suitable selections for each application may include:

3.1. Unglazed Porcelain Ceramic Tile: 2" x 2” or 3” x 3” porcelain ceramic tiles as manufactured domestically by American Olean, Crossville Inc., or Daltile for use in restrooms and showers on floors.
3.2. Glazed Porcelain Ceramic Tile: 2” x 2”, 4” x 4” or 6” x 6” porcelain ceramic tiles as manufactured domestically by American Olean, Crossville Inc., or Daltile for use in restrooms on walls. Do not use 4 ¼” x 4 ¼” tile.
3.3. Unglazed Quarry Tile: 6" x 6” or 8” x 8” ceramic tiles as manufactured

domestically by American Olean, Crossville Inc., or Summitville for use on floors or walls usually in food service or utilitarian areas.

3.4. Recycled Content Ceramic Tile: 8” x 8” or 12” x 12” ceramic tile as manufactured domestically by Crossville Inc. or Terra Green Ceramics with minimum 55% recycled content for use on floors in restrooms or other public spaces.

3.5. Porcelain Paver Tiles: 12” x 12” or 16” x 16” porcelain paver tile as manufactured domestically by American Olean, Crossville Inc. or Summitville for use on floors in restrooms or other public spaces.

3.6. Grout Joints: Select appropriate products so that installation of larger tiles shall have narrow grout joints (1/8” preferred, 1/4” maximum) to minimize problems associated with cleaning and maintenance.

4. Installation: Careful specification of mortars, mastics, grouts and sealers is necessary to assure the low to zero VOC levels during installation. Require *Technical Data Sheets (TDS) and Material Safety Data Sheets (MSDS) to* assure compliance.

Suspended Acoustical Ceilings

1. General: The use of suspended acoustical ceiling systems is a practical, affordable design approach that promotes noise reduction, allows access to mechanical systems and provides flexibility for changes in the future. Products used in interior spaces shall be top quality mineral fiber panels with a highly reflective, washable surface that are resistant to humidity, sagging, mold and mildew. Suspension systems shall have exposed tee profile fabricated of hot galvanized steel with baked on painted finish.

2. Design Considerations: Specify tiles and grid with high recycled content that can be recycled in the future to minimize resource use.

3. Products: Selections may include, but are not limited to:

3.1. Acoustical Ceiling Tile (ACT): Standard 2' x 2' x 5/8", non-directional, mineral fiber panels, for use in offices, classrooms, conference rooms and corridors. Specify fire rated tiles if required.

3.2. Acoustical Ceiling Tile (ACT): Specialty 2’ x 2’ x 5/8”, non-directional for use in wet areas and laboratories to resist moisture, steam and chemicals. Specify fire rated tiles if required.

3.3. Suspended Grid; Heavy Duty (HD) or Intermediate Duty (ID) exposed tee grid system with 15/16” standard grid dimension or 9/16” narrow grid dimension. Specify fire rated grid if required.

Resilient Flooring

1. General: The use of resilient flooring provides an economical solution for flooring in a variety of areas, including but not limited to corridors, work rooms, copy rooms, offices and classrooms. Resilient flooring selections for laboratories shall meet project criteria for chemical resistance and maintainability. Do not install resilient flooring in restrooms or food service areas. Specify top quality aesthetically pleasing products, with characteristics of cleanability and slip resistance. Color selections shall minimize the showing of dust and/or footprints
2. Design Considerations: High quality resilient flooring is a long lasting, durable product that is easy to maintain over its lifetime. The use of flooring manufactured with high recycled post-consumer and/or post-industrial content is encouraged. The selection of zero or low VOC primers, adhesives and sealants will help to eliminate indoor air quality problems.
3. Products: Selections may include the following choices, be suitable for the particular application.
    3.1. Linoleum Sheet Flooring
    3.2. Rubber Tile or Sheet Flooring
    3.3. Vinyl Composition Tile or Sheet Flooring
    3.4. Rubber Base: Specify rubber cove base, four inches high, using 100 foot rolls. Avoid the use of preformed interior and exterior corners.

Carpet

1. General: The use of carpet provides an economical solution for flooring in a variety of areas, including but not limited to offices, conference rooms, and classrooms. Specify top quality aesthetically pleasing products, with characteristics of cleanability and acoustical properties. Color selections shall minimize the showing of dust and/or footprints. Avoid very light, very dark or solid color carpeting. Avoid the use of cut pile carpeting, instead selecting loop or cut and loop combination for increased durability.
2. Sustainable Considerations: High quality carpet is a long lasting, durable product that is easy to maintain over its lifetime. The use of carpet tiles allows damaged or stained tiles to be replaced individually, without having to replace carpet in its entirety. The use of carpet manufactured from bio-based materials or with high recycled post-consumer and/or post-industrial content is encouraged. The selection of zero or low VOC adhesives and leveling compounds will help to eliminate indoor air quality problems
3. Products: Carpet for high traffic areas shall have smooth surface texture. Selections may include, but are not limited to:
    3.1. Tufted carpet tile (preferred)
    3.2. Tufted roll carpeting (with OUA approval)
4. Characteristics: Selection and warranty criteria as follows:

4.1. Yarn System: 100% Invista Type 6,6; Solutia Type 6,6; BASF Type 6
4.2. Dye Method: 100% Solution Dyed
4.3. Construction: Tufted
4.4. Texture: Textured loop or cut/loop
4.5. Gauge: Minimum 1/10
4.6. Stitches per Inch: Minimum 9
4.7. Pile Weight: 18-20 oz. per yard (high traffic areas) 20-26 oz per yard (medium traffic areas)
4.8. Backing: Polyolefin, polypropylene, polyvinyl butryal or urethane
4.9. Soil/Stain Resistance: Application by fiber producer and manufacturer required
4.10. Warranty for dimensional instability; against delaminating, edge ravel
4.11. 15 year wear warranty
4.12. Should comply with Carpet and Rug Institute Green Label Plus program.

5. Installation:

5.1. It is recommended in renovation projects that existing carpet to be removed shall be removed and recycled through the Carpet America Recovery Effort (CARE) or other approved third party certification programs to divert carpet from the landfill.
5.2. It is recommended that all new carpet to be installed at Virginia Tech shall be received in the installer's warehouse, unboxed or unrolled and left to off-gas for a minimum period of 48 hours prior to delivery to site.
5.3. Upon completion of carpet installation leave remnants with Virginia Tech. Any special spare stock requirements shall be determined on a case by case basis.

**** END OF DIVISION 9 ****

DIVISION 10 – SPECIALTIES

Toilet Accessories

1. Paper Towel Dispenser; Type 300 stainless steel, design for single fold paper towels (quantity 400), key lock, surface mounted, equal to Bobrick B-263.
2. Soap Dispenser; Stainless steel, designed for liquid soap dispensing, dispenser valve front mounted with push action for operation, 40 ounce capacity reservoir, no refill container (must hold bulk soap), top fill, lockable door, equal to Bobrick B-2111.
3. Toilet Paper Dispenser; Stainless steel, with viewing slot to determine quantity of paper left. Dispenser must accommodate a 13” x 4” with a 3” core single ply roll of toilet paper. There shall be tear strips located on two sides of the dispersing slot for the paper to be easily torn from the roll. The dispenser cover shall be lockable and include one key.
4. Surface-mounted toilet paper dispenser in Handicap Accessible Stalls: Surface-Mounted heavy-duty cast aluminum bracket with satin finish, to accommodate two standard-core toilet paper rolls up to 6" diameter Theft-resistant spindles to have concealed locking device and *no controlled delivery*, equal to Bobrick B-2740 or B-27460 in areas with potential for vandalism.
5. Feminine Napkin Vendor Machine; Stainless steel, type 304, satin finish, welded construction, field replaceable door, 18 gage minimum, full length piano hinge, coin mechanism set for $.25 operation, equal to Bobrick B-352.
6. Sanitary Napkin Disposal; Stainless steel type 304, 22 gage, satin finish, surface mounted, cover to have full length piano hinge and bottom unlocks with key, equal to Bobrick B-270.

Toilet Partitions

1. Stall Partitions; Stainless steel, type 302, #4 satin or textured finish, vertically grained, 1" thick and formed of sheet steel that is fabricated into a sandwich construction and laminated to a double-faced honey comb core under pressure. All edges shall be interlocked with a roll-formed edge molding. All corners shall be welded and ground smooth. Corner clips are unacceptable. Stall partitions fabricated from recycled content polymers may be considered as an alternate to stainless steel.
2. Stall Pilasters; Stainless steel, type 302, #4 satin finish and vertically grained, 1-1/4" thick and formed of sheet steel that is fabricated into a sandwich construction and laminated to a double-faced honey comb core under pressure. Face plates shall be welded together at intervals of 18" on center around edge perimeter to insure a rigid

one piece unit. All edges shall be interlocked with a roll-formed edge molding. All corners shall be welded and ground smooth. Corner clips are unacceptable.

3. Stall Pilaster Shoes; 3" high polished 20 gage stainless steel shoe of one piece construction. Tamper-proof shoe assembly with concealed hold down anchor clips. Exposed shoe is unacceptable.

4. Stall Doors; Stainless steel, type 302, #4 satin finish and vertically grained, 1" thick and formed of sheet steel that is fabricated into a sandwich construction and laminated to a double-faced honey comb core under pressure. Face plates shall be welded together at intervals of 18" on center around edge perimeter to insure a rigid one piece unit. All edges shall be interlocked with a roll-formed edge molding. All corners shall be welded and ground smooth. Corner clips are unacceptable.

5. Stall Hardware and Fittings; All doors, panels and pilasters shall be prepared with suitable internal reinforcement and pre-drilled to accommodate all hardware and fittings. Each compartment shall be complete with all hardware, door hinges, door latch, stop and keeper, coat hook and necessary fittings and fastenings for a complete installation.

6. Stall Pilaster and Wall Fittings; Wall and pilaster brackets shall be heavy Zamac #3 chrome plated die casting. The dividing partitions and pilasters shall be attached to wall with two brackets of double EAR or one EAR type depending on wall conditions. Dividing partitions shall be attached to the pilasters with two "U" brackets. All hinge brackets, strike and keeper shall be through bolted,one-way theft-proof heads. All other hardware and fittings to have appropriate screws. All fastenings to have a highly polished finish.

7. Partition Locks; Slide bolt latch equal to SURFACO, 3-1/2" Bet screw #9G0136.

8. Handicapped Grab Bars; Stainless steel sizes to fit layout of room.

9. Provide wall mounted shelving in restrooms to accommodate books, backpacks, etc.

Fire Extinguishers and Cabinets

1. Fire extinguisher cabinets shall be incorporated into all projects as required by code and sized for the required extinguisher.

2. Fire extinguisher cabinet doors shall not be equipped with any type of lock. Only roller latches, or something providing an equivalent level of function, shall be used. Access without a key is required for extinguisher inspections

3. Contract specifications shall identify the extinguisher type and size and note that the extinguishers shall be provided and installed by the University.

**** END OF DIVISION 10 ****

DIVISION 11 – EQUIPMENT

Custodial Closets

1. Key Cabinet; 20 gage steel minimum, baked enamel finish, grey color, concealed hinge, key type lock, 12" x 12" x 2" minimum size, one per building.

**** END OF DIVISION 11 ****

DIVISION 12 – FURNISHINGS

General

1. The *Construction & Professional Services Manual, Chapter 5* describes A/E Basic Services related to interior furnishings. During the preliminary design phase, furniture and equipment plans are submitted to demonstrate the functional use of space. Virginia Tech's design review process includes review and input on these floor plans by the Office of the University Architect (OUA). These plans shall be used as the basis for locating receptacles, switches, data outlets, lighting, etc. during the remainder of the design process.

2. Based upon the above referenced floor plans, the A/E shall provide outline specifications and a budget cost estimate reflecting appropriate vendor pricing (discounts, freight, delivery, installation) for Virginia Tech's use.

3. The A/E contract may be amended to include professional interior design services related to furniture selection and procurement *OR* Virginia Tech may enter into a separate interior design contract defined by Section 507.0 of the *Construction & Professional Services Manual.*

4. The design and procurement process will be thoroughly defined for project. Under the terms of the *interior design contract* particular attention shall be given to furnishings in public spaces.

5. All furniture plans shall be labeled and keyed sufficiently to cross reference to specifications and procurement documents for easy reference.

Sustainable Considerations

1. Furniture selections shall be high quality, durable items that are manufactured within a *500* mile radius of the project site, with a preference for manufacturers with established environmental policies in place.

2. Furniture that is extravagant, costly or with high maintenance finishes shall be avoided. Specialty or higher end furniture may be acceptable for public spaces as deemed appropriate by the OUA.

3. Plan layouts and furniture selections with respect to maximizing daylight and access to views for all building occupants. Consider lower panels and glazed panels for systems workstations. Avoid the use of panels that are 80" or higher that may obstruct adequate air flow and daylight penetration.

4. Furniture items selected shall emit zero or very low amounts of volatile organic compounds (VOCs) to eliminate problems associated with off-gassing and indoor air quality.

5. Furniture and upholstery selections shall include the following design strategies wherever possible:

   5.1. Post-consumer and/or post-industrial recycled content
   5.2. Refurbished furniture, including systems workstations
   5.3. Products with 10 year warranty, 15 years preferred
   5.4. Materials that have been extracted locally or regionally
   5.5. Certified wood products or sustainable species from abundant, local sources
   5.6. Rapidly renewable materials (such as straw, wheat, sunflower board)
   5.7. Non toxic, low emitting adhesives, sealants, paints and finishes
   5.8. Energy efficient task lighting
   5.9. Products/materials free of formaldehyde, halogen, heavy metals, polyvinyl chloride, chlorine, plasticizers, antimony, harmful dyes, topical treatments
   5.10. Products/materials that are safely disposable, recyclable, or biodegradable
   5.11. Fabrics that are durable, minimum 50,000 double rubs, 100,000 preferred
   5.12. Fabrics that are flame retardant, antibacterial, easy to clean
   5.13. If the use of leather is approved, specify only vegetable tanned leather

**** END OF DIVISION 12 ****

DIVISION 14 - CONVEYING SYSTEMS

Elevators

1. Perform work in accordance with the following:
   1.1. ANSI A117.1 Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
   1.2. ANSI/ASME A17.1 – Safety code for Elevators and Escalators.
   1.3. ANSI/UL 108 – Fire Tests of Door Assemblies

2. Submittals shall include shop drawings, schematic wiring diagram, product data and maintenance manuals. Maintenance manuals are required and shall minimally include operating and maintenance instructions, parts listing, recommended parts inventory listing, purchase source listing for major and critical components, and emergency instructions. Provide three sets of maintenance manuals for the Virginia Tech use after approval of all shop drawings.

3. Hydraulic Elevators. Jack cylinder shall be installed inside a PVC pipe. (The PVC jacket is helpful in preventing corrosion to the jack cylinder which shall be provided with dielectric protection. If the jack leaks underground, the PVC jacket helps to contain the hydraulic oil).

4. Prior to Virginia Tech acceptance of the installation, an inspection must be performed and acceptance tests must be witnessed by an independent elevator inspector to verify conformance of elevators and chair lifts with code requirements. Virginia Tech shall employ the services of an independent elevator inspector. Any deficiencies shall be corrected by the contractor at no cost to Virginia Tech. Virginia Tech requires three weeks notification prior to testing to schedule inspector.

5. Elevator shall be provided with a 12 month warranty which begins on the date of Substantial Completion.

6. Hydraulic Elevator. Install piping above ground where possible. If necessary to route underground, cover with permanent protective wrapping before backfilling. Provide shut off valve in machine room for maintenance purposes. Underground hydraulic piping for elevators shall be schedule 80.

7. Full maintenance shall be provided by skilled, competent employees of the elevator Installer for a period of 12 months following Date of Substantial Completion at no additional cost to the Virginia Tech. Full maintenance services to be included under this contract and at no additional cost to Virginia Tech shall minimally include (1) monthly preventive maintenance performed during normal working hours, (2) repair or replacement of worn or defective parts or components, (3) lubricating, cleaning, and adjusting as required for proper elevator operation in conformance with specified requirements and (4) 24-hours-per-day, 7-days-per-week emergency callback service. Exclude only repair or replacement due to misuse, abuse, accidents, or neglect caused by persons other than Installer's personnel.

8. Submittals: Contract documents shall require a letter from the elevator manufacturer (on manufacturer's letterhead) verifying that the manufacturer acknowledges and will comply with all requirements of the specifications relative to repair and maintenance tools. Specifically, the letter shall include language that acknowledges the acceptance of the following:

9. Any and all maintenance diagnostic tools, electrical schematic wiring diagrams and any access codes and passwords required to perform any maintenance function over the life of the equipment such as diagnostics, adjustments or parameter reprogramming shall be provided to the Owner on the Date of Substantial Completion. Tools may be handheld or built into the control system and shall function for the life of the equipment without the requirement to return them to the Manufacturer. Provide complete operations and maintenance manuals and maintenance training manuals including diagnostics instructions for troubleshooting the microprocessor system. The Owner shall not be required to sign licensing agreements related to the us of maintenance or repair tools.

10. It is the intention of the Owner to obtain competitive bids for all maintenance and repair services and material for the elevator provided. Accordingly, the use of proprietary equipment or equipment requiring the use of any proprietary items throughout the life of the equipment is unacceptable. In addition, any special tools, prints, technical data, layouts, hardware, software, etc. required throughout the life of the equipment and which cannot be obtained from multiple suppliers, must be provided by the manufacturer to the Owner at substantial completion of the project.

11. Chair lifts shall not require keys for operation.

12. Elevator equipment rooms shall not be used for access to roofs or other parts of the building unless elevator equipment is fenced or walled in.

13. Traction-type elevators shall have machinery located overhead.

14. Elevator pits shall have sump pumps and adequate drains to prevent the accumulation of water. Drains shall not be connected to building sewers.

15. An emergency telephone will be furnished by the Owner for field installation by the contractor. A 6" x 8" recessed cabinet with door, between 19" and 48" above the cab floor, shall be indicated on the shop drawings.

16. Elevator cab floors shall be rubber floor tile with "lo-disc" raised circular design for a non-slip surface. Acceptable manufacturers include Roppe Rubber Co., Johnsonite and Musson Rubber Co.

17. Provide a sweep on the machine room door to provide for dust protection.

18. Provide all signage as required by applicable codes.

19. Elevators shall be provided with a full ray electronic door detection device. The device shall project detection beams across the full car entrance from the floor to a 72 inch minimum height. When interrupted at any point, the device shall cause closing doors to stop and reopen and enact an alarm buzzer. The doors shall again attempt to close unless the detection beam is activated in which case the doors will reopen. The process shall repeat continuously until the obstruction is removed from

the entrance. Provide a keyed switch in the car operating panel or a toggle switch in the service cabinet that will disconnect the electronic detection device.

20. Residence hall elevators shall have textured stainless steel cab interiors and vandal resistant hall call stations, light fixtures, car stations, position indicators, etc.

21. Provide conduit for analog telephone wiring from the telephone backboard to the elevator controller. Power for the elevator telephone must be on an emergency circuit.

22. All electric motors on elevator or conveying equipment shall be "Premium Efficiency" installed.

23. Hydraulic elevators shall be provided with emergency battery back-up elevator lowering devices such that in a power outage, the elevator will lower to the main landing and doors will open so that entrapped passengers can safely exit.

24. All elevators shall be provided with emergency lighting.

**** END OF DIVISION 14 ****

DIVISION 15 – MECHANICAL

General Provisions

General:

1. Provide access doors for all maintenance items above inaccessible ceilings and into inaccessible walls. If necessary, fire rated access doors shall be used to preserve wall fire rating.
2. All buildings shall contain storage space for a minimum of one complete change of air filters for all HVAC equipment. The storage space shall be dry and (preferably) accessible from the loading dock or service entrance.
3. Accessible doors to crawl spaces shall be located as close as possible to mechanical equipment under floor.
4. Locate filter boxes and other maintainable equipment outside of critical areas served, such as operating rooms, so that items can be serviced without disrupting operations in the room or releasing contaminants into space.
5. Locate humidifiers, fan coil units, terminal boxes, and other equipment containing water over hallways rather than occupied or critical spaces wherever possible. Where necessary to locate such equipment over such spaces, provide secondary drain pans.
6. Provide adequate roof access (stairs or elevator) wherever serviceable equipment is roof mounted. Ladders to roof hatches are not acceptable.
7. Provide control air compressor/filter-dryer for each building. Utilize plant control air where available as a redundant backup.
8. In atriums or other multi-story open to roof areas, maintenance and accessibility shall be a consideration when mounting fans, lights and other equipment above the floor.
9. Condensate receiver and pumps and backflow preventors shall be furnished by the University and installed by the Contractor. Backflow prevention devices shall be installed INSIDE the building.
10. Primary manufacturer/model number to be specified for various types of mechanical equipment is specified herein. Provide a minimum of two additional and equivalent valve manufacturers and model numbers for each primary manufacturer and model number listed.
11. Provide bound, indexed operation and maintenance (O&M) manuals. Manuals shall be organized by systems and fully indexed by equipment type. Must contain original manufacture's bulletins and manuals, copies are not acceptable.
12. Mechanical System Designer shall list building design loads and the installed equipment capacities for heating, ventilation, cooling and domestic hot water on the

first mechanical drawing.

13. Process cooling requirements shall be addressed by a dedicated process cooling system. Process cooling shall not be achieved using the building chilled water system, the campus chilled water system or the building domestic water system.
14. Any new HVAC systems (especially involving 100% outside makeup air) shall include a heat pipe or heat wheel for heat recovery.
15. All HVAC systems installed in excess of 1 hp shall have a variable speed drive on the fan motor.

Pipes and Pipe Fittings:

1. ABS piping is unacceptable.
2. Do not install heating hot water or other similar service piping susceptible to freezing in overhanging soffit areas.
3. On both domestic water and mechanical systems, no sweat connection valves shall be used. Use only flanged or threaded valves.
4. Extra heavy cast iron hub piping shall be used on all sanitary and storm sewer drains that are located under concrete floor slabs or under other inaccessible floor construction. No PVC piping shall be used under floor slabs.
5. All piping on high pressure steam systems (above 15 psi) shall be minimum Schedule 80.
6. All joints on copper pipe 2 ½ inches diameter and larger shall be brazed instead of soldered.
7. Steam, chilled water and hot water piping shall be insulated to minimum standards.
8. No mechanically formed tee connections or couplings shall be used on domestic water piping systems.

Valves:

1. Include sufficient zone isolation/shut off valves in cold/hot water, heating hot water, chilled water, steam and other service piping to allow maintenance and replacement of terminal equipment without shutting down entire building.
2. Install valves on all lines that penetrate the floor from below.
3. Install valves on all branch lines off of main lines.
4. Install valves on all lines at locations such that each floor can be isolated independent of main building.
5. Any equipment such as showers, darkrooms, etc., requiring mixing of hot and cold

water shall utilize a pressure compensated mixing valve rather than a temperature compensated mixing valve.

6. Install control valves where they can be reached from the floor where possible.
7. All valves and steam devices used on steam lines shall be rated for minimum 500 degrees F and 1 ½ times the working pressure.
8. Butterfly Valves: Only high performance type shall be used. Acceptable manufacturers are Bray Series 41, and Xomox. Others only on approval of Virginia Tech.
   - 8.1. High Performance Butterfly Valves shall be double offset design in accordance with ANSI Class 150, 300 or 600, as required and MSS-SP68 “face to face”.
   - 8.2. Blow-out proof stem and in accordance with API 609.
   - 8.3. Full lug end pattern.
   - 8.4. Double Dead-End bi-directional zero leakage must exceed ANSI Class IV leakage standard.
   - 8.5. Valves 2 ½ “ and smaller provided with lock handles
   - 8.6. Valves 3” and larger with manual hand wheel worm gear.
9. Ball valves shall be Xomox Class 150 full port threaded or flanged. No sweat valves are to be used.
10. Any point that the piping of supply and return water is connected on chilled water or heating water there shall be hand valves to isolate each. Control valves shall not be used for isolation.

Piping Specialties:

1. Provide sufficient air vents in chilled and hot water piping systems to easily bleed entrapped air.
2. Pipe chases shall be provided in sufficient size to accommodate maintenance personnel (at least three feet wide). Do not locate pipe chases in custodial closets.

Meters:

1. Provide differential pressure indicator (manometer) for all serviceable filters and locate the indicator where it can be readily observed. Mark on the indicator the "clean" and "replace filter" points.

Pumps:

1. Provide parallel stand-by pump for all primary pumped building systems, such as chilled water, heating and domestic hot water, etc.

2. Pumps shall be Bell & Gossett or equal.
3. Any pump motor installed over 1 hp shall have a variable speed drive.

Mechanical Identification:

1. Mark location of air handlers, fan coil units, mixing boxes, etc., above ceilings with identifying "buttons" to facilitate maintenance through ceiling.
2. Tag roof top exhaust fans and associated fume hood to facilitate maintenance and identification.
3. Utilize standard tag or placard to mark all major equipment. Tag all valves and provide valve chart for each floor.
4. Utilize standard Commonwealth of Virginia color coding for various building service piping and ductwork. Mark each with name of service, direction of flow, and associated unit served where appropriate.
5. All systems handling hazardous materials must have appropriate marking and visual or audible alarms to protect building occupants and maintenance personnel. Mark exhaust fans on roof which handle hazardous fumes with appropriate color code.
6. Mark air handling units with large letters and numbers.
7. All fire dampers shall be numbered and identified on chart in mechanical room.

Mechanical Rooms and Equipment Locations:

1. The Architect/Engineer shall, in the earliest stages of design development, be responsible for establishing and/or verifying programmatic requirements for mechanical rooms in order to:
2. Provide adequate safe access and manufacturer’s recommended working clearances for all equipment.
3. Provide for replacement of the largest piece of equipment without removing permanent walls, large items of equipment or equipment essential to the principal on-going day to day building use.
4. Provide direct access from the exterior for major mechanical rooms exceeding 100 net square feet.
5. In phased projects mechanical rooms shall be sized to include equipment for all the phases.
6. Air handling units, zone control devices, such as VAV boxes, mixing boxes, reheat coils, etc., shall also be located to provide unobstructed access to filters, manual valves, zone control devices and automatic control equipment.
7. Mechanical rooms shall be ventilated by a thermostatically controlled fan
8. Mechanical rooms shall have a floor drain.

9. Access to ducted fan coil units on occupied floors shall be from corridors, rather than through offices, classrooms, laboratory ceilings, or other occupied spaces.

10. The installation of any air handling units with cooling coils above the ceiling level shall include an emergency drain pan installed beneath the unit. This emergency drain pan shall be piped so the occupant can detect any condensate that collects in the emergency drain pan. Such a flow tube shall terminate ½ inch below finish ceiling and match the finish of the ceiling.

11. Equipment mounting stands shall be constructed of steel. Wood stands are not acceptable.

Ventilation

1. Outside air intakes shall not draw in exhaust air from adjacent systems, loading docks, parking lots, emergency generators, chemical storage, sewer manholes, etc.

Air Conditioning

1. Chilled water shall be used as the cooling medium for all new buildings unless specific approval is obtained from the University for an alternate method.

2. For projects in an existing building, if sufficient capacity is available in an existing chilled water system, chilled water shall be used as the cooling medium for any new or renovated spaces.

3. Direct Exchange (DX) systems shall not be used except after specific approval by the university. On DX systems, total refrigerant charge shall be listed on the unit.

4. Glycols and other heat transfer fluids shall only be used in limited systems such as heat recovery loops, or thermal storage systems which serve only a single central station AHU. Use only after specific approval by the university.

5. Water-cooled condensing units using domestic, potable water on a single-pass cycle are prohibited.

Refrigeration Systems

1. Installations shall be complete with dryers, sight glasses, thermostatic expansion valves and thermostatically controlled solenoid valves for pump-down operation (except for capillary tube units). Refrigerant liquid and suction piping shall be type “K” hard-drawn copper. Suction lines shall be insulated. The need for defrosting is not limited to electrical units. In larger installations, hot gas defrost is required. Installation shall be provided with necessary protective devices, including, but not limited to, electrical overload devices, low suction-pressure cutouts, oil traps, crankcase heaters, anti-cycling timers and head pressure control.

2. Main piping fittings for dryers, sight glasses, expansion valves and controls shall be flared. A nitrogen purge shall be maintained while soldering all joints. Copper-

to-copper joints shall be evacuated to 29.5 inches (water) gauge vacuum and held for at least 24 hours under this vacuum prior to charging the system with refrigerant. Refrigerant shall be approved by Physical Plant.

Cooling Coil Condensate

1. Cooling coil condensate shall be piped to sanitary drains.
2. Pumped condensate systems shall not be used.
3. Cooling coil condensate lines shall have cleanouts which allow access of all branches of the condensate drain system.
4. Cooling coil condensate lines shall be minimum 1 ¼ inch ID.
5. Lines less than 1 ½ inch shall be copper instead of PVC.

Chemical Treatment

1. The Architect/Engineer shall coordinate with the Project Manager and the University's Chemical Treatment Consultant as to the required specifications for chemical cleaning and equipment to be furnished by the Contractor. The chemicals to be used by the Contractor for the specified initial treatment shall be furnished by the University. All chemical treatments shall be performed by the University after systems have been cleaned, flushed, and filled.

2. After cleaning and chemically treating the HVAC system, the Contractor shall furnish the University in writing, the following information:

    2.1. Date of initial treatment

    2.2. Type of chemical(s) used for treatment

    2.3. Estimated date that further treatment or testing will be required.

Fire Protection Systems

1. In buildings with sprinklers, fire pumps and/or standpipes, separate water service for fire protection shall be provided, and shall not be through the domestic metered water service.
2. Specifications shall indicate that following the completed installation, Virginia Tech Physical Plant's Fire Protection Specialist and their independent consultant will inspect the installation prior to final inspection and acceptance by the State Fire Marshal and report any deficiencies.

3. In all buildings with fire alarm systems, all control valves, including post indicator and wall indicator valves, shall be electrically supervised by the fire alarm panel. At all locations that control valves are concealed above ceilings or behind access doors, a sign shall be provided on the ceiling below the valve or the access door indicating the location of the control valve.
4. In residential buildings, all control valves that are located in spaces accessible by the occupants of the building shall be provided with lockable tamper prevention devices and locks (that shall be specified by the University).
5. Control valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms and shall be easily accessible. The control valves shall be accessible with the use of no more than a six foot stepladder. Provide 24" x 24" access door for valves located above inaccessible ceiling types.
6. Control valves shall not be installed, above or below ceilings in classrooms, offices, conference rooms or any dormitory living quarters.
7. Each control valve shall be supplied with a sign indicating the area of the building that is served by the valve.
8. At all locations that inspector test valves (ITV) are concealed above ceilings or behind access doors, a sign shall be provided on the ceiling below the valve or on the access door indicating the location of the ITV.
9. Inspector test valves shall only be installed in mechanical rooms, corridors, stairwells, fire pump rooms, sprinkler valve rooms and custodial closets and shall be easily accessible. The ITV's shall be accessible with the use of no more than a six foot stepladder.
10. Inspector test valves shall not be installed, above or below ceilings, in classrooms, offices, conference rooms or in dormitory living quarters or in any area requiring entry through a classroom, office, conference room or any dormitory living quarters.
11. Inspector test valves discharge shall be piped to the exterior of the building.
12. Drain valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms and shall be easily accessible. The drain valves shall be accessible with the use of no more than a six foot stepladder.
13. Drain valves shall not be installed, above or below ceilings, in classrooms, offices, conference rooms or in dormitory living quarters, or in any area requiring entry through a classroom, office, conference room or any dormitory living.
14. Main drains discharge shall be piped to the exterior of the building
15. Auxiliary drain valves discharge shall be piped to a drain capable of handling the discharge at full flow or to the exterior of the building.
16. In addition to building code requirements, in buildings more than two stories tall, all stairways that have an exterior exit shall be provided with standpipes and fire department hose valves on each level.
17. In residential buildings, each fire department hose valve shall be provided with a

lockable tamper prevention device and a lock (that shall be specified by the University).

18. No sprinkler heads from any manufacturer which incorporate a rubber O-ring shall be permitted to be installed in university buildings. If a unique situation exists where a head with a rubber O-ring is the only type that will work, specific permission to use the head must be obtained from the university on a case-by-case basis.

19. The stock of spare fire sprinklers shall correspond and the quantity be in proportion to the types and temperature ratings of the sprinklers in the property.

20. A digital set of as-built sprinkler system plans shall be provided and shall include information for every individual sprinkler head location which identifies the manufacturer, model, temperature rating and date of manufacture for the head that was actually installed. In addition, a digital summary shall also be provided which lists all the individual types of heads installed for the whole building, and the total number installed of each type. It is the responsibility of the sprinkler contractor to verify in the field that the inventory accurately represents the heads that were actually installed. Reliance solely on the approved shop drawings is not acceptable.

Plumbing

1. **Restrooms**
   - 1.1. **Floor Drains;** Installed in all restrooms, centrally located with floor slightly sloped toward drain, 6" inlet with 2" outlet, chrome plated brass or nickel bronze.
   - 1.2. **Water Closet;** Watersaver vitreous china, wall hung, siphon jet, elongated closet bowl with 1-1/2" top spud with 5-1/4" floor to center outlet equal to Eljer Auburn Watersaver Vitreous China #111-1405.
   - 1.3. In all restrooms in new construction and major renovation projects, touchless faucets on lavatories and touchless flush valves on commodes and urinals shall be used. Hrd-wired type shall be installed where practical. Battery pack type shall be used in areas where hard-wired is not feasible.
   - 1.4. Touchless devices shall be as manufactured by Zurn or approved equal.

2. **Hallways**

   - 2.1. **Drinking Fountain;** Specify, wall or surface mounted, fully accessible drinking fountains in corridors; exact locations to be determined during design.

3. **Housekeeping Closets**

   - 3.1. **Service Sink:** Floor mounted, precast concrete or stone construction; 8" maximum height from floor to rim, 24" x 24" (minimum size). Faucet - vacuum breaker, integral stops, spout with pail hook and nose end, top single

brace, renewable units and valve seats, equal to Eljer 749-1200 or 749-1400.

4. **Laboratories**

4.1. Drain and waste lines shall be selected for chemical resistance **and** heat resistance where steam is used as a laboratory medium.

5. **Domestic Water**

5.1. Shut off valves are required on each floor, on take-offs from all vertical risers, and at the connection to each piece of equipment.
5.2. Dielectric fittings shall be used with connecting piping of dissimiliar metals.
5.3. Drain valves shall be installed in accessible locations at all low points in the piping system to permit drainage and servicing.
5.4. No iron pipe or fittings (including galvanized) shall be used in any potable water system.

Heating, Ventilation, and Air Conditioning

1. Indoor design conditions for cooled & heated spaces shall be 74°F dry bulb & 50% relative humidity for summer and 68°F dry bulb for winter. Summer outdoor design temperature shall be 91°F dry bulb and 74°F wet bulb. Winter outdoor design temperature shall be minus (-) 10°F. Design altitude shall be 2150 for all design calculations.
2. Design quantities of outside air for ventilation of occupied spaces shall be as per current ASHRAE requirements.
3. Ventilation rates (No. of air changes) for spaces such as restrooms, mechanical rooms, etc. shall be as per current ASHRAE requirements.
4. Use only steam (not hot water) pre-heat coils on air handlers with high outside air percentage.
5. Provide adequate freeze proofing for all air handling equipment with high percentage of outside air. Provide coils that can be drained.
6. Provide stand-by or redundant equipment, cycled or alternating lead-lag sequence for critical needs (e.g. standby compressors on refrigeration for food storage).
7. Use dual independent refrigeration circuits on HVAC equipment where available, particularly when serving critical areas.
8. Utilize semi-hermetic compressors rather than hermetic compressors for all HVAC/refrigerant equipment larger than 10 nominal tons, where available.
9. Provide minimum 5 year parts and labor warranty on HVAC compressors.
10. Any new or renovated building containing more than one chiller shall have a primary/secondary chilled water pumping system.

11. Aluminum tubing in HVAC coils is unacceptable.

12. All air handlers and fan coil units shall be located with provisions for sufficient space to service units, (e.g., change filters, sheaves, bearings, motors and coils, lubricate components and replace belts).

13. Provide high-limit on steam humidifiers to prevent spraying liquid condensate into duct system.

14. Avoid water coils and piping in rooftop air handling units.

15. Steam traps shall be Illinois or equal.

16. All cooling towers shall be of the induced draft (draw-through) type.

17. Air handling unit fans shall be specified to mid-range speed instead of near maximum. (Units are coming apart at high speed). Units shall be sized so the motor will be smaller horsepower than the maximum allowed for fan size.

18. Specify variable frequency drives instead of vortex dampers for air flow volume control.

19. Piping and conduit shall be run parallel and perpendicular to building structure (walls, ceilings, floors).

20. Drain pans in air handling units and fan coil units shall be double layer insulated, tilted in two directions so it will drain no matter how the unit is set.

21. All Hydronic Control Valves shall be selected with a minimum close-off pressure capacity of 45 - 50 psig.

22. Direct steam heating systems shall be designed for low pressure operation. Typically, coils and heating equipment shall be selected at 5 psi steam pressure to meet required heating capacity. The system shall be designed for operation at 10 psi with relief set at 15 psi. These design conditions apply whether the steam source is the campus low pressure (nominal 15 psi) or the high pressure (nominal 90 psi) distribution system.

23. Drain lines that carry condensate from two or more units shall be minimum 1 ¼ inch diameter. Copper pipe shall be used on lines smaller than 1 ½ inch.

24. No unpumped condensate return lines shall run on an upgrade for either

    steam or air conditioning condensate.

25. Cooling coils shall be selected at a face velocity that will permit all condensate to drain into the drain pan and will not allow blow over.

    On air handling units, heating and cooling coils shall be adequately separated (minimum 15 inches) to properly install the freezestat. When possible, factory install the freezestat across the coil and route to a connection outside of the unit housing.

26. For steam humidifiers located in air handling units or in supply air ducts, the source of steam shall be the Central Campus Steam Plant high pressure line where practical. Factors including the humidifier location relative to the steam lines, first

cost operation and maintenance costs shall be considered in the selection of the humidifier.

27. Except in extraordinary circumstances as determined by the design engineer, air handling units which provide internal isolation for components (fans, etc.) shall not require external isolation.

28. Temperature sensors shall be installed on the discharge side of all coils

29. Steam condensate return lines that have more than one steam trap connected to them shall be 1-1/2" or larger.

30. All equipment used on hydronic systems shall be capable of operating correctly with pressures and flows that the system develops. Valves shall open and close fully and not make noise.

31. Face and Bypass Dampers are required in air handling units that supply 100% outside air and have a steam pre-heat coil.

Variable Frequency Drives

1. Variable Frequency Drives - Three manufacturers to specify – ABB, Allen Bradley, and Square D.

2. All VFD's shall be provided with a manual or automatic type constant speed bypass circuit. The bypass circuit shall be provided in the drive enclosure. A harmonic analysis shall be performed by the drive manufacturer based on the system documentation. Provide this information as a part of the submittal. Provide isolation transformers in a separate enclosure. VFD's shall include input line reactor.

3. Electrical output for variable speed drives shall not exceed 10% THD.

Air Distribution

1. Size restroom grilles and diffusers according to State, Federal and local codes for room size, air quality, etc.; Stainless steel, type 304, or aluminum, satin or brushed finish shall be used.

2. Use care in locating outside air intake relative to exhausts, vents, or other discharges. Do not locate near loading docks, parking areas, or other vehicular traffic areas.

3. Transferred return air for ventilation (second hand ventilation air) is unacceptable.

4. Where fume hoods are present, provision must be made for make-up-air, such as hoods being of the "add-air" or "auxiliary-air" design and including a motor operated shut off valve in the exhaust stack.

5. All fire dampers shall have access doors.

6. Ceiling returns plenums shall not be used. All return air shall be ducted from conditioned building spaces back to air handling units.

7. No interior duct insulation (liner) shall be used.

   7.1. Duct insulation shall be by use of either:

      7.1.1. Exterior duct wrap or,

      7.1.2. Factory fabricated double wall metal duct with solid metal inner wall with insulation between walls or,

      7.1.3. Factory fabricated double wall metal duct with perforated metal inner wall with insulation between walls and 2 mil thick Mylar between inner liner and insulation. (Use this method only where noise is of particular concern)

      7.1.4. All interior air contact surfaces of ducts shall be coated with PorterSept anti-microbial paint, Avron 46 or be constructed with metal treated with AgION anti-microbial compound. (see #14 below)

      7.1.5. Where perforated inner walls are used on double wall duct, the metal perforations are not to be bridged with paint prior to assembly of double wall ducts. Painting shall not be done after assembly to prevent bridging sheet metal perforations.

8. Double wall construction shall be specified for Air Handling Units, Fan Coil Units, Variable Air Volume Boxes or other Terminal Boxes. Insulation shall be between the inner and outer walls. The inner wall shall be solid metal (not perforated) so that no insulation is exposed to the air stream.

9. All interior surfaces of air handling units (excluding coils, fins and fan wheels) shall be coated with anti-microbial paint or be constructed with metal treated with AgION anti-microbial compound.

10. Air filtration shall be minimum 80% efficiency for air handling systems serving general classroom and office spaces. This is typically achieved by using a 30 to 40% efficient 2 inch pleat or panel pre-filter and an 80% efficient final bag or rigid box (cartridge) filter.

11. Keep air handling equipment clean during construction:

   11.1. If equipment is going to be operated during construction, change filters once/month or more often if needed and install filter media over return grilles

   11.2. Keep fan coil units clean by covering inlet and outlet during construction when not in use.

   11.3. Building must be turned over to the University upon project completion with clean air handling equipment and duct systems; including a clean set of air filters installed in the air handling equipment and with a quantity of filters for one additional change left in the building.

12. All interior surfaces of outside air, supply and return air ducts including dampers, turning vanes and extractors shall be treated with an anti-microbial substance (See

#14 below).

13. All interior surfaces of fan coil units, VAV boxes and other terminal boxes, excluding coils and fan wheels, shall be coated with an anti-microbial substance (See #14 below).

14. Acceptable anti-microbial treatments for interior surfaces of ductwork and equipment shall be as indicated below (approved proposed equals will be considered but must be specifically approved by the university):

    14.1. Anti-Microbial Paint – PorterSept Product #3830 by Porter Paint Co.

    14.2. AgION anti-microbial compound treatment for metal duct and equipment, blue coating. Process as provided by Lindab, Inc.

    14.3. Avron 46 anti-microbial coating by Semco, Inc.

15. The application of anti-microbial paint to the interior surfaces of air handling units, fan coil units, VAV boxes and other terminal boxes shall be done at the factory. Field coating of these surfaces is not acceptable. Interior coating of ductwork can either be field or factory applied.

16. Ductwork that is exposed to the weather shall be double wall, smooth inside and out, insulated, with flanged connections. Joints shall be insulated and the outside panel painted with weather resistant paint or be stainless steel exterior.

Laboratory Buildings

1. ”Co-Mingling” or mixing of general laboratory exhaust and exhaust directly from fume hoods is allowable as long as it is accomplished in compliance with any applicable building and life safety codes.

2. Where fume hoods and general room exhaust streams are combined, the duct shall be round stainless steel (Type 316?) ductwork with welded seams and flanged or welded connections. The stainless steel ductwork shall be run from the point of collection (hood connection or room exhaust grille/inlet) to the main riser for that portion of the building. The main duct riser may be constructed of stainless steel or anti corrosion coated galvanized or other suitable materials. Where exhaust streams are NOT combined, only the fume hood exhaust ductwork need be run in stainless steel, coated, or other suitable anti-corrosion materials.

3. No heat recovery wheels (or any other technology which does not completely separate the exhaust and intake airstreams) will be considered for energy recovery building exhausts which handle fume hood exhaust, whether combined or not.

4. Variable air volume control dampers controlling the exhaust flow from fume hoods and general room exhaust shall fail OPEN upon loss of control power or control air.

5. Emergency generators shall be sized to provide adequate power for all exhaust fans serving combined fume hood and general room exhaust systems. Supply air handler outside air intake louvers shall fail or power OPEN to prevent excessive

negative building pressurization upon loss of primary power source. Supply air handlers do not have to be included in emergency generator capacity. Where fume hood exhaust is separate from general room exhaust, only the fume hood exhaust fans need to be included in calculating the emergency generator capacity.

6. Co-mingled or combined fume hood and general room exhaust systems must be considered and designed as "hazardous exhaust systems" in accordance with the International Mechanical Code, and other applicable building and life safety codes.

Cooling Towers

Provide a packaged induced draft cooling tower(s) for installation by Virginia Tech Utilities Group personnel. The cooling tower(s) shall be installed on steel structural support in accordance with manufacturer's installation recommendations.

Design Criteria:

The cooling tower(s) shall have the following design criteria:

1. Location
2. No. Cells x
3. Cooling Water Flow XXXXGPM
4. Entering Water Temp. 95^0 F.
5. Leaving Water Temp. 85^0 F.
6. Ambient Wet Bulb Summer design wet bulb plus 2^0 F.
7. Motor HP xxxHP
8. Motor Voltage/Ph xxx/3
9. Motor Speed RPM xxxx/xxx
10. Guarding: Provide appropriate guards meeting all OSHA recommendations for all rotating and/or nip points.
11. Manufacturers: Acceptable manufacturers shall be Marley, Baltimore Air Coil, Tower Tech or engineered approved equal.

Submittal Information:

Provide the following submittal data as part of the bid response: dimension drawings and installation information, structural requirements, electrical service requirements, performance data, and a complete description of corrosion protection for steel components. The cooling tower(s) shall be induced draft, cross flow, vertical discharge, draw through type, factory assembled.

1. General

    1.1. Structural components of the tower, including the cold water basin, framework, mechanical equipment supports, casing, hot water basins, fan deck, and fan cylinder shall be fabricated of heavy gauge steel (basin and floor shall be a min. 16 gauge and sides shall be a min. 11 gauge), and be protected against corrosion by G-210 galvanizing, or equivalent, that meets the requirements of salt fog testing in accordance with ASTMB 117. Factory welded components shall be hot-dip galvanized after completion of fabrication to a zinc thickness equivalent of G-210. Cold galvanizing will not be acceptable.

2. Basin Sections

    2.1. Minimum 16 USSG galvanized steel

    2.2. Cold water basin with side outlet connections consisting of suction, overflow, and drain piping. Heat tape shall be installed on manual sump drain piping.

    2.3. Condenser water outlet connections with a clog resistant, lift out strainer with perforated openings sized smaller than spray nozzle orifices, mounted in assemble with an anti-cavitation device.

3. Fan Sections

    3.1. Provide single fan propeller type with corrosion resistant cast aluminum blades, adjustable pitch, individually attached to a cast aluminum or cast iron hub.

    3.2. Provide hot dipped galvanized steel fan cylinder with close, but adequate tolerance for fan blade tips.

    3.3. Provide heavy gauge hot dipped galvanized wire grill type fan guard over fan cylinder.

    3.4. Provide fan with vibration switch to de-energize fan in the event of excessive vibration.

4. Fan Bearings

    4.1. Heavy duty roller type bearings integral with gear reducer.

5. Fan Drives

    5.1. Fan shall be driven through helical gear reducer. Gear reducer shall have synthetic rubber oil seals and shall be designed to require oil changes on five year intervals. Speed reducers employing pulleys and belts shall not be acceptable unless manufacturer warrants such speed reducing equipment to be maintenance free for a five (5) year period.

    5.2. All cooling towers shall have variable speed driven fans.

6. Fan Motor

6.1. Motor(s) shall be TEFC, 1.15 service factor, variable torque, and specially insulated for cooling tower duty. Motor shall operate in the shaft-horizontal position and nameplate horsepower shall not be exceeded at design operation

7. Casings

7.1. Casings shall be heavy gauge steel protected against corrosion by G-210 galvanizing, or equivalent, with lapped joints ealed watertight.

7.2. Provide large galvanized steel access doors located in each end wall casing for entry into the cold water basin and fan plenum area. Access doors shall be operable form inside as well as outside the tower

7.3. The tower and all its components shall be designed to withstand a wind load of 30 psf, as well as a Zone 4 seismic load, per UBC. Fan deck and hot water basin covers shall be designed for 50 psf live load or a 200 lb. Concentrated load. Fork lift slots shall be provided to facilitate movement at grade level.

7.4. Provide galvanized steel guardrails, handrails and ladder. Guardrails shall be capable of withstanding a 200 lb. Concentrated load in any direction.

8. Tower fill and drift eliminators

8.1. Tower fill shall be lightweight and manufactured of non-corrosive material.

8.2. Drift eliminators shall be two-pass manufactured of non-corrosive honeycomb type material supported in galvanized steel framing. Maximum allowable drift loss shall be less than 0.2 percent of the water circulated.

9. Water distribution

9.1. Open gravity type hot water distribution basin using replaceable polypropylene or PVC diffusing type metering orifices. Heavy duty flow regulator valves shall be provided at the discharge into each hot water distribution basin to equalize water flows. These valves shall be disc type with cast iron bodies and stainless steel stems. Valves shall be right-angle type precluding the need for inlet fittings.

9.2. Basin cover(s) shall be removable galvanized steel panel(s) supported by basin sides, top of cover flush with basin. These covers shall withstand loads described in paragraph G (3).

10. Basi ı Heaters

10.1. Provide electric immersion heaters and controls to prevent freezing in the collection basin. One or more stainless steel immersion heaters shall be installed in threaded couplings provided in the side of the basin. A NEMA 4 enclosure shall house a magnetic contactor to energize heaters; a transformer to provide 24 volt control circuit power; and a solid state circuit board for temperature and low-water cut-off shall be provided. A control

probe shall be located in the basin to monitor water level and temperature. The system shall be capable of maintaining 40 deg. F. water temperature at an ambient air temperature of –10 deg. F.

Mechanical Systems Commissioning

1. Scope of Work: The Mechanical equipment and systems defined in Division 1 – General Commissioning Requirements will be commissioned. List the project-specific items of Mechanical equipment and systems to be commissioned in this Section.
2. Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
   - 2.1. Mechanical equipment installation verification
   - 2.2. Mechanical system and equipment startup testing, adjusting and calibration
   - 2.3. Mechanical Systems Functional Performance Testing
3. References and/or Standards: List applicable standards and codes that apply to the commissioning of the equipment and systems commissioned in this section.
4. Related Sections: List other sections of the specifications that relate to the commissioning work of this section, and require coordination and cooperation by Contractor and all subcontractors.
5. Sample Forms/Reports: Provide adequately detailed sample forms, checklists and report formats for all commissioning inspections, tests and reports which require the cooperation and assistance of the Contractor and subcontractors for completion.
6. Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.
7. Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work or preparation shall be rescheduled, and all costs of re-testing will be borne by the Contractor.
8. Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

Demonstration of Mechanical Equipment

1. Provide project walk-through, instruction and start-up by Contractor and factory technical representative, where appropriate. Consider video taping instructions for future reference.
2. In individual buildings, only closed loop systems, such as secondary heating water, shall have chemical treatment (chemical treatment for fluids from central systems will be provided at the heating or chiller plant).

**** END OF DIVISION 15 ****

DIVISION 16 – ELECTRICAL

General Provisions

1. Electrical closets and distribution shall be centrally located throughout the building.
2. In atriums or other multi-story open to roof areas, accessibility and maintenance shall be a consideration when mounting lights.
3. Access doors to crawl spaces shall be located as close as possible to electrical equipment under floor.
4. Provide separate electrical and telecommunications closets. Custodial closets shall not be used to house electrical or telecommunications equipment.
5. Provide one duplex receptacle for each stair landing.
6. Corridor wall receptacles (primarily used for floor cleaning equipment) shall be circuited separate from interior office/classroom receptacles.
7. The Contractor shall submit warranties and guarantees in one commercial quality, hardback binder sized to accommodate 8.5 by 11 inch pages, with a table of contents and two (2) copies of each warranty or guarantee. Marked tabs shall separate warranties and guarantees in sections following the order of the specifications.
8. Electrical wiring system shall be designed and installed with as much flexibility as practical and reasonable.
9. In demolition associated with renovations, all wire shall be removed back to the panel board and all accessible conduit shall be removed.
10. Neon and/or cold cathode lighting systems are not permitted for use in exterior lighting systems.

Raceways

1. Minimum conduit size shall be ¾". Flexible metal conduit shall be used only for whips to lighting fixtures and equipment. All empty conduit shall have a 65-lb. test polymer (or equivalent) pull string tied off at both ends.

Conductors

Use of MC cable is not permitted. BX cable is not permitted. (BX cable is a MC cable)

1. All conductors shall be copper. All power conductors shall be awg #12 or larger. Minimum control wire shall be awg #14 and minimum signal wire size no smaller than awg #18. All awg #10 and smaller wire shall be solid conductors and awg #8 and larger wire shall be stranded.
2. Neutrals shall not be under sized.

Wiring Devices

1. All wiring devices shall be industrial heavy duty specification grade, rated a minimum 20A, 125V.

Emergency Generators

1. Emergency generators rated 50KW or less shall be natural gas with propane backup. Fuel tanks shall not be located underground. Propane tanks shall be furnished by Virginia Tech. Emergency generators rated above 50KW shall be diesel.

Service and Distribution

1. One line diagram of electrical system shall be posted in the switchgear room or in vicinity of main distribution panel.
2. Panelboards shall be flush mounted only in areas with grid type ceilings or open ceilings. Do not locate panelboards in custodial closets.
3. Distribution panelboard shall be provided complete with all mounting hardware for mounting any size breaker that the panel will accept and breakers shall be plug-in type.
4. Provide a minimum of one 100 ampere, 30 pole panelboard per laboratory.
5. Provide 50% spare breaker space in each distribution panel in all new buildings. Provide 20% spare breaker space in each panelboard.
6. All panelboard indices shall identify all equipment served by each circuit, (i.e. Rcpt - Rooms 111, 112, 115).
7. Any panelboard spaces shall be fully bussed.

Interior Lighting Systems

1. Standard light fixtures are 2-,3-,or 4-lamp, 2'x4' fluorescent lay-in fixtures with electronic ballasts and T-8 lamps. T-8 lamps shall have low mercury content, a color rendering index of 75 or greater and a color temperature of 4100k in academic and general buildings. High mercury content lamps are unacceptable.
2. Light fixtures shall be selected to permit the use of lamps that are on State contract, readily available from multiple manufacturers and are in typical use at the University.
3. No lighting fixtures shall be specified for which the manufacturer will require a minimum order for the purchase of replacements. Non-catalog and custom lighting fixtures are to be economically justified and avoided whenever possible.
4. Electronic ballasts shall have a minimum power factor of 0.95 and a maximum THD of 10%
5. Ballasts shall be warranted for 60 months from date of manufacture and shall have

harmonic distortion of less than 15%. Ballasts shall be of the parallel lamp connection design such that lamps remain fully lit if any of the companion lamps fail.

6. Virginia Tech requires the use of light emitting diode (LED) lighted exit signs with diffused lenses. Only red lettered exit signs will be used. Exit lights shall be equal to Lithonia Modular xs/xl series.

7. Typical locations for occupancy sensors include small rooms such as individual restrooms, one person offices, and small storage rooms like closets, supply rooms or recycling rooms, areas of rescue assistance and conference/classrooms when possible. Ceiling mounted occupancy sensors shall be provided in conference rooms and classrooms. Wall switches also be provided in conference rooms and classrooms such that lights may be controlled by switches when space is occupied.

8. Locate light fixture schedule on drawings. Schedule shall contain a description fixture, not simply a model number.

9. Use of fluorescent dimming systems is discouraged, except where "daylight harvesting" requires it. Any daylight harvesting system shall be specified as such and shall be furnished by one manufacturer as opposed to components from various manufacturers to create daylight harvesting opportunities. All components shall be standard products in production in the USA a minimum of 5 years. Daylight harvesting systems specification shall also require job specific installation instructions and wiring diagrams for use during installation. Record as-built drawings indicating any changes for these systems shall also be provided upon project completion. When approved, the ballasts shall have a dimming range of 100% to 1%. Ballasts shall have a 5 year warranty.

10. Lighting systems installed shall not exceed 1 Watt per square foot total.

Fire Alarm Systems

1. Fire alarm systems shall comply with the Virginia Tech Fire Alarm Design Standards."

Motors and Controls

1. All motor variable frequency controls shall meet IEEE recommended practices and requirements for harmonic control in electrical power systems. See IEEE standard 519-1992.

2. Motors of ¾ horsepower and larger shall be 3-phase power of the highest available and appropriate voltage. All such motors shall be equipped with permanently lubricated bearings.

3. Motors of 1 hp and larger shall be "Premium Efficiency."

Communication Cabling

1. Conform to Virginia Tech Cabling Standard.

Exterior Lighting Systems

1. Neon lights and cold cathode lighting systems shall not be allowed for exterior lighting applications

Electrical Systems Commissioning

1. Scope of Work: The Electrical equipment and systems defined in Division 1 – General Commissioning Requirements will be commissioned. List the project-specific items of Electrical equipment and systems to be commissioned in this Section.
2. Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
   - 2.1.1. Electrical equipment installation verification
   - 2.1.2. Electrical system and equipment startup testing, adjusting and calibration
   - 2.1.3. Electrical Systems Functional Performance Testing
3. References and/or Standards: List applicable standards and codes that apply to the commissioning of the equipment and systems commissioned in this section.
4. Related Sections: List other sections of the specifications that relate to the commissioning work of this section, and require coordination and cooperation by Contractor and all subcontractors.
5. Sample Forms/Reports: Provide adequately detailed sample forms, checklists and report formats for all commissioning inspections, tests and reports which require the cooperation and assistance of the Contractor and subcontractors for completion.
6. Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.
7. Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work, equipment malfunction or lack of adequate preparation shall be rescheduled at the convenience of the Owner and Commissioning Authority, and that all costs of re-testing will be borne by the Contractor.

8. Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

**** END OF DIVISION 16 ****

DIVISION 17 – BUILDING AUTOMATION SYSTEMS

1. Design heating valves to “fail-open”. In areas where an over temperature condition may be as critical as freezing conditions, provide a high temperature limit to de-energize air handling equipment.
2. Local HVAC controls shall be compatible with existing Siemens Building Technologies, Inc. energy management system (EMS). Level of DDC control to be determined.
3. Provide thermostatically actuated control valves on all radiation (heating) units. This is in addition to outside air reset or zone.
4. Locate thermometers, gauges, etc., where they can be readily observed from floor level. Provide instruments with the appropriate range.
5. BAS design must conform to following Virginia Tech Building Automation System Standards.
6. Unless specifically directed otherwise, Siemens Building Technologies is the sole supplier of building automation systems for campus buildings.

Building Automation Commissioning

1. Scope of Work: The Building Automation equipment and systems defined in Division 1 – General Commissioning Requirements will be commissioned. List the project-specific items of Building Automation equipment and systems to be commissioned in this Section.
2. Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
   - 2.1.1. Building Automation equipment installation verification
   - 2.1.2. Building Automation system and equipment startup testing, adjusting and calibration
   - 2.1.3. Building Automation Systems Functional Performance Testing
3. References and/or Standards: List applicable standards and codes that apply to the commissioning of the equipment and systems commissioned in this section.
4. Related Sections: List other sections of the specifications that relate to the commissioning work of this section, and require coordination and cooperation by Contractor and all subcontractors.
5. Sample Forms/Reports: Provide adequately detailed sample forms, checklists and report formats for all commissioning inspections, tests and reports which require the cooperation and assistance of the Contractor and subcontractors for completion.
6. Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.

7. Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work or preparation shall be rescheduled, and all costs of re-testing will be borne by the Contractor.

8. Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

**** END OF DIVISION 17 ****