



WILLIAM & MARY

CHARTERED 1693

# Facilities Management Technical Standards

April 2019

Edition 2.1

*This publication represents the combined efforts and professional expertise of the directors, superintendents, managers, craftspeople, and other staff members throughout Facilities Management and the Code Review Team. Without their valuable contributions and careful review, the Facilities Management Technical Standards would not have been possible.*



Table of Contents

FOREWORD .....6
INTRODUCTION .....7
GR GENERAL REQUIREMENTS.....8
GR 1 General Information..... 8
GR2 Coordination Requirements ..... 10
DR GENERAL DESIGN REQUIREMENTS .....12
DR 1 DESIGN PRINCIPLES.....12
DR 1.1 University Design Guideline Report:..... 12
DR 1.2 Service Life:..... 13
DR 2 SITE PLANNING .....14
DR 2.1 Building Height..... 14
DR 2.2 Parking ..... 14
DR 2.3 Loading Docks and Service Access ..... 14
DR 2.4 Equipment Screening: ..... 14
DR 3 FUNCTIONAL AND SPACE PLANNING REQUIREMENTS.....15
DR 3.1 Space Guidelines:..... 15
DR 3.2 Room Number Assignment Procedure ..... 15
DR 3.3 Room-Specific Requirements ..... 16
DR 4 BUILDING DEDICATION PLAQUES .....23
DR 4.1 Plaque Development Process:..... 23
DR 4.2 Plaque Style: ..... 23
HP HISTORIC PRESERVATION .....24
HP 1 GENERAL INFORMATION .....24
HP 1.1 State and National Landmarks: ..... 24
HP 2 ARCHAEOLOGICAL CONCERNS .....24
TS TECHNICAL STANDARDS.....25
02 00 00 EXISTING CONDITIONS.....25
02 40 00 Demolition and Structure Moving ..... 25
02 80 00 Facility Remediation ..... 25
03 00 00 CONCRETE .....26
03 30 00 Cast-in-Place Concrete ..... 26
04 00 00 MASONRY .....27
04 20 00 Unit Masonry..... 27
06 00 00 WOOD, PLASTICS, AND COMPOSITES .....27
06 10 00 Rough Carpentry ..... 27
07 00 00 THERMAL AND MOISTURE PROTECTION .....28
07 30 00 Steep Slope Roofing ..... 28
07 40 00 Roofing and Siding Panels ..... 29



---

07 50 00 Membrane Roofing.....	29
07 60 00 Flashing and Sheet Metal .....	30
07 70 00 Roof and Wall Specialties and Accessories.....	30
<b>08 00 00 OPENINGS .....</b>	<b>32</b>
08 10 00 Doors and Frames.....	32
08 50 00 Windows.....	33
08 60 00 Roof Windows and Skylights .....	33
08 70 00 Hardware .....	33
08 80 00 Glazing .....	34
08 90 00 Louvers and Vents.....	34
<b>09 00 00 FINISHES .....</b>	<b>36</b>
09 05 00 Common Work Results for Finishes .....	36
09 20 00 Plaster and Gypsum Board .....	36
09 30 00 Tiling .....	36
09 50 00 Ceilings.....	37
09 60 00 Flooring .....	37
09 70 00 Wall Finishes.....	38
09 90 00 Painting and Coating .....	38
<b>10 00 00 SPECIALTIES.....</b>	<b>39</b>
10 10 00 Information Specialties.....	39
10 20 00 Interior Specialties.....	39
10 30 00 Fireplaces and Stoves .....	40
10 40 00 Safety Specialties.....	40
10 50 00 Storage Specialties.....	40
<b>12 00 00 FURNISHINGS .....</b>	<b>41</b>
12 50 00 Furniture .....	41
<b>14 00 00 CONVEYING EQUIPMENT.....</b>	<b>42</b>
14 10 00 Dumbwaiters.....	42
14 20 00 Elevators .....	42
<b>21 00 00 FIRE SUPPRESSION.....</b>	<b>44</b>
21 05 00 Common Work Results for Fire Suppression.....	44
21 10 00 Water Based Fire Suppression Systems .....	44
21 30 00 Fire Pumps.....	45
<b>22 00 00 PLUMBING .....</b>	<b>46</b>
22 10 00 Plumbing Piping .....	47
22 30 00 Plumbing Equipment .....	48
22 40 00 Plumbing Fixtures .....	48
22 47 00 Drinking Fountains and Water Coolers.....	49
22 60 00 Gas and Vacuum Systems for Laboratory and Healthcare Facilities .....	49
<b>23 00 00 HEATING, VENTILATING, AND AIR CONDITIONING.....</b>	<b>50</b>
23 05 00 Common Work Results for HVAC .....	50
23 10 00 Facility Fuel Systems .....	57
23 20 00 HVAC Piping and Pumps.....	58

---



## Facilities Management Technical Standards

---

23 30 00 HVAC Air Distribution .....	64
23 40 00 HVAC Air Cleaning Devices .....	67
23 50 00 Central Heating Equipment .....	67
23 60 00 Central Cooling Equipment .....	67
23 70 00 Central HVAC Equipment.....	69
23 80 00 Decentralized HVAC Equipment .....	70
<b>26 00 00 ELECTRICAL.....</b>	<b>71</b>
26 20 00 Low-Voltage Electrical Transmission .....	74
26 50 00 Lighting .....	76
26 51 00 Interior Lighting .....	76
<b>27 00 00 COMMUNICATIONS.....</b>	<b>80</b>
<b>28 00 00 ELECTRONIC SAFETY AND SECURITY .....</b>	<b>81</b>
28 10 00 Electronic Access Control and Intrusion Detection.....	81
28 20 00 Electronic Surveillance.....	81
28 30 00 Electronic Detection and Alarm .....	81
<b>31 00 00 EARTHWORK.....</b>	<b>84</b>
<b>32 00 00 EXTERIOR IMPROVEMENTS .....</b>	<b>86</b>
32 30 00 Site Improvements .....	88
32 80 00 Irrigation .....	89
32 90 00 Planting.....	89
<b>33 00 00 UTILITIES.....</b>	<b>90</b>
33 20 00 Wells.....	92
33 30 00 Sanitary Sewerage Utilities .....	92
33 40 00 Storm Drainage Utilities.....	93
33 60 00 Hydronic and Steam Energy Utilities .....	95
33 80 00 Communications Utilities .....	96



***A Vision Statement for the Planning and Design  
of the College of William and Mary  
Buildings and Grounds***

The College of William & Mary occupies a hallowed place in the history of the nation and, more specifically, in the development of the American collegiate campus. The planning and design principles embodied in the early planning concepts of the university established precedents with far reaching influence - a legacy which we will continue and enhance.

These standards enable the technical translation of the concepts contained in the Campus Design Guidelines Report (May, 2003) into state of the art building systems; and, for the first time, codify technical criteria for all future design. These standards express the College of William and Mary application of university unique discretionary criteria/technical options consistent with the requirements of the Virginia Uniform Statewide Building Code. Application of these standards is intended to accomplish the following objectives:

- Codify technical design standards for all building systems.
- Enable consistent and uniform application of standards in all future design.
- Facilitate future operations and maintenance through judicious life cycle engineering which begins with the end in mind.
- Provide a framework that will be adjusted, as required, to keep pace with pedagogical, technological, and regulatory change.
- Create buildings, building systems and supporting infrastructure equal to the quality of our students, faculty and staff, and perpetuate a heritage of excellence.



## Foreword

April 4, 2019

The College of William and Mary **Facilities Management Technical Standards** have been prepared to guide and assist architectural and engineering consultants and Facilities Management staff in the planning, design and preparation of design documents for construction and renovation of the university's facilities.

The Standards in this publication identify specific or unique standards and requirements for university projects and the 'lessons learned' from previous projects. As such, the Standards supplement and are in addition to mandatory codes, industry standards and other authoritative resources applicable under the laws of the Commonwealth of Virginia and the Federal Government.

There may be particular project circumstances that, in the judgment of the Architect or Engineer, warrant alternatives to these Standards. Such recommendations are welcome and will be conscientiously considered. However, unless the university Associate Vice President for Facilities Management (AVP FM) gives special approval for alternatives prior to implementation, the Architect and/or Engineer must comply with the Standards as stated in this publication. Recommendations for alternatives to these standards shall be submitted to the AVP FM in a Determination and Findings format via the Director of Facilities Planning, Design and Construction.

Recommendations are welcome from **Standards** users for additions and modifications. Please submit any comments to the Director, Facilities Planning, Design, and Construction.

For information related to Facilities Management, visit the website

<http://www.wm.edu/offices/facilities/index.php>

A handwritten signature in black ink that reads "Van Dobson".

Van Dobson, P.E.  
Associate Vice President for  
Facilities Management



## Introduction

The **Facilities Management Technical Standards** are intended for the use of architects, landscape architects, and engineers involved in the preparation of construction documents for the university. The Standards are a reference for facilities project managers and other personnel whose responsibilities include implementing institutional lessons-learned through design, construction and in-house services.

The Standards provide procedural and technical requirements broadly applicable to all design and construction. As part of the contractual agreement between the design professional and the university, conscientious application of the Standards is a tool to expedite the design and construction process in a cooperative, partnering effort. In like manner, Facilities Management personnel are responsible for executing the intent of the Standards.

The format of this second edition of the university's Standards is intended to be user friendly, with an emphasis on a pre-design understanding for a partnering effort between architect, engineer, end user, and a variety of facilities personnel under the responsibility of the Project Manager.

These Standards, and any added supplements, shall be followed for all projects unless due process is used for waivers or modifications. It is intended that the Standards be incorporated, not simply referenced, into the design documents.

Periodic supplements to these Standards may be published and distributed to anyone on record as having a copy of the Standards. Individuals interested in being added to or removed from the distribution list for these **Standards** may forward a request to Brittney Breisch at [bbreisch@wm.edu](mailto:bbreisch@wm.edu) or by calling 757-221-5360.



## GR General Requirements

### GR 1 General Information

#### GR 1.1 Application:

The College of William and Mary (W&M) Facilities Management Technical Standards (TS) shall apply to all design projects. The Standards are to be incorporated into the design and construction documents; not simply referenced.

#### GR 1.1.1 Relief from W&M Facilities Management Technical Standards:

The College of William and Mary Facilities Management Technical Standards (TS) are intended to supplement the Virginia Uniform Statewide Building Code (VUSBC) and codify minimum technical criteria and standards to be implemented as applicable in all Facilities Management projects for the College of William and Mary. If for any reason any section of the TS is determined to be impractical to implement, relief from the specific requirement can be requested by submitting a Determination & Finding (D&F) to the AVP FM.

The D&F may be initiated by the consulting Architect/Engineer (A/E) or the University Project Manager (PM).

Signature on the D&F by the A/E is optional, at the discretion of the PM.

#### GR 1.2 Determination and Findings

Determination & Findings (D&F) are used to document and approve:

1. Deviations from and interpretations of the College of William & Mary Technical Standards
2. Interpretations of College of William and Mary Erosion and Sediment Control Standards
3. Code modifications
4. Code interpretations
5. Maintenance Code Official determinations of application of current code to existing structures

#### GR 1.2.2 D&F Responsibility

**Architect & Engineer (A/E) of Record:** Compliance with the VUSBC and the TS is the responsibility of the A/E of record. When compliance is not technically feasible or a determination or interpretation is required, the A/E of Record or University PM shall identify the need and submit the appropriate D&F.

**University CRT:** The University CRT will review submitted documents for compliance with the VUSBC and identify discrepancies not identified by the A/E or University PM. The A/E shall either comply with the identified code or submit a D&F documenting the need and purpose of the deviation.

#### GR 1.2.3 Preparation:

The D&F form shall be prepared by the A/E of Record or the university PM. The preparer shall:

- 1) Identify the type of D&F and approving authority (Note pull down menu in D&F Title)
- 2) Identify all parties who are required to sign the D&F.
- 3) Identify the action requested. The request shall be specific and identify the applicable code or technical standard by name and number.





- 4) Provide all pertinent project information
- 5) Provide background information. The information shall be concise and specific to the request. The reason for the request shall be identified in this section of the D&F.
- 6) Provide the Determination. The determination shall identify the options and the associated pros and cons
- 7) Provide the Finding. The finding shall include the proposed resolution, as well as the reason for the proposed resolution.
- 8) Provide the anticipated impact to project in terms of time and money saved by approving the D&F.

**GR 1.2.4 Approval Process:**

The PM is responsible for submitting the D&F and obtaining the approving signatures for all D&F's within 2 weeks once the need for the D&F is identified. The final approving authority for D&F is:

- 1) Code and Life Safety related issues - CBO
- 2) Erosion and Sediment control issues - Director of Facilities Planning, Design and Construction.
- 3) Technical Standards (W&M Campus) - AVP FM.
- 4) Technical Standards (VIMS Campus) – Director, Facilities Management

**GR 1.2.5 Tracking:**

The Director FPDC shall track and report the status of Determination & Findings to the AVP FM on a weekly basis.

**GR 1.2.6 Blank Form and Examples:**

A blank Determination & Findings form can be found at:

<https://www.wm.edu/offices/facilities/departments-directors/fpdc/forms/>

**GR 1.3 Definitions/Terms**

**GR 1.3.1 University Grounds**

1. **College of William and Mary:** Inclusive of all State owned or leased property comprising the Main Campus and any Satellite Campus representing the College of William and Mary and the Virginia Institute of Marine Science. Agency Codes are:
  - a. 204 – James Monroe's Highland
  - b. 204 – College of William and Mary
  - c. 268 – Virginia Institute of Marine Science
2. **Historic Campus** – Area bounded by Richmond Road, Jamestown Road and the fence to the west of the Wren Building.
3. **North Campus** – Area bounded by the Sunken Garden on the south, Richmond Road on the north, the north branch of Crim Dell on the west, including properties along the north side of Richmond Road.
4. **South Campus** – Area bounded by the Sunken Garden and Crim Dell on the north, Jamestown Road on the south, Lake Matoaka on the west and including properties along the south side of Jamestown Road.



5. **Law School Precinct** – Area bounded by Newport Avenue on the north, South Henry Street on the west, McCormack-Nagelson Tennis center on the south and Colonial Parkway on the east.
6. **School of Education Precinct** – Area bounded by Monticello Avenue to the North, Mount Vernon Avenue to the East, Matoaka Court to the South and Compton Drive to the West.
7. **West Woods** – Area bounded by the north branch of Crim Dell on the east, the main branch of Crim Dell and Lake Matoaka on the south, Brooks Street and Lake Matoaka on the west and the residences along College Terrace on the north.
8. **Old Campus** – Diamond-shaped area around the Sunken Garden bounded on the north by Richmond Road and a line from Blow Hall to the now-closed portion of James Blair Drive, on the east by the Historic Campus, on the south by Jamestown Road and Landrum Drive and on the west by Crim Dell and the now-closed portion of James Blair Drive. This area is split and encompassed partially in the North Campus and partially in the South Campus areas.
9. **Dillard Complex** – Area located at the intersection of Ironbound Road and Longhill Connector, approximately one-and-one-half miles from the main campus.

### GR 1.3.2 Roles & Responsibilities

1. **“Project Manager”** as used in these Standards, unless otherwise defined, is synonymous with “university PM”, the designated Facilities Management person responsible to the Building Committee and university administration for the management of project design and construction within the established scope, budget and schedule. The PM is the university’s designated contact person for the Architect/Engineer.
2. **"Architect/Engineer"** as used in these Standards is the Architect or Engineer of record who contracts with the university as the prime design professional to provide architectural or engineering services for a project. The term includes any associates or consultants employed by the Architect/Engineer of record in the provision of project design services.
3. **“Construction Manager”** as used in these Standards, unless otherwise defined, is the Facilities Management person responsible to the Director, Facilities Planning, Design, and Construction for administration of construction, project inspection, and coordination with other university persons or entities related to utilities, communications, and information technology.
4. **“CRT”** as used in these Standards, unless otherwise defined, is the university team responsible to the Building Official for review of project submissions to ensure that the contract documents are prepared in accordance with applicable codes.

### GR 1.3.4 Order of Precedence:

Where these Technical Standards exceed code or legal requirements, the Technical Standards shall govern.

## GR2 Coordination Requirements

### GR 2.1 Design and Construction Coordination:

The PM serves as the primary contact person for all aspects of each project. The PM, and by extension the A/E and CM/GC, is supported by and work with the following staff members in execution of assigned projects:



## Facilities Management Technical Standards

Aspect of work	Contact	Comments
Code compliance	College Building Official	
Maintainability of finished work	Director of Operations and Maintenance	
Utilities system and connections	Associate Director for Utilities	Primary contact with all utilities providers.
Grounds disturbances and improvements	Associate Director for Grounds and Gardens	
Erosion and sediment control	Director, Facilities Planning, Design, and Construction	
Information technology systems and connections	Chief Information Officer	
Fire safety of finished work	Director of Environment, Health, and Safety	
Occupational safety of finished work	Director of Environment, Health, and Safety	
Spill Prevention, Countermeasures and Control Requirements. (SPCC)	Director of Environment, Health, and Safety	
Lighting near Small Hall	Chair, Physics Department	All new or replacement site lighting in proximity to Small Hall is reviewed by Chair, Physics Department at the schematic design phase.



## DR General Design Requirements

### DR 1 Design Principles

#### DR 1.1 University Design Guideline Report:

The building exterior shall be consistent with the university Design Guideline Report (the Guidelines) referenced in the vision statement at the beginning of these standards. The Guidelines encourage unity in design over time, while simultaneously allowing flexibility for positive innovation.

1. **Architectural Objectives:** Five objectives should be considered in determining the architectural expression of each new building, addition or renovation to create a continuum of design across the campus from east (most traditional) to west (transitional):
  - a. **Unified Architectural and Landscape Character:** The campus architectural and landscape character should be unified. Within this objective, four criteria should guide design:
    - i. Proximity to the Old Campus and/or Jamestown Road
    - ii. Architectural characteristics of the existing neighboring buildings
    - iii. Proposed use and scale of the new building
    - iv. Hierarchical position within the campus plan
  - b. **Preservation of the Old Campus Character:** The architectural configuration and character of the Old Campus should be preserved.
  - c. **Public Space Creation and Circulation:** New public spaces on the campus should be created and connected by clearly articulated pedestrian circulation paths. New public buildings should create and frame new public spaces whenever possible.
  - d. **Removal of Existing Barriers:** Existing barriers to unifying the campus, such as roads and parking should be removed (or at least minimized) wherever possible.
  - e. **Ravine Preservation and Enhancement:** The unique naturalistic attributes of the Ravine intervening within the campus landscape should be preserved and enhanced.
2. **Engineering Objectives:**
  - a. **Fifty Year Building Structures:** Building structures/envelopes shall incorporate materials and detailing consistent with a building life span of not less than 50 years.
  - b. **Optimized Energy Conservation:** Energy conservation and management shall be optimized through a complete and rigorous analysis of life cycle costs.
    - i. Applicability: building envelope, HVAC system selection, and other systems determined by the university
    - ii. Execution: A/E firm using project funds
    - iii. Energy model using Trane Trace, Carrier HAP, Energy Plus or other approved software
    - iv. Inputs: hours of operation; hourly weather data including wet and dry bulb temperature; equipment type and efficiency; set back and set up control set points and warm up / cool down



- v. Outputs: 8,760 hour/year modeling data for base case and any separate option; monthly energy consumption and on-peak demand for the main utilities consumed
- c. **LEED Application:** Environmental sensitivity will be recognized thru application of the LEED process to achieve LEED Silver certification in terms of actual design. Registration and formal acknowledgement of this engineering sensitivity is not required beyond documentation of the LEED points achieved during design.
- d. **Serviceable Considerations:** Serviceability consideration as outlined by ASCE/SEI 7, Paragraph C2.3, latest edition, shall be incorporated into the structural design analysis of new structures.

## DR 1.2 Service Life:

Service life of various buildings and facilities is defined as follows:

1. **Permanent construction:** Permanent construction will be designed and constructed to serve a life expectancy of 50 years or more, will be energy efficient, and will include finishes, materials, and systems selected for low maintenance and low life cycle costs.
2. **Semi-permanent construction:** Semi-permanent construction will be designed and constructed to serve a life expectancy of more than 5 years but less than 50 years (generally a 25 year service life), will be energy efficient, and will include finishes, materials, and systems selected for moderate degree of maintenance using the life-cycle approach.
3. **Temporary construction:** Temporary construction will be designed and constructed to serve life expectancy of 5 years or less, will use low cost construction, and systems selected with maintenance factors being a secondary consideration.



## DR 2 Site Planning

### DR 2.1 Building Height

1. **Maximum Height:** Building height shall be no higher than 45 feet above the highest grade line.
2. **Exceptions:** Where exceptions are granted, the A/E shall confirm with the Federal Aviation Association (FAA) that the building does not interfere with the approach paths to the Williamsburg Community Airport. Written confirmation shall be provided to the university at the Schematic Design Phase.

### DR 2.2 Parking

1. **Prohibited:** Parking under a building and parking within 20 feet of a building are prohibited.

### DR 2.3 Loading Docks and Service Access

1. **Prohibited:** Internal loading docks are prohibited.
2. **Service Access:** In the absence of a loading dock, provisions are to be made to provide service access to the street side of the building. At a minimum one or more service parking spaces shall be provided on the street side of the building.

### DR 2.4 Equipment Screening:

Equipment located at grade level shall be screened from view of other buildings, streets, and walkways.



## DR 3 Functional and Space Planning Requirements

### DR 3.1 Space Guidelines:

The following State Council of Higher Education for Virginia (SCHEV) space guidelines shall be used for the planning of all university facilities:

1. **Vice Presidents:** 300 net square feet (NSF)

Deans, Associate Vice Presidents: 200 net square feet

- a) Includes Assistant Vice Presidents, Directors reporting to Vice Presidents and the President

Administrative and Faculty Offices:

- b) Full Time employees: 110 net square feet

- c) Temporary Employees: Coordinate with PM for allowable square footage

2. Support Spaces (clerical, conference and reception) and Administrative Offices:

- a) 00-05 Full Time Employees (FTE) 30 NSF per FTE, plus 120 NSF

- b) 06-15 Full Time Employees 30 NSF per FTE, plus 200 NSF

- c) 16-25 Full Time Employees 30 NSF per FTE, plus 50 NSF

- d) 25 and over 30 NSF per FTE

3. **Open Office Circulation:** 15% net square feet in addition to normal allowance

### DR 3.2 Room Number Assignment Procedure

- 1) **Approved Room Numbers:** All accessible enclosed spaces must have (SCHEV) room numbers assigned by the Facilities Management's Planning, Design and Construction Department during design. The approved room numbers provided by the PM shall be incorporated in the construction document (95%) submission.
- 2) **Room Numbering Format:** Room numbers must be unique within the building. (This means the entire building, even if the project is an addition). Assign room numbers by floors as follows:
  - a) 0xxx - basement or underground level
  - b) 1xxx - ground or first floor
  - c) 2xxx - second floor
  - d) 3xxx - third floor; etc.
- 3) **Designated Start Point:** Number rooms consecutively from the designated start point. The start point is to be designated by the PM based on the building layout.
- 4) **Even/Odd Room Numbers:** Assign even numbered rooms are on one side of the corridor and odd numbered rooms on the other.
- 5) **All Spaces:** Assign every space a room number, including toilets, janitor closets, mechanical, electrical, telecommunications, and circulation, e.g., vestibules, lobbies, corridors, elevators, etc.



- 6) **Sub-Spaces:** Assign spaces inside rooms the same number as on the hallway door, except with an alpha suffix, e.g., 201 main room, 201A supervisor office, 201B file room, 201J janitor closet, etc.
- 7) **Specialty Rooms:** Assign specialty rooms with suffixes as follows:
  - a) 201E electrical
  - b) 201J janitor closet
  - c) 201M mechanical
  - d) 201P circulation (corridors or lobbies)
  - e) 201T toilet
  - f) 201V vestibule
  - g) 201Z (telecommunications/data)
- 8) **Stairs and Elevators:** Assign room numbers as follows:
  - a) Stairs – floor#ST\_alpha (e.g., 1ST\_A)
  - b) Elevator – floor#ELseq# (e.g., 1EL1)

## DR 3.3 Room-Specific Requirements

### DR 3.3.1 Custodial Rooms

#### DR 3.3.1.1 Primary Custodial Rooms:

Provide one primary custodial room in each building on main level and centrally located to accommodate the size and needs of the building. This room shall be a minimum of 120 SF.

1. **Features to Include:** The primary custodial room shall contain the following features:
  - a) **Open Floor Space:** Open floor space sufficient in area to provide storage for a custodian cart and floor machines.
  - b) **Wall Shelves:** Minimum of two (2) stainless steel wall shelves being approximately 5 ft. long x 14 inches deep with a minimum of 18 inches separation between the shelves; the upper shelf shall not be higher than 6' from the floor.
  - c) **Broom & Mop Hangers:** Broom and mop hangers to be mounted on the wall (number to be determined by size of facility).
  - d) **Lockers:** Space for a minimum of two stacked locker units.
  - e) **Electrical Outlet:** Two (2) GFCI type duplex electrical outlets centered 18 inches above the floor in accessible locations (on wall adjacent to corridor door).
    - i) **Exhaust:** See “23 05 00 - Common Work Results for HVAC” for minimum exhaust requirements.
2. **Items to Exclude:** No plumbing or fire sprinkler system control valves, electric, data, or alarm panels shall be located in any space specifically constructed for custodial services. Custodial rooms shall open on to a hallway and shall not open into a restroom.

#### DR 3.3.1.2 Additional Custodial Rooms:

In addition to the primary custodial room, provide at least one custodial room on each floor including the main level. For initial planning purposes, provide one additional room for each approximately 15,000 SF of





floor area. The final number of rooms and their sizes will be determined after consultation with the Director of Building Services after preliminary layout of facility has been determined by the designer.

1. Features to Include: The auxiliary custodial closets will consist of:
  - a) **Open Floor Space:** Each room shall be approximately 80 SF minimum. Exact locations will be determined by after consultation with the Director of Building Services.
  - b) **Cart Space:** Approximately 20 SF of open floor space to accommodate a custodial cart and equipment.
  - c) **Service Sink:** One floor mounted service sink in back corner of room. Provide heavy duty hot and cold water faucets with backflow preventers or vacuum breakers. Walls surrounding sink shall be ceramic tile and extend four (4) feet high and one (1) foot along each wall from the sink.
  - d) **Wall Shelves:** Minimum of two (2) stainless steel wall shelves being approximately 5 ft. long x 14 inches deep with a minimum of 18 inches separation between the shelves; the upper shelf shall not be higher than 6' from the floor.
  - e) **Broom & Mop Hangers:** Broom and mop hangers to be mounted on the walls (number to be determined by size of facility).
  - f) **Electrical Outlets:** At least one (1) GFCI type duplex electrical outlet centered 18 inches above the floor in accessible location (preferably on wall adjacent to corridor door).
  - g) **Exhaust:** See "23 05 00 - Common Work Results for HVAC" for minimum exhaust requirements.

### DR 3.3.2 Recycling Rooms

1. Where Required: Each floor of new construction shall provide for space for recycling activities. Specific requirements for space will be dependent upon building size, use, and configuration.
2. Preliminary Planning: The following guidelines may be used for preliminary planning:
  - a) Size: 80 square foot room near or adjoining a loading dock or primary service door.
  - b) Shelving: Minimum of one (1) floor space 16 inches by 52 inches to accommodate paper storage shelving in each departmental or functional area. Paper storage is preferred in copy rooms.
  - c) Container Space: Minimum of one (1) floor space 24 inches by 24 inches on each floor of each wing to accommodate recycling waste stream. Beverage container space is preferred in vending, lunch or kitchen areas.

### DR 3.3.3 Mechanical Rooms

- 1) **Programming Requirements:** 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:
  - a) **Adequate Service Access:** Provide adequate safe access and manufacturer's recommended working clearances for all equipment.
  - b) **Equipment Replacement:** Provide for replacement of the largest piece of equipment without removing permanent walls or large items of equipment or equipment essential to the ongoing day to day building use. Stairs, doorways, corridors and louvers intended for this purpose shall be coordinated with equipment requirements. Consideration shall be given to elevator/floor/roof load limitations when considering pathways for equipment replacement.
  - c) **Storage:** Space for storage of mechanical drawings, maintenance manuals, filters and spare parts shall be provided.



- d) **Direct Access:** Provide direct access from the exterior or main corridor for major mechanical rooms exceeding 100 net square feet suited for replacement of equipment and preventing disruption of normal building functions.
  - e) **Outside Air Intake Louvers:** Assure that consideration has been given to the location of air intakes relative to potential contaminants.
  - f) **Phased Construction:** In phased projects mechanical rooms shall be sized to include equipment for all the phases, including temporary equipment locations during the construction process.
- 2) **Room Requirements:** Mechanical rooms shall be provided with the following:
- a) **Ventilation:** Mechanical rooms shall be ventilated by a thermostatically controlled fan to maintain a maximum 10° rise above outdoor ambient.
  - b) **Heating:** Heat to a minimum of 55° DB
  - c) **Plumbing Requirements:** Provide a minimum of one hose bib and floor drains equipped with basket strainers as necessary to accommodate equipment condensate as well as blow down, drain down and cleaning operations.
  - d) **IT Communications:** Mechanical equipment rooms shall be provided with wireless communication to the Campus network for communication with the building automation system or ethernet jack(s) in locations coordinated with IT.
  - e) **Electrical Requirements:**
    - **Lighting fixtures** shall be coordinated with mechanical systems and equipment to remain serviceable and provide the intended lighting levels. Motion activated lighting is prohibited.
    - **Convenience outlets** shall be provided at major pieces of equipment and at intervals of no greater than 25 feet.
  - f) **Fire Rating Requirements:**
    - In existing mechanical rooms, no project or renovation shall reduce the fire rating of existing mechanical rooms, regardless of code changes which would allow a lower rating.
  - g) **Sprinkler Requirements:** All new and renovated mechanical systems shall be coordinated with sprinkler systems to allow for intended spray patterns. Sprinkler heads shall be relocated or new heads installed to account for obstructions.
- 3) **Attics:** When attics are used as mechanical equipment rooms, the following shall apply in addition to the requirements outlined above:
- a) **Allowable Equipment:** Attic spaces may be used for air handling equipment, small inline pumps, control and electrical panels and transformers.
    - When air handling units are located in attics, zone control devices, such as VAV boxes, mixing boxes, reheat coils, etc., shall also be located in the attic rather than in the ceiling of occupied spaces below provided there is sufficient space.
  - b) **Prohibited Equipment:** Compressors, condensers, and distribution pumps shall not be located in attics and where practical shall be located on grade to minimize vibration transmitted to the building structure.



- c) **Access:** Attic spaces shall be accessed from interior stairs. Where practical, elevator access shall be provided. Folding stairs, ships ladders and alternating tread ladders are not allowed.
- d) **Floor Moisture Detectors:** Attic mechanical spaces shall be equipped with floor moisture detectors tied to the building automation system.
- 4) **Equipment Platforms:** Equipment platforms located in attics, high bays and similar locations shall be provided with OSHA compliant guards.
  - a) **Access:** Provide clear access unimpeded by building components such as pipes and conduits. Access shall be by stair, ships ladder or permanent ladder. Alternating tread ladders are not allowed. Portable ladders shall be allowed provided ceiling access (where applicable) and floor space allows for OSHA compliant use.
  - b) **Platform Requirements:** Requirements for equipment replacement, sprinklers, IT communications, lights and convenience outlets outlined above shall apply.
- 5) **Ladder Accessed Equipment:** Unobstructed accesses to filters, manual valves, zone control devices, automatic control equipment, etc., shall be provided.
  - a) **Equipment Located above Finished Ceilings:** Serviceable equipment and valves shall be located within 24" of finished ceilings.

#### DR 3.3.4 Vivarium

- 1) **Criteria:** Vivarium and other research or clinically related animal holding facilities are required to be designed to meet accreditation requirements of the 'AAALAC', including architectural, mechanical, electrical and plumbing standards established by the current edition of the 'Guide for the Care and Use of Laboratory Animals', available from National Academy Press <http://books.nap.edu/catalog/5140.html>. AAALAC International is a private, nonprofit organization that promotes the humane treatment of animals in science through voluntary accreditation and assessment programs. AAALAC stands for the "Association for Assessment and Accreditation of Laboratory Animal Care." See web link: <http://www.aaalac.org/index.cfm>

#### DR 3.3.5 Class Rooms

- 1) **Equipment:**
  - a) Projection Screens:
    - Provide a minimum of two screens per classroom, lecture and seminar rooms.
    - Note all dimensions and angles on the construction documents to allow exact placement to avoid wall mounted projections such as light switches, chalk boards, etc.
- 2) **Furnishings:**
  - a) Windows and Window Coverings:
    - Provide dual layer shades (opaque and translucent) at exterior windows.
    - Provide vertical sunlight shields between adjacent shades and mount tightly to window frames to prevent light spillage from washing out the projection screens.
    - Shades with plastic operating parts are not allowed.
- 3) **HVAC:**
  - a) Maximum Noise Criteria (NC):
    - Ambient: Max NC = 30
    - At Diffusers, Grilles and Registers: Max NC = 20



### **DR 3.3.6 Residential Dormitories, Sororities and Fraternities**

- 1) **Use Group Requirements:** All new Residential dormitories, Sororities and Fraternities shall be designed to both R1 and R2 use group requirements. Facilities undergoing major renovations shall be made to comply with the greatest extent practical.
- 2) **Individual Thermostat Control:** Each bedroom space will be provided with occupant controllable individual thermostatic control. Common spaces with similar heat gain/loss characteristics shall be allowed to be zoned together.

### **DR 3.3.7 Information Technology and Communications**

#### **DR 3.3.7.1 Telecommunications and Server Room Requirements**

- 1) **Dedicated Use:** Equipment rooms shall be dedicated for information technology and telecommunications use (telephone, data and entertainment video services). These rooms shall not be used to support any other building utility.
- 2) **Room Size:** Equipment room sizing shall be coordinated with the IT Department through the PM. Equipment rooms shall be sized for the projected number of outlets served including not less than thirty-three percent growth in addition to all auxiliary equipment approved to be installed in the room.
  - a) **Minimum Room Size Requirements:**
    - A minimum size of 7'-0" x 9'-0"
    - A 7'-6" minimum clear height; 9'-0" preferred
- 3) **Ceilings:** No suspended or false ceiling unless required by building code construction requirements
- 4) **Doors:** A lockable 3'-0" minimum width, 6'-8" minimum height door opening out unless prohibited by building code requirements for fire exit access passage width.
- 5) **Lighting:** 50 foot-candles illumination level at 3'-0" above floor, mounted 7'-6" minimum clear above floor (no wall mounted light fixtures)
- 6) **HVAC Requirements:**
  - a) **Independent HVAC Systems:** Cooling systems provided for critical Information Technology systems and server systems (those serving as a central hub for other buildings) shall be independent of regional and building chilled water systems.
  - b) **HVAC Capacity:** Capacity to maintain ambient room temperature over the range 64 to 85 degrees F, 30-75% relative humidity, positive pressure with air exchange sufficient to dissipate heat generated by equipment (typically not less than 2500 watts)
  - c) **Redundant Capacity and Standby Power Requirements:** The University PM together with the building committee and design team shall evaluate the nature of the IT/server equipment to determine the need for redundant capacity and standby power requirements. The decision shall be included in the Basis of Design at the schematic submittal phase.
- 7) **Mounting Board:** Fire-treated ¾" type A-C plywood from floor to 8'-0" above finish floor on three walls.



- 8) **Rated Penetrations:** Provide fire rated pathways from telecommunication rooms to accessible ceiling space and from floor to floor. Fire rated pathway shall be equal to that manufactured by EZ-Path or legrand/Wiremold Flamestopper.

#### **DR 3.3.7.2 Telecommunications Room Location and Connectivity Requirements**

1. **Vertical Stacking:** Telecommunications rooms shall be stacked vertically where possible and be interconnected by bushed sleeve floor penetrations extending 1” above the floor.
2. **Horizontal Connectivity:** Be interconnected horizontally at minimum of every three floors with a cable tray above suspended ceiling or conduit where ceiling is not accessible, with a run distance not exceeding 295 feet.
3. **Maximum Cable Run:** Be within 295 feet of cable run distance of the most remote site (multiple rooms required where this distance cannot be achieved with one room).

#### **DR 3.3.8 Stairways**

1. **Riser and Tread Construction:** All stairs that are not a means of egress shall be constructed to the same criteria as a means of egress stair.

#### **DR 3.3.9 Family/Gender Neutral Restrooms**

1. **Family/Gender Neutral Restrooms:** Family/gender neutral restrooms shall be provided for all new construction and major renovation projects. A minimum of one family/gender neutral restroom shall be provided per building with a preference for one family/gender neutral restroom per floor.
  - a) **Minimum Requirements:** All family/gender neutral restrooms shall be equipped with and meet the following minimum standards:
    - **Accessibility:** Shall be fully handicap accessible.
    - **Changing Table:** Provide a changing table.
    - **Seating:** Seating shall be provided for nursing mothers and/or care givers.
    - **Security:** Shall be lockable from the inside.
    - **Toilets:** Use only toilets; no urinals
    - **Signage:** All family/gender neutral restrooms will have a sign that says: “Family/Gender Neutral Restroom”

#### **DR 3.3.10 Unfinished Space**

1. **Services:** Space designated as unfinished in new construction shall have plumbing, HVAC and electrical utilities stubbed to minimize disruption should they be finished at some later date. Carpet or other method of dust control shall be installed in the unfinished space at doors separating unfinished from finished space.

#### **DR 3.3.11 Rooftop**

- 1) **Prohibited Roof Mounted Equipment:** Rooftop mounted equipment (excluding cooling towers, fume hood exhausts, power roof ventilators, and similar equipment functionally required on roof tops) is prohibited. Adequate space for building systems equipment shall be provided within the building envelope and specifically noted during programming and schematic design.



- 2) **Maintenance Considerations:** Where rooftop mounted equipment is approved or necessary there shall be considerations for access carrying maintenance tools and equipment, replacement of the equipment, and lighting for night maintenance or repair.
  - a) **Equipment:** Elevated rooftop equipment shall have permanently installed ladders and platforms to provide access to all access doors and items that require maintenance. Ladders, platforms and cages, where appropriate, shall be provided in accordance with VOSHA Standards.
- 3) **Roof Access:** Roofs with mechanical or electrical equipment shall have access by an enclosed stairway except in renovations where impractical. Ladders and a hatchway may be used for access to roofs without rooftop equipment. Ladders and cages, where appropriate, shall be provided in accordance with VOSHA Standards.
- 4) **Roof Walkways:** Rooftop mechanical and electrical equipment shall be accessible by durable walkways to protect the roofing during required maintenance or repair. Service walkways shall not be less than two feet wide and shall extend six feet from the equipment on sides requiring service or repair accessibility.
- 5) **Equipment Screening:** Roof top equipment, where permitted by exception, shall be screened from view of other buildings, streets, and walkways.

### **DR 3.3.12 Building Material Storage Space**

1. **Space:** Configure available attic, basement, or building void space for storage of building materials to be turned over by the contractor following completion of the project. Approximately 100 square feet is sufficient for most buildings.



## DR 4 Building Dedication Plaques

1. **Where Required:** Building plaques shall be installed in all new buildings, additions with major entrances, and major renovations.

### DR 4.1 Plaque Development Process:

1. **Initiation of Plaque:** Text for building plaques will be drafted by the Senior Vice President for Finance and Administration.
2. **Review:** The Executive Assistant to the President will review the draft and make changes, as appropriate, and will review plaque with the President, who has final approval of all plaque text.
3. **Execution:** The Office of Finance and Administration will execute production of the plaque. The office will determine the location of the plaque in consultation with a departmental representative, if appropriate. The office will originate the work orders to have the plaque installed.

### DR 4.2 Plaque Style:

1. **Type of Plaque:** Cast bronze (unless building trim is aluminum or pewter)
2. **Letter Style:** ITC New Baskerville- all letters capitalized
3. **Color:** Black with single line/bevel edge
4. **Background:** Leatherette



## HP HISTORIC PRESERVATION

### HP 1 General Information

**Intent:** Historical preservation is a major consideration at William & Mary. The following is a list of buildings within the “Historic Campus” and “Old Campus”

1. **Historic (Colonial) Campus**
  - Brafferton and Brafferton Kitchen
  - Presidents House and Support Buildings
  - Wren Building
  - Wren Dependency Building North and South
2. **Old Campus**
  - Barrett Hall
  - Blow Hall
  - Chandler Hall
  - Ewell Hall
  - James Blair Hall
  - Jefferson Hall
  - Landrum Hall
  - McGlothlin-Street Hall
  - Old Dominion Hall
  - Tucker Hall
  - Washington Hall

#### HP 1.1 State and National Landmarks:

1. **Background:** The Sir Christopher Wren Building, the cornerstone of the colonial campus, was designated a National Historic Landmark in 1960 and placed on the Virginia Landmarks Register in 1969. The colonial campus is part of the Williamsburg Historic District, which is listed on both the Virginia and National Landmark Registers.

### HP 2 Archaeological Concerns

- 1) **Intent:** The University has from time to time discovered subsurface archaeological materials requiring immediate and expedient investigation as to their merits and the means by which they will be removed and/or preserved. If the Contractor unearths material that appears to be of archaeological interest, he shall cease work in the immediate vicinity and notify the university PM or Construction Manager immediately.
  - a) **Archaeological Investigation:** It is the university’s responsibility to advise the Architect/Engineer of known or potential sites having archaeological significance, as well the intent of the university to perform an archaeological investigation. The Architect/Engineer shall request confirmation from the PM.
  - b) **Discoveries During Construction:** In the event of a discovery during construction, the PM will make provisions for site investigation.





## TS Technical Standards

Technical standards are organized in accordance with the Construction Specifications Institute Master Format standard.

Only those sections where specific details are warranted are included in the Technical Standards.

### 02 00 00 Existing Conditions

#### 02 40 00 Demolition and Structure Moving

##### 02 41 00 Demolition

1. **Tree Removal:** All tree removals require prior approval by the AVP FM.
2. **Paint Removal:** Paint removal by open flame shall not be permitted. Where paint is removed by a heating process, a fire extinguisher must be available at the work site.

#### 02 80 00 Facility Remediation

##### 02 83 00 Lead Remediation

1. **Existing Conditions:** Many of the university's older buildings have lead based paint. Prior to any project that may disturb existing lead based paint, a project specific hazmat survey shall be conducted and provided to the Architect/Engineer. Where the Architect/Engineer has technical cause or concern that lead paint exists on a project, the university PM shall be notified in writing.
2. **Coordination with the University's EHS Office:** Lead paint surveys and removal shall be coordinated with the university's EHS Office.



## **03 00 00 Concrete**

### **03 30 00 Cast-in-Place Concrete**

- 1) **Exposed Concrete Floors:** All exposed concrete floors shall be sealed. Provide a sealer hardener in high-traffic areas, or where the floor surface is subject to heavy, impact, and/or rolling loads.



## 04 00 00 Masonry

1. **Prohibited:** The use of metal stud framing in brick veneer exterior walls is prohibited.

### 04 20 00 Unit Masonry

1. **Parapet Walls:** All parapet walls up to 3'-0" height above roofing shall be flashed from coping to roofing. The inside face of parapets exceeding 3'-0" height above roofing shall be brick faced or faced with an approved exterior material other than exposed concrete masonry units.
2. **Veneer Masonry:** Face brick and other masonry veneers shall be backed with masonry units.
3. **Stone and Slate:** Cut stone, rough stone and slate shall be used only for trim, not as the basic wall material.
4. **Masonry Thresholds:** Brick or stone thresholds, in conjunction with metal thresholds, shall rest entirely on the building foundation walls. Masonry thresholds shall not bear directly on a floor system or floor system components.
5. **Water Repellent Coatings:** Water repellent coatings on above grade masonry shall not be used.
6. **Cladding/Siding:** Brick cladding the standard for all buildings. Other siding materials are acceptable only in ancillary building surface areas such as dormers.
7. **Flashing:** All through wall flashing shall be 16-oz. minimum copper or equivalent fabric coated copper. Dead soft stainless steel may also be used. Other metals or vinyl flashing shall not be used.
8. **Coping Flashing:** All coping flashing shall be through wall type.

### 04 21 00 Clay Unit Masonry

1. **Brick Types:**
  - a) **Historic Campus:** Wood mold brick or soft-mud brick in standard size and conforming to ASTM C216 shall be used on all university buildings that are part of the historic campus.
  - b) **Non-Historic Campus:** Wire cut brick conforming to ASTM C216 may be used for all university projects that are not part of the historic campus. Unless otherwise approved all brick used shall be Grade SW, Type FBS, and minimum average compressive strength 3000 psi. Minimum Net Area Assemblage Compressive Strength shall be 1500 psi.
  - c) **Existing Buildings:** Additions to existing buildings shall match the existing brick in size, color, and texture.
2. **Existing Brick:** Removal of existing brick for use on additions or renovations shall be carefully executed to prevent cracks, splits, spalls and damage to the surface integrity of the units.

## 06 00 00 Wood, Plastics, and Composites

### 06 10 00 Rough Carpentry

1. **Blocking and Miscellaneous Carpentry:** Panel materials shall be plywood, not oriented strand board (OSB) or particleboard. All wood blocking and panel materials that contact masonry, concrete, or ground



shall be pressure preservative treated. Screw-type fasteners shall be used to fasten wood to wood, or wood to masonry.

## 07 00 00 Thermal and Moisture Protection

### 07 30 00 Steep Slope Roofing

1. **Slope:** Roofing systems for new construction or additions typically shall be sloped roofing systems.
2. **Materials:** Where applicable to existing buildings or so established by the design criteria, steep-slope roofing is governed by the following material choices. Types of roofing systems permitted:
  - a) **Slate:** When designing an addition to an existing building or partially replacing slate roofing on an existing building that has slate shingles, new slate shall match the existing.
    - (1) Specify genuine unfading blue-black slate, ASTM C406, Grade S-1, of size, thickness, texture, exposure style, shape and color to match existing. Unless specifically established in design criteria, new slate roofing shall be similarly specified. All slate shall be hard, dense, sound, and rock punched for two nails.
    - (2) No cracked slate shall be used. No broken corners on covered ends shall be allowed. All exposed corners shall be partially full. Slate used at the university is typically 3/8" thick nominally, with face dimensions of 10 inches wide by 16 inches long. No corner break shall exceed 1/2" in either dimension. Slates shall have the following physical properties:
      - (a) Modulus of rupture: 9,000 psi per ASTM C120
      - (b) Water absorption rate: 0.25% per ASTM C121
      - (c) Depth of softening/acid resistance: 0.001 inches per ASTM C127
    - (3) 60 mil, self-adhesive polymer-modified bituminous sheet ice and water barrier, with slip resistant mineral granule surface, shall extend continuously from outer edges of eaves, gutters, and rake edges to a point at least 24" inside the line of the exterior wall below, 30" from roof penetrations, and 18" to both sides of valleys using a single 36" wide sheet.
    - (4) Closed valleys are prohibited.
    - (5) New slate roofs shall be installed over 3/4" tongue and groove, solid lumber decking or 3/4" plywood with H-clips.
  - b) **Metal:** Acceptable materials include:
    3. Aluminum or steel architectural standing seam, manufactured roof panel system with Kynar finish.
    4. Copper, field-formed double-lock standing seam.
      - a) **Shingles:** Excluding slate shingles, shingle roofs including wood shingles and shakes, are seldom used on university projects. Exceptions include in-kind replacement of existing roofing. If approved, three-tab fiberglass or dimensional shingles may be used.

### 07 31 00 Shingles and Shakes

1. **Warranty:** Minimum manufacturer's warranty for three-tab fiberglass or dimensional shingles is 25-year warranty.



## 07 40 00 Roofing and Siding Panels

### 07 41 00 Roof Panels

1. **Warranty:** Minimum manufacturer's warranty for pre-formed metal panel roofing systems is 20-year, non-prorated water tightness and finish warranties.

### 07 50 00 Membrane Roofing

1. **Membrane:** The following low-slope membrane roofing systems are allowed:
  - a) **Ethylene Propylene Diene Monomer (EPDM):** EPDM shall be a black single-ply, 60-mil thickness fully adhered system. A reinforced membrane is preferred and shall be used where there is high grease content of exhaust air at roof level. If a ballasted system is approved, it shall be designed to withstand a 100 mph wind load. A mechanically fastened system is prohibited.
  - b) **Built-up:** Built-up Roofing shall be asphalt bitumen, 4-ply minimum system with aggregate surfacing.
  - c) **Hybrid:** Hybrid Roofing shall be a 4-ply asphalt built-up roof, with a granule surfaced modified bitumen cap sheet having a minimum cap sheet thickness of 150 mils.
2. **Prohibited:** The following roofing systems are prohibited:
  - a) Sprayed-on polyurethane foam
  - b) Modified Bitumen systems, with the exception of the hybrid system above)
  - c) TPO: Thermoplastic Olefin (polyolefin)
  - d) Cold applied roof systems
  - e) Roof systems that are torch applied
  - f) Protected Roof Membrane (PRM) systems, also referred to as inverted roof assemblies
3. **Prohibited:** Application of a new roofing system over an existing system (roof-over) is prohibited.
4. **Materials:** Obtain primary and secondary roofing and insulation materials from the roof system manufacturer to ensure a single source responsibility for entire roofing system.
5. **Warranty:** Minimum manufacturer's warranty period for low-slope roofing systems is 20- year, no limit, full system warranty.
6. **Uplift Rating:** Low-slope roofing assemblies shall have a wind uplift rating of Class I-90.
7. **Insulation:** Maximum single board thickness for flat insulation shall be 2-inches. Polyisocyanurate board insulation shall have a nominal average compressible strength of 25 psi. Material provided shall be labeled to show compliance with this requirement. Board insulation shall be installed with a minimum of two layers. The first layer shall be set with the long joints in a straight line and the end joints staggered in running bond. Subsequent layers shall be applied in the same manner with the joints staggered from the first layer to prevent thermal bridging. Fit boards together with no gaps to achieve a complete thermal envelope. Pull tests shall be required for all mechanical fasteners. The following insulation materials are prohibited:
  - (a) Phenolic foam insulation



- (b) Organic fiberboard insulation, including use as tapered edges
  - (c) Non-structural glass mat face, noncombustible, water resistant treated gypsum core panels in ballasted roof systems
8. **EPDM Walkway Pads:** Walkway pads shall be installed to protect the membrane in those areas exposed to repetitive foot traffic provided the installation does not jeopardize the manufacturer's warranty for the roof.
- a) Walkways shall be installed at all traffic concentration points (i.e., roof hatches, access doors, rooftop ladders, etc.) regardless of traffic frequency
  - b) Walkways shall also be installed if regular maintenance (once a month or more) is necessary to service rooftop equipment.

## **07 60 00 Flashing and Sheet Metal**

### **07 62 00 Sheet Metal Flashing and Trim**

1. **Metal Flashing:** Metal flashing, counter flashing, cleats, drip edges, exposed metal trim/ridge cap, cant strips and exposed metal valleys shall be copper, 16 oz. (0.216-inch thick) or stainless steel, non-magnetic, sheet minimum thickness 0.015-inch thick (28 gauge) unless otherwise indicated.

### **07 70 00 Roof and Wall Specialties and Accessories**

- 1. **Material:** Copper sheet metal shall be used for flashing, scuppers, and eyebrow roof vents.
- 2. **Joints:** Solder all non-expansion joints in metal work.

### **07 71 00 Roof Specialties**

- 1. **Drainage:** All buildings shall have a positive means of conducting rainwater from the roof to an underground stormwater system.
- 2. **Gutters:** On sloped roofs, adequately sized and securely installed gutters and downspouts of minimum 16 gauge copper are required. A minimum slope of 1/16 inch per foot for gutters is required. A minimum of two downspouts for each drain area shall be provided. Downspouts shall be securely fastened to the vertical plane, emptying into a cast iron boot at grade connected to a stormwater system.
- 3. **Protective Baskets:** Where a building is located near a tree, down leader protective baskets shall be provided to keep leaves away from drain inlets in gutters.
- 4. **Concealed Gutters:** Built-in or concealed gutters are prohibited for new construction. Where existing built-in metal gutters need repair a metal gutter liner shall be terne-coated stainless steel, non-magnetic, with both sides coated with a minimum terne alloy. Minimum thickness shall be 0.015-inches (28 gauge). Built-in gutter liners shall have 3/4" wide formed expansion folds spaced every two linear feet prior to fabrication of gutter profile.
- 5. **Reglets:** Built-in reglets shall be used for all wall-flashing terminations. Surface applied reglets shall only be used on existing buildings where installation of built-in reglets is not possible.
- 6. **Abandoned Equipment:** Abandoned equipment shall be removed and the decking repaired as part of re-roofing projects.
- 7. **Clearance:** Where rooftop equipment is utilized the clearance under rooftop equipment and horizontal supporting members shall be 18-inches for equipment up to 24-inches wide, and 24-inches for equipment



over 24-inches in width. Supports shall be mounted and fastened to structural deck or framing, not insulation.

8. **Prohibited:** Use of sleepers for rooftop equipment is prohibited.
9. **Curbs:** Equipment curbs shall not be placed in drainage valleys. Crickets shall be installed on upslope sides of equipment curbs.

### **07 72 00 Roof Accessories**

1. **Snow Guards:** Snow guards are required for all roofs with a slope of 6 in 12 or greater and over all entrances regardless of slope. A minimum of three staggered rows is required. Snow guards shall be copper, stainless steel or bronze, butterfly type. Wire snow guards are not acceptable.
2. **Hatches:** Where roof hatches are used, they shall be insulated, lockable, and have a retractable post for safe egress and ingress. Roof hatches shall feature thermal breaks.



## 08 00 00 Openings

### 08 10 00 Doors and Frames

1. **Automatic Openers:** All main entrance doors along accessible routes shall be low-energy electromechanical automatic operators equipped with sensor or push button activated automatic doors. The use of automatic sliding exterior doors is encouraged for high traffic entrances.
2. **Access Control:** Entrances shall be fitted with an electrical box, conduit system and power source to accommodate the university's card reader security system. (1" Conduit, 4x4 electrical box at appropriate ADA height on exterior of building with cover plate and a power source on the interior above the ceiling)
3. **Prohibited:** Floor mounted door closers are prohibited.
4. **Size:** All doors shall have a minimum width of 3'-0" and minimum height of 7'-0" using only manufacturer's standard door sizes.
5. **Glazing:** Clear glazed vision panels shall be used in all interior classroom and stair doors.
6. **Prohibited:** The following door types are prohibited:
  - a) Bifolding doors
  - b) Folding doors
  - c) Folding grilles
  - d) Hollow core wood doors
  - e) Plastic laminated doors
  - f) Pocket doors

### 08 11 00 Metal Doors and Frames

1. **Door Construction:** Exterior Metal doors shall be insulated. Hollow metal doors shall have minimum 16 gauge facing skins, galvanized, 1 3/4-inch thick minimum.
2. **Frame Construction:** Hollow metal frames shall be minimum 16 gauge, galvanized and fully grouted when used in masonry walls.
  - a) **Welded Construction:** All metal door frames shall be welded construction. Knockdown frames are prohibited.
  - b) **Use With Wood Doors:** Metal frames in conjunction with the approved use of wood exterior doors shall be used in all cases except in the Historic District.
3. **Alternative Door Materials:** Other metal door materials shall be anodized aluminum or stainless steel where warranted by aesthetic and budget considerations.

### 08 14 00 Wood Doors

1. **Door Construction:** Solid core wood doors shall be five ply, 1 3/4-inch thick minimum. Paneled wood doors shall be detailed and manufactured to withstand weather exposure. Use of paneled style door is restricted to the Historic District and existing buildings when it is in keeping with the established architectural treatment.





2. **Warranty:** Specifications shall call for lifetime warranty of wood doors.

## 08 50 00 Windows

1. **Exterior Windows:** Wood windows shall be provided in the historic campus, aluminum windows shall be provided elsewhere.
  - a) Glazing:
    - i) **Historic Campus:** Single glazing with an internal storm sash.
    - ii) **Buildings Outside of the Historic Campus:** Double-glazing, with a vacuum seal and low E glass.
2. **Aluminum Windows:** Aluminum windows and storefront shall have thermal break frames.
3. **Crank Operators:** Crank operators shall not be used on operable windows.
4. **Tinted Windows:** Tinted windows are not permitted.

## 08 60 00 Roof Windows and Skylights

1. **Skylight Structures:** The use of skylight structures are not permitted.
2. **Fall Protection:** If the prohibition is waived, skylights shall have exterior grills or guards to provide fall protection.
3. **Curbs:** If the prohibition is waived, skylights shall have a minimum 5" high curb on sloped roofs; 12" on flat roofs. Indicated curb heights shall be measured from the top of the roof line.

## 08 70 00 Hardware

1. **Locks:** The university uses a Schlage 6-pin, Great Grand Master system; all cores shall be 6-pin and interchangeable or removable. Schlage shall supply all cylinders and cores accordingly.
  - a) Locksets shall be Schlage, heavy duty, ND-series. All interior locksets shall have lever handles with removable core.
  - b) Push button combination locksets or similar types of security hardware may be used where required by program and shall have an override keyed to the university's system. Use of combination locks otherwise is prohibited.
  - c) All classrooms, seminar rooms, and conference rooms shall be manually lockable from inside the room without use of a key.
2. **Lock Type:** Electrically controlled locks shall be the electromechanical type or mechanical strike type. Electrically controlled locks shall be electromechanical, able to accept blue tooth and/or wifi. Must be able to accept cards used on campus and work with CBORD Access Systems.
3. **Closers:**
  - a) **Closer Details:** All door closers shall be of the heavy-duty type, of cast iron bodies, and having at least a 10-year warranty. Aluminum bodies are prohibited. Closers shall be mounted to doors with through-bolts.
  - b) **Prohibited:** Floor closers and concealed overhead closers are prohibited.



4. **Stops:** Intermediate steel plates or channel reinforcement shall back knob bumpers mounted on drywall construction. Floor stops shall not be used.
5. **Hinges:** All doors with closers shall have ball bearing hinges. The use of floor pivot hinges is prohibited.
6. **Kick Plates:** Doors subject to abuse by equipment associated with building function shall have kick plates or armor plates as appropriate.
7. **Panic Devices:** All exterior doors will be secured with panic devices that are either rim, mortise, concealed vertical rod, surface mount vertical rod, or concealed cable. Device will be warranted at least 42 months for mechanical and 18 months for electric. Exterior trim must be able to accept Schlage FSIC cores.

## 08 80 00 Glazing

1. **Interior Partitions:** Glazing for interior partitions shall have a minimum thickness of 1/4".
  - a) **Cross Rails:** Cross rails are required in glazed partitions at handrail height.
2. Glass specified to have Underwriter's Laboratory (UL) Listing shall have the label left on the glass. The university will remove the labels after acceptance of the building or renovation.
3. **Wire Reinforced Glazing:** (Historically used in fire rated assemblies) Wire reinforced glazing is prohibited for new or retrofit installations. Where existing locations are damaged and required to be replaced, the replacement shall be fire rated safety glazing.

## 08 90 00 Louvers and Vents

1. **Storm Resistance:** Specify a storm resistant louver to minimize water infiltration under high wind conditions.
2. **Prohibited Louver Blades:** Inverted "V" shaped louver blades that provide a potential nesting habitat for birds are not allowed.
3. **Material:** Extruded aluminum frame and blades.
4. **Screen:** Specify each louver to be provided with a bird screen. Insect screens are not allowed.
5. **Finish:** Anodized or powder coated.
6. **Outside Air Intakes:** Site and building design shall include consideration of outside air intakes for heating, ventilation and air conditioning related to sources of noxious or toxic fumes. Consideration also shall include proximity to wind-blown dust from streets, fields and ground care activities Outside air intakes shall not be located near:
  - a) Loading docks.
  - b) Generators
  - c) Cooling towers or evaporative coolers
  - d) Vehicle entrances
  - e) Other external sources of noxious or toxic fumes
7. **Minimum Height Above Finished Grade:** Outside air intakes shall be sufficiently above exterior grade (30'-0" or at third story level) on new buildings and for major renovations of existing facilities, to avoid



intake of noxious or toxic fumes associated with vehicles, maintenance equipment, electrical generators, similar sources of fumes permanently or intermittently associated with building functions and maintenance, and to discourage malicious contamination.



## 09 00 00 Finishes

### 09 05 00 Common Work Results for Finishes

1. **Quality:** As a public university, extravagant and/or higher maintenance finishes are discouraged.
2. **Durability:** Areas likely to remain in the same use for ten (10) or more years require durable, lower maintenance finishes.
3. **Standard Stock:** Interior flooring, wall covering and ceilings shall be selected from manufacturer's standard material selection. Custom material selections are prohibited, irrespective of initial lower costs resulting from significant quantities.
4. **Studs:** Metal stud or masonry partitions shall be used for all non-bearing partitions. Metal stud minimum thickness for partitioning shall be 20 gauge, 16" on center.
5. **Prohibited:** Demountable partitions and accordion folding partitions are prohibited.
6. **Marking:** Fire/smoke ratings shall be spray painted utilizing a stencil. Color shall be red. Minimum lettering height shall be three inches.
7. **Access Panels:** Where access panels are required, the lead designer shall include a sheet(s) showing their calculation of approximately how many access panels will be required, and where they will be located.

### 09 20 00 Plaster and Gypsum Board

1. **Minimum Thickness:** The minimum single layer thickness shall be 5/8-inch for walls.
2. **High Abuse Areas:** Abuse resistant gypsum board shall be used in areas such as corridors, student lounges, recreation rooms and other similar high-traffic/abuse spaces.
3. **Mold Resistance:** All gypsum board shall be mold resistant.
4. **Wet Locations:** All gypsum board in wet areas such as toilets, baths, janitor closets and slop sink areas shall be mold and moisture resistant.

### 09 24 00 Cement Plastering

1. **Portland Cement Plaster:** Portland cement plaster stucco, with or without aggregate, may be used for base and finish coats on masonry, roughened monolithic concrete and metal lath. It shall not be used over wood lath, fiberboard lath, gypsum lath, gypsum tile or other types of base coat.
  - a) **Where Allowed:** Portland cement plaster may be used where humidity, wetting and drying, and freezing and thawing is likely to occur.

### 09 30 00 Tiling

1. **Ceramic Tile:** Ceramic tile floor and base shall be used in restrooms and showers; with nonslip floor surfacing. Detailing shall minimize moisture penetration to concrete substrate.
  - a) Cement backer board shall be used in all metal stud partition systems.
  - b) The detailing on the construction documents shall include a membrane type moisture barrier which shall minimize moisture penetration to substrate and/or metal studs.



2. **Quarry Tile:** Quarry tile floor and base shall be used in laundries and food preparation areas and shall have integral non-ferrous non-slip surfacing.

## 09 50 00 Ceilings

1. **Access to Utilities:** Access to all utilities above the ceiling shall be provided regardless of ceiling type used. When acoustical tile ceilings are not used, ceiling fixture selection and layout of above ceiling utilities shall be made to minimize the number of ceiling access panels. Access panels are not required in lay-in acoustical tile ceilings.
2. All lab spaces will have ceilings installed below building system components.

## 09 51 00 Acoustical Ceilings

1. **Standard Size:** Acoustical lay in tile ceilings shall be 24"x24".
2. **Fire Rated Acoustical Ceilings:** Fire rated acoustical ceilings shall not require clips to hold panels in place.
  - a) **Identification:** The ceiling grid for fire rated lay in tile acoustical ceiling shall be labeled with red lettering on 10' intervals.
3. **High Abuse Areas:** High abuse type ceiling tiles shall be used in areas such as student lounges, recreation rooms and other similar spaces.

## 09 60 00 Flooring

### 09 64 00 Wood Flooring

1. **Approval:** Wood flooring, excluding athletic flooring, is not permitted.
2. **Installation:** When used, weather protected entrances shall prevent water damages to flooring. When approved for use over a concrete slab, a moisture barrier is required.

### 09 65 00 Resilient Flooring

1. Resilient Flooring:
  - a) **Floor Tiles:** Resilient tile flooring shall be 12 inch by 12-inch vinyl composition tile, of homogeneous solid composition, with a minimum thickness of 1/8 inch.
  - b) **Sheet Flooring:** Sheet flooring shall be vinyl, of homogeneous though composition, commercially graded flooring, with a minimum thickness of 1/8 inch.
2. **Resilient Base:** The standard resilient base in university facilities is a heavy-duty vinyl or rubber base with a minimum height of 4 inches. For areas subject to heavy-wheeled equipment traffic or frequent maintenance buffing equipment, the minimum height shall be 6 inches.
  - a) **Outside Corners:** Shall be specified as premolded.
3. **Stair Treads:** Rubber non-slip stair treads shall be provided on all interior stairs except for monumental stairs which may have other tread surfaces.



### **09 68 00 Carpeting**

1. **Padding:** The use of separate padding under carpet is prohibited.

### **09 70 00 Wall Finishes**

- 1) **Prohibited:** Wall coverings with textures capable of harboring dirt and/or organic contamination are prohibited.
- 2) **Vinyl Wall Coverings:** Where vinyl coated wall coverings are used, the following weights are minimum requirements:
  - a) **Light Weight Wall Coverings:** (12 to 16 oz. per square yard) in areas of light traffic or areas which are normally out of reach, where it replaces paint to eliminate maintenance.
  - b) **Medium Weight Wall Coverings:** (14 to 20 oz. per square yard) for areas with average traffic (offices, reception areas, hospital rooms and dining rooms).
  - c) **Heavy Weight Wall Coverings:** (24 to 32 oz. per square yard) for areas (corridors, classrooms, gymnasiums and service areas) where there is heavy traffic.

### **09 90 00 Painting and Coating**

- 1) **Paint Finish:**
  - a) **Walls:** Paint for walls shall be satin finish.
  - b) **Trim:** Paint for trim shall be semi-gloss.
- 2) **Color:** To assure economical repainting in the future, all interior classroom, office, corridor or other routine working spaces shall be painted with off-white colors.

### **09 91 00 Painting**

- 1) **Exterior Color Standards:** William and Mary 'grey' shall be used, with no exceptions, for all trim. At the preliminary design stage, color numbers and manufacturers will be provided.
- 2) **Design Limitations:** While the university respects the artistic freedom inherent in the architectural design process, it requires that all designers work within the traditional pattern that has evolved at the university since the early nineteenth century.



## 10 00 00 Specialties

### 10 10 00 Information Specialties

#### 10 11 00 Visual Display Units

1. **Chalkboards:** Use chalkboards of either 1/4 to 3/8 inch natural slate or laminated porcelain enameled steel with butted panels.
2. **Trim and Accessories:** All chalkboards will have trim and full width chalk trays, two-inch tack strip with map rails as an integral part of the chalkboard assembly head trim in all classrooms. Include accessories for map rail use.

#### 10 14 00 Signage

1. **Wall Mounted Directories:** Wall mounted directories are required for new buildings, additions and renovated structures (where existing directories are not adaptable).

### 10 20 00 Interior Specialties

#### 10 21 00 Compartments and Cubicles

1. **Toilet Partitions:** Commercial quality high-density polymer resin overhead braced toilet partitions are required.
2. **Minimum Dimensions:** Excluding accessible stalls, minimum toilet stall dimensions shall be 2' - 11" in clear width and 4' - 11" in clear length.

#### 10 26 00 Wall and Door Protection

- 1) **Wall and Corner Guards** Wall and corner guards are required in corridors and other areas where service carts, moveable equipment, and such similar equipment will typically be used.
  - a) **Prohibited:** Plastic guards are prohibited.

#### 10 28 00 Toilet, Bath and Laundry Accessories

- 1) **General Requirements:** All accessories shall be stainless steel unless otherwise noted. No through partition accessories will be allowed. All below to be provided and installed by the contractor.
  - a) **Soap Dispensers:** Dispensers shall be Lite 'N Foamy Manual/Push Bar Hand Soap Dispenser, white. One dispenser for every two sinks is required.
  - b) **Waste Receptacles:** Receptacles shall be Georgia Pacific Trash Receptacle Unit, Higher Capacity (12 gallon), 16 inch On Center Studs, Model 59491, Stainless Steel, 17.2" X 7.75" X 56.0".
  - c) **Hand Towel Dispensers:** Dispensers shall be Georgia Pacific enMotion Recessed Automated Touchless Towel Dispenser, Model 59466, Stainless Steel, 13.3" X 8.0" X 16.4".
  - d) **Toilet Tissue Dispensers:** Dispensers shall be Georgia Pacific Compact Double Roll Bath Tissue Dispenser, Model 53771, Translucent. One dispenser per stall is required.
  - e) **Sanitary Napkin Receptacle:** Receptacles shall be Safe-Use Plastic Sanitary Napkin Receptacle, gray, wall mountable, empty from the bottom. One dispenser per women's restroom stall is required.



- f) **Sanitary Napkin Dispensers:** Sanitary napkin dispensers are not to be included in the design.
- g) **Mirrors:** Mirrors shall be specified with a minimum ten-year warranty against silver spoilage.

### **10 30 00 Fireplaces and Stoves**

- 1. **Fireplaces and Stoves:** Fireplaces and stoves are not permitted other than in residence halls.
- 2. **Integration with the Fire Alarm System:** If a fireplace is permitted, provisions shall be made to shut off the gas supply and/or electrical power upon receiving a signal from the fire alarm panel.

### **10 40 00 Safety Specialties**

- 1. **Fire Extinguisher Cabinets and Hooks:** Fire extinguisher cabinets shall be provided in public locations. Hooks may be provided for fire extinguishers in “back of house” locations such as mechanical rooms and break rooms where vandalism is less likely to occur.

### **10 50 00 Storage Specialties**

- 1. **Wardrobes, Lockers and Coat Closets:** The university provides wardrobes for student housing rooms.

### **10 57 00 Wardrobe and Closet Specialties**

- 1. **Coat and Hat Racks:** Provide wall mounted coat racks, hat racks or hooks in all classroom, office and laboratory buildings, including provisions for accessibility by physically disabled persons.





## 12 00 00 Furnishings

### 12 50 00 Furniture

#### 12 59 00 Systems Furniture

1. **Moveable Partitions:** The University utilizes established contracts for the design, purchase and installation of moveable (open office) partitions and associated components.
  - a. **Review and Coordination:** The Architect/Engineer shall review the vendor's drawings and specifications for coordination and interface with office systems and incorporate the system design into the Contract Documents. Coordination shall include:
    - Electrical requirements
    - Data and Telecommunications requirements
    - HVAC for coordination with thermostat locations



## 14 00 00 Conveying Equipment

### 14 10 00 Dumbwaiters

1. **Prohibited:** Dumbwaiters are prohibited.

### 14 20 00 Elevators

1. **Elevator Machine Rooms and Pits:**

- a) **Prohibited Use:** Elevator equipment rooms shall not be used for access to roofs or other parts of the building.
- b) **Elevator Pits:** Elevator pits shall have sump pits for use of a portable sump pump by Facilities Management personnel. Drainage from the elevator pit shall not be connected to any building drainage or sewer system. Sump pits shall be equipped with a float sensor connected to university central system and shall also have an audible and visual alarm panel in the elevator machine room.

- **Prohibited:** Mercury switches are prohibited.
- **Electrical Outlet:** The Outlet in the hoist way shall be above the lowest landing floor level and adjacent to the door opening.
- **Fused Disconnect Switch:** The electric fused disconnect switch for the elevator shall be adjacent to the door jamb of the main access door to the machine room.

2. **Prohibited Equipment:** Traction-type elevators and machine-room-less (MRL) elevators are prohibited.

3. **Accessible Egress:** Where elevators are utilized for accessible egress and machine rooms are remote from hoist ways, the interconnecting utilities shall be protected by a fire rated assembly equivalent to the hoist way and machine room.

4. **Controls:** In addition to the requirements of ADAAG 407, passenger elevators shall provide:

- a) **Mounting:** Hall call and cab controls shall be flush, not raised.
- b) **Emergency Phone:** 6" x 8" cutout for emergency telephone, located between 24" and 48" above the cab floor. University to provide and install telephone. Conduit, wiring and all other requirements shall be provided in design and by the Contractor to accommodate a Talk-A-Phone ETP-100.
- c) **Controls:** Elevator controls shall be solid-state "Selective Collective Automatic Operation", as defined in ASME/ANSI A17.1. Controller shall be non-proprietary and shall not require a battery to maintain programming. Control system shall be microprocessor based for dispatch and motor control, capable of computer based monitoring with terminals for connection.

5. **Documentation:** The specifications shall be explicit regarding:

- a) **Diagrams:** Contractor shall provide four (4) sets of all electric schematic wiring diagrams, access codes or passwords required for all maintenance functions, including diagnostics, adjustments and parameter reprogramming. Tools may be hand held or built into the control systems, and shall function for the lifetime of the equipment. Tools that require recharging or reprogramming shall not be used.
- b) **Tools and Equipment:** The successful contractor upon completion of the project shall provide any special tools, prints, and technical operation of equipment that cannot be obtained from multiple



suppliers to the university. Specifications shall be explicit that all tools, adjusters, manuals and schematic wiring diagrams become the **property of the university** to be used at their discretion related to the installed elevator or elevators.

- c) **Adjustments:** Prior to the end of the warranty period, the Elevator Contractor shall inspect, readjust and certify the elevator as required to meet all performance parameters specified. A written report shall be submitted by the Elevator Contractor to the university Service Contract Manager.



## 21 00 00 Fire Suppression

### 21 05 00 Common Work Results for Fire Suppression

1. **Intent:** All new construction and major renovation projects shall include fire detection, alarm, and suppression systems.
2. **Hangers and Supports:** Specify in accordance with NFPA-13.
3. **Sprinkler Control Valves:** Sprinkler control valves located above suspended ceilings shall be marked with a sprinkler control valve sign on the ceiling panel. The sign shall be 2 inches x 6 inches and shall have red lettering on a white background.
4. **Hose Threads:** Hose threads for standpipe and fire department connections shall be “National Standard Threads”.
5. **Building Protection During Construction:** In renovation projects where the building is to remain occupied during construction, the following measures shall be included in the contract documents:
  - a) **Existing Standpipes:** All operational standpipes are to be maintained at all times.
  - b) **Existing Systems:** Sprinkler systems in areas being renovated shall be fully operational when the contractor leaves the site each day.
  - c) **Impairments:** Disablement of a Fire Suppression System during construction or renovation shall be in accordance the university’s Fire Protection System Impairment directive. A fire watch shall be provided at all times that a sprinkler system is inactive.
  - d) **Fire Extinguishers:** The University provides portable fire extinguishers.

### 21 10 00 Water Based Fire Suppression Systems

1. **Minimum Performance Requirements:** All fire protection systems shall be designed in accordance with NFPA-13. NFPA-13R systems shall not be used on Campus.
  - a) **When Required:** A new hydrant flow test shall be performed when:
    - There is no existing flow data to rely on.
    - Existing flow data is older than 12 months as measured from the date hydraulic calculations are submitted for review.
    - Water utility improvements have been made since the last flow test.
2. **Separate Water Line:** Fire protection service shall not be through the domestic metered water system. Buildings requiring sprinklers, fire pumps or fire protection standpipes, shall require a separate water line and backflow preventer for the fire protection service.
3. **Individual Building Service:** For projects involving multiple buildings, a separate post indicator valve, backflow preventer and fire department connection shall be provided for each building.
4. **Approval by Local Fire Department:** The location of Post Indicator Valves and Fire Department Connection shall be coordinated with and approved by the authorized person from the local Fire Department, or appropriate jurisdiction for projects not located on university Grounds.
  - a) Fire department approval shall be coordinated through the university EHS.
  - b) The fire department connection check valve shall be located within a building where possible or in a valve pit when location within a building is not possible.
5. **Stair Landings:** A sprinkler head shall be provided above each landing in each stairwell.



6. **Quick Response Sprinkler Heads:** The design area reduction shall not be taken for quick response heads if the quick response heads are provided with a decorative cover.
7. **Decorative Covers:** Recessed heads with decorative covers shall not be used except for high impact visual locations for which specific permission has been granted.
8. **Prohibited:** Plastic valves and piping systems and components are prohibited.
9. **Stand Pipes:** In buildings of two or more stories, risers shall occur in each exit stair with fire department hose connections at each level. Provide fire valve cabinets where practical.
10. **Hydraulic Information Name Plates:** Name plates containing hydraulic information for each riser shall be metal with etched or stamped hydraulic information. Permanent marker is not acceptable.
11. Elevator, Sprinkler and Fire Alarm Coordination: Shall be as follows:
  - a) **Fire Alarm Requirements:** See Section 28 31 00 "Fire Detection and Alarm" for fire alarm requirements.
  - b) Sprinkler Heads:
12. **Locations:** Only as required by NFPA-13.
13. **Temperature Rating:** Intermediate rating of 212°.
14. **Response:** Standard Response only. (Not quick response)
15. **Supply:** Direct from sprinkler wet pipe system. (Note: Branch shall serve machine room and elevator pit only.)
  - a) Flow Switch:
16. **Location:** An accessible location outside of the machine room and/or hoist way.
17. **Testing:** Provide a means of draining and testing the flow switch. This drain valve shall also located outside of the machine room and hoist way.
18. **Operation:** Immediately disconnect the main power line and activate the building fire alarm system if applicable.

## 21 30 00 Fire Pumps

1. **Fire Pumps:** Fire pumps shall not be used unless determined by hydraulic calculations to be necessary. When appropriate, the engineer shall evaluate the building using the room design methodology to determine if the fire pump requirement can be negated.
2. **Prohibited:** Type MI (Mineral Insulated) cable shall not be used to feed fire pumps, even though it is allowed in article 695 of the NEC. An alternate approved method shall be used.



## 22 00 00 Plumbing

### 22 05 00 Common Work Results for Plumbing

1. **Serviceability:** The provisions of the Virginia Mechanical Code that require equipment to be accessible for inspection, service, repair and replacement without disabling the function of a fire resistance rated assembly or removing permanent construction shall apply equally to this division.
2. **Pressure reducing valves:** Pressure reducing valves shall be provided in buildings, as needed, at the domestic water entrance just downstream of the meter.
3. **Pipe Installation:** Piping for domestic water and hydronic hot/chilled water systems shall not be installed in or under concrete slabs on grade, except where necessitated by building entrances or under sidewalks.
4. **Shut off valves:** Shut off valves are required at the main service entrance into buildings and at vertical branch risers and take-offs from vertical main risers on each floor.
5. **Water Source:** Domestic water is obtained from the university distribution system. New service lines shall be valved at the point of connection to the main and at entry to the building. Provide a valve box for the new service valve.
6. **Water Meters:** Water meters shall be installed at the point of entry to each building and at well heads. Meters shall be capable of showing cumulative gallons used, and of measuring the maximum and minimum anticipated flow rates.
  - a. **Meter Type:**
    - Meters for largely varying flows such as dormitories, shall be compound meters.
    - Meters for domestic water shall be electromagnetic or ultrasonic transit time, all others shall be turbine type or ultrasonic transit time.
    - Nutating disc water meters may be used as appropriate for low-to-moderate flow rates for pipe sizes from 5/8" to 2"
  - b. **Minimum Accuracy:** Each being revenue grade, having a maximum inaccuracy of 1% of rate and span.
  - c. **Construction:** Meters shall be constructed of brass or bronze and shall have a strainer installed upstream.
  - d. **Auxiliary Contacts (Building Locations Only):** Meters shall be provided with capability to connect to the building automation system via suitable Ethernet Interface Device, and preferably be capable of local data storage.
  - e. **Deduct Meters:** Irrigation systems and building mechanical systems, including but not limited to boiler, chiller and cooling tower make-up and blow down shall be metered separately.
  - f. **Fire Protection Systems:** Fire protection service shall not be through the domestic metered water system.
  - g. **Installation:**
    - **Bypass:** A valved bypass that can accommodate full flow conditions shall be provided around all water meters.



- **Strainer:** Provide a strainer with blow down valve upstream of the meter bypass loop.
- 7. **Building Back Flow Preventer:** Provide a backflow preventer (BFP) downstream of the meter bypass loop.
- 8. **Hose Bib Requirements:** Hose bibs shall be spaced at a maximum of 100 feet around the entire building and shall be freeze protected.
- 9. **Aerators:** Aerators for lavatories, kitchens and similar use shall be 0.5 GPM maximum.
- 10. **Hot Water Recirculating Systems:** Recirculating hot water systems shall have a flow-measuring device (circuit setter) with a multi-turn flow-regulating valve.
- 11. **Connecting Dissimilar Metals:** Bronze fittings shall be used when connecting piping of dissimilar metals.
- 12. **Drain Valves:** Drain valves shall be installed in accessible locations at all low points in the piping system to permit drainage and servicing.
- 13. **Disinfection of Potable Water System:** Water line shall be disinfected and tested for bacteria. Provide the test results to the university PM at substantial completion.

## 22 07 00 Plumbing Insulation

1. **Condensation Prevention:** All Plumbing lines subject to condensation shall be insulated.
2. **Continuous Insulation:** Insulation shall run continuously through walls and floor slabs
3. **Joints and Seams:** All joints and seams shall be sealed vapor tight.
4. **Sanitary System:** Sanitary lines and floor drains receiving HVAC condensate shall be insulated similar to roof drains and rain leaders.

## 22 10 00 Plumbing Piping

### 22 11 00 Facility Water Distribution

1. New Systems:
  - a) **Materials:** All domestic water piping inside buildings shall be hard drawn copper.
  - b) **Joints:** Mechanical joints such as compression or Victaulic fittings shall not be used.
  - c) **Pipe Supports:** Supports and other metal parts subject to use shall be galvanized or copper clad.
    - **Changes of Direction:** Specifications shall call for supports at changes of direction to prevent cantilevered piping conditions.
    - **Vertical Support:** Piping shall be supported vertically to prevent movement.
  - d) **Service Isolation:** Shut off valves are required on each floor, on take-offs from all vertical risers, and at the connection to each piece of equipment.
2. Existing Systems:
3. **General Provisions:** For existing systems being modified, the provisions identified under “New Systems” above shall apply to new work.
4. **Joints:** Mechanical joints may be used for repairs when it is not possible to make hard joint connections.



5. **Dead Legs Prohibited:** When plumbing fixtures are removed but not replaced, domestic water pipes shall be removed to the main to prevent leaving a dead leg, and terminated with a capped ball valve. Where plumbing fixtures are removed but the water pipes will be reused the pipes shall be capped to prevent debris from entering pipes.

## 22 13 00 Facility Sanitary Sewerage

1. **Clean Out Locations:** Sanitary cleanouts shall be located with a minimum clearance of 18 inches from adjoining walls or built-in features, such as toilet stalls or casework. Unless approved as an exception for servicing vertical risers or for drains serving urinals, cleanouts shall not be located in vertical surfaces.
2. **Trap Primers:** In lieu of trap primers, floor drains and indirect waste receptacles shall be provided with a self-sealing device similar to those manufactured by “ProSet Trap Guards”. Provide a performance specification or if necessary follow the DCM procedures for a sole source or proprietary specification.

## 22 30 00 Plumbing Equipment

1. **Water Heaters:** Water heaters serving only restroom lavatories, custodial closets or other areas with limited usage shall be local point of use instantaneous or tank type electric water heaters. All other water heaters shall be central systems served by natural gas or one of the university’s central heating plants when available and practical.
  - a) **Swem Plant as a Hot Water Source:** If the Swem Heating Plant is used as a source of heat for domestic hot water, the designer shall assume an entering hot water temperature of 160 degrees during summertime operations.
  - b) **Heat Exchangers:** Facilities Management has committed to using only non-toxic chemicals for their water treatment program. Based on this commitment, when allowed by code, the Engineer of Record has the option, of selecting single wall heat exchangers for generating domestic hot water from steam or building heating hot water.

## 22 40 00 Plumbing Fixtures

### 22 42 00 Commercial Plumbing Fixtures

1. **Toilets:** Floor mounted siphon jet bowl with a dual-flush flush valve, 1.6 gal/flush.
2. **Urinals:** Wall mounted, .5 gal/flush. Waterless urinals are not allowed.
3. **Flush Valves:** Manual flush valves shall be provided for all toilets and urinals.
4. **Sinks:** Manual faucets shall be provided on all sinks.

### 22 45 00 Emergency Plumbing Fixtures

1. **OSHA Requirements:** Emergency shower and/or eyewash and/or drench hose systems shall be installed in new and renovated facilities as required by OSHA.
2. **Existing Plumbing Systems:** Existing plumbing systems shall be evaluated to ensure they can support the new emergency fixtures.
3. **Minimum Pipe Size:** The minimum pipe size to an emergency shower shall be 1 ¼”. If a mixing valve is used, each leg into the valve shall be a minimum of 1 ¼”.





4. **Tepid Water:** For the purpose of sizing the water heaters, tepid water is defined as being in the range of 70° to 95°F.

## **22 47 00 Drinking Fountains and Water Coolers**

1. **Water Bottle Filling Station:** All new construction and significant renovations will include at least one water bottle filling station.

## **22 60 00 Gas and Vacuum Systems for Laboratory and Healthcare Facilities**

### **22 63 00 Gas Systems for Laboratory Facilities**

1. **Natural Gas Outlets:** Natural gas outlets shall not be installed in bio-safety cabinets or other contained rooms or areas that are not fully exhausted.



## 23 00 00 Heating, Ventilating, and Air Conditioning

### 23 05 00 Common Work Results for HVAC

1. **System Type:** If central plant chilled water will not be available when needed, a water chiller shall be provided for central systems; DX or window air conditioners may be utilized only for single zone systems. If central plant steam or hot water is not available when needed, standalone boilers may be utilized.
2. **Secondary Heating Water:** Fan coil units, perimeter radiation, preheat coils, reheat coils, and all other heating in occupied spaces, shall use secondary heating water generated in an exchanger in the building.
3. **Four-Pipe System:** Fan coil and air handling systems shall be designed as part of a 4-pipe system rather than 2-pipe systems.
4. **Temperature:** The secondary heating water for a building shall be between 90 and 180 degrees Fahrenheit for heating. A means of night, weekend, and holiday, setback control shall be provided on each converter for energy conservation purposes.
5. **Media:** Ethylene Glycol shall not be used. Propylene Glycol is acceptable. Corrosion inhibitors shall be non-toxic.
6. **Backup System Connection:** In buildings as specified, provide valved and capped tees on the building steam system or LTHW loop for connection of a temporary boiler for emergency heat. The backup system shall be sized for all building loads, including domestic hot water, humidifiers, sterilizers, autoclaves, etc.
7. Meters and Gauges:
  - a) **Utility Metering:** Utility meters shall be connected to both the BAS and energy metering system via an Ethernet interface device with local storage capability. Metering for heating water, steam and chilled water shall have the capability to record instantaneous and peak demand, totalization and trending for the appropriate flow and temperatures to determine energy consumption for each building.
    - **BTU Meters:** BTU Meters: BTU meters are to be ultrasonic type.
    - **Meter Calibration:** All metering shall be installed and calibrated according manufacturers specifications.
  - b) **Gauges:** Gauges shall be specified on supply/return of pumps and suction diffusers, chillers, converters, and where lines enter and exit mechanical rooms. Where non-digital readout gauges are used, the following shall apply:
    - **Operating Range:** Gauges shall read to twice the operating pressure.
    - **Non-Pulsating:** All gauges shall be non-pulsating.
    - **General Use:** Gauges for general use shall have screw-type recalibration, bronze bushed movements and single unit construction.
    - **Minimum Size:** Provide 4.5 inch diameter gauges for all steam and water lines mounted overhead. Mounting height shall be a maximum of 8'-0" above the operating floor. All other gauges may be a minimum of 3 inch diameter.



- **Calibration:** Gauges shall be calibrated for static head.
- c) **Thermometers:** Thermometers shall be specified on supply/return water chillers, boilers, water heaters and coils.
  - **Operating Range:** Thermometers shall read to twice the operating temperature.
  - **Construction:** Thermometers shall be bi-metallic type.
- 8. **Hangers and Supports:** As a minimum, the following information shall be included in the specifications:
  - a) **Independent Support:** Require pipe, duct and equipment to be supported independently of each other to minimize stress at points of connection.
  - b) **Steel Bridging:** The structural bridging is not to be allowed for use in supporting ductwork, piping and equipment
  - c) **Light weight joists:** Connections to open web joists shall be limited to the panel points for maximum strength.
  - d) **Light Gauge Metal Trusses:** Specify allowable method and location of attachment.
    - **Drilling and Cutting:** Drilling and Cutting of truss web and chords shall not be allowed without written permission from the truss manufacturer.
- 9. **Prohibited:** Supporting anything from truss web members is prohibited.
- 10. **Design Conditions:**
  - a) **Load Calculations:**
    - **Interior:** Heating: 72° F Maximum  
Cooling: 72° F Minimum
    - **Exterior:** Cooling: Dry Bulb: 95° F  
Wet Bulb: 78° F  
Heating: 14° F.
    - **Spare Capacity:** A maximum of 10% spare capacity may be added to the design calculations to ensure indoor design conditions can be maintained.
    - **Relative Humidity (Cooling Season):** 55% regardless of the outdoor temperature and humidity, or percentage of outside air. Lower indoor humidity levels shall be maintained when justified by project criteria.
    - **Relative Humidity (Heating Season):** Humidification is not to be provided unless justified by special project criteria.
  - b) **Outdoor Equipment Selection:**
    - **Water Cooled:** 80° WB
    - **Air Cooled:** 95° DB when installed at grade  
105° DB maximum when installed on roofs or other areas of high solar influence.



11. **Minimum Exhaust Requirements:** The following are minimum exhaust requirements over and above code requirements:
  - a) **Areas with sinks and/or microwaves:** 50 cfm each.
  - b) **Custodial Rooms and Janitor Closets:** 75 cfm each.
  - c) **Battery Charging Rooms:** 0.5 cfm per sq. ft.
  - d) **Toilet Rooms:** Recirculation from toilet rooms shall be prohibited.
  - e) **Electrical Rooms:** Exhausted to allow a maximum of a 5°F rise above ambient room conditions.
  - f) **Heat Producing Equipment:** Exhaust, or return if approved, shall be provided near heat producing equipment such as freezers, refrigerators, icemakers, cold drink machines, autoclaves, etc.
12. **Unconditioned Air:** Unconditioned air shall not be supplied directly to occupied spaces or into the returns of fan coil units.
13. **Outside Air Flow Control:** Separate economizer and minimum air flow dampers shall be included for any air handling unit with supply air flow of 10,000 cfm or more. All outside air flow dampers are to be fully modulating and controlled by the building automation system. Air flow stations of the thermal dispersion type shall be installed on the minimum air flow damper and on the single damper of any air handling unit with capacity below 10,000 cfm.
14. **Location:** Air conditioning compressors, condensers, and similar equipment serving buildings shall be in an exterior, ground-mounted location readily accessible for maintenance, and effectively shielded from view.
15. **Vibration and Sound Isolation Requirements:**
  - a) **Maximum Allowable Sound Pressure Levels:** Sound pressure levels around exterior mechanical and electrical equipment shall not exceed 55 dbA or the dbA/time limitations set forth in the Occupational Noise Exposure/Hearing Conservation Amendment latest edition.
  - b) **Vibration Isolators:** Mechanical and electrical equipment, associated piping and ductwork shall be mounted on vibration isolators to minimize transmission of vibration and noise to the building structure or spaces.
  - c) **Large Motors:** All motors over five horsepower must be solidly attached to a base common with the driven unit to minimize alignment problems.
  - d) **Drive Systems:** Solid sheaves and band belts shall be used to minimize vibration in multiple belt driven equipment.
  - e) **Static and Dynamic Balancing:** All rotating equipment shall be balanced, both statically and dynamically. The structure supporting the equipment shall not have any natural frequencies within plus or minus 20 percent of the normal operating speeds.
  - f) **Maximum Vibration Velocity:** The equipment, while operating, shall not exceed a self-excited radial vibration velocity of 0.10 inch per second, or an axial vibration velocity of 0.05 inch per second, when measured with a vibration meter.
  - g) **Vibration Test Pickups:** Vibration test pickups shall be placed on bearing caps in the horizontal, vertical and axial directions, or on equipment mounting feet if the bearing caps are concealed.



- h) **Mechanical Room Enclosures:** Walls and floors enclosing mechanical rooms adjoining occupied spaces shall have a sound transmission factor of 10 decibels, or greater, above the determined or probable airborne noise level of operating equipment. In no such applications shall the rating be less than a 55-decibel STC.

**16. Systems Identification:**

- a) **Piping Systems:** All piping and equipment in mechanical equipment rooms and central plants shall be identified according to the “Scheme for the Identification of Piping Systems”, ANSI A13.1 and the “Safety Code Color for Marking Physical Hazards”, ANSI Z53.1, latest revisions.
- **Application:** Use stencils and/or adhesive labels showing contents of the piping and the direction of flow.
  - **Maximum Intervals:** Piping shall be identified at 30’ intervals, on both sides of penetrations through walls and floors, and at each directional change.
- b) **Valve Tags:** All valves shall also be identified with stamped brass tags or discs secured with non-ferrous beaded chain. Value numbers shall be engraved or stamped as large as possible on tags (1 inch by 2 inches) or discs (1.25 inch diameter) attached to the valves by 10-gauge brass "s" hooks. Provide a framed valve schedule in mechanical rooms.
- c) **Equipment Identification:** All motor driven equipment, HVAC components, and major electrical boxes shall be individually numbered on the drawings by the Architect/Engineer and have corresponding number plates (white lettering on black background) on the equipment. (Example: For unit heaters, use UH-1, UH-2, etc., even though both units are of the same size and type.) All designations shall be integrated with and distinguished from existing designations.
- **Lettering Height:** Unit designation shall be a minimum of 1” high. Additional information shall be no smaller than ¼”

**17. Testing, Adjusting and Balancing for HVAC:**

- a) **Pumps:** Testing and balancing of building chilled and hot water distribution pumps shall use the revenue meters rather than DP across pumps. A portable meter with the same level of accuracy as the revenue shall be used on branches which will not have full flow; a suitable meter can be borrowed from the university if available.

18. **Energy Conservation:** Energy conservation measures that reduce the peak-cooling load (such as heat or energy recovery) with up to a 15-year payback shall be employed and documentation of measures shall be included in project documentation. Other energy conservation measures with up to a 10-year payback are acceptable.

19. **Support:** When DDC is used on air handler units (AHU), a laptop hook up shall be provided at each AHU, chiller, etc.

20. **Freeze Protection:** Freeze protection shall be provided on all air handling units. Freeze stats shall stop the supply fan, close the outside damper, and open the heating coil valve, by having specified a normally open valve and commanding it fully open.

21. **Prohibited:** The use of electric resistance as the primary source of heat is not allowed.

22. **Pressurization:** All buildings shall have a nominal positive pressure. Positive pressure is to be maintained during all modes, but may be neutral if all exhaust fans are off. The total building shall maintain positive pressure wherein special use rooms, laboratories, etc. may require negative pressure.



- a) Building pressurization shall be established and verified during TABB activities. Target a value between 0.01-0.03" w once the building pressure is established,
- b) TABB contractor will document the minimum outside air flow required to maintain building pressure while in mechanical cooling mode.

23. **Valve Test Ports / Drains:** Plastic components on valves equipped with test ports and / or drain capability are prohibited. These valve components shall be brass.

### 23 09 00 Instrumentation and Control for HVAC

1. **Building Automation System (BAS) Use:** The university Building Automation System (BAS) has been established to provide a high level of continuous computerized monitoring and control capabilities. Architects/Engineers are directed to utilize these existing systems for such monitoring and control.
2. **Systems to be Monitored:** Systems requiring some form of remote monitoring and/or control include, but are not limited to, heating, ventilation and air conditioning (HVAC), fire alarm and security systems.
3. **Acceptable Vendors:** Bidding of building automation systems shall be limited to:
  - a) Johnson Controls Inc. Metasys Extended Architecture (Web based).
  - b) Siemens Controls (Web based).
4. **Latest Technology:** All BAS component hardware will be new, and will consist of the manufacturer's latest technology.
5. **Sensors and Transmitters:**
  - a) **Wells:** Wells for temperature and pressure sensors shall be stainless steel separable wells installed under the appropriate piping or ductwork specification.
6. **Actuators:** All actuators shall be electronic.
  - a) **Normally Open:** Actuators associated with building heating valves shall be normally open, except where noted below:
    - **Laboratories:** Actuators controlling hot or chilled water in laboratories and other locations with critical temperature and/or humidity requirements shall be provided without a spring return.
  - b) **Swem Distribution Loop:** All main building valves controlling the distribution of hot and chilled water from the Swem Plant shall be normally closed to allow flow to be directed to the Small Hall NMR, ISC1 Vivarium, and ISC3 High Performance Computing Center under a power outage condition.
7. **Sequence of Operation & Points List:**
  - a) **Adjustable Set Points:** Adjustable set points shall be made readily available to the operator on the points list and graphics.
    - **Allowable Set Point Range:** Maximum and minimum set points for each range shall be indicated in the graphics package.
  - b) **Automatic Reset:** All equipment shall be designed to automatically reset upon recovery from a power interruption.
    - **Exception:** Boilers and other fuel fired equipment shall be manually reset.



- c) **Critical Safety Interlocks:** Critical safety interlocks which are not directly wired under Division 16, such as freeze stats, high limit protectors, end switches etc., shall be directly connected, under this division so as not to depend on any digital control system “Sequence of Operation” to perform their safety function.
- d) **Filter Monitoring:** Main filters shall have DP sensors tied into the building automation system. Provide magnahelic or inclined manometer on all other filters.
- e) **Reset Schedules:** Whenever temperature or pressure reset schedules are used, the specification shall require the set points to be operator adjustable in the graphics package. Reset programming shall be provided for supply air down duct pressure, supply air temperature and outside air flow set points. They shall be based on the critical zone damper position, critical zone demand (actual / design air flow) and space CO<sub>2</sub> level respectively.
- f) **Pumps:** Hot and chilled water pumps that are sized for N+1 capacity shall be controlled in a lead standby configuration.
- **Run Time Monitoring:** The control system shall monitor run time and switch the lead pump after a pre-determined number of hours. The number of hours shall be operator adjustable.
  - **Alarm:** Upon pump failure, an alarm shall be sent to the head end and the standby pump shall be energized.
- g) **Ventilation Control:**
- **Carbon Dioxide Sensors:** Controls such as carbon dioxide (CO<sub>2</sub>) or occupancy sensors shall be used to modulate outside airflow in classrooms, auditoria, dining facilities, athletic spaces, and similar spaces. On units with CO<sub>2</sub> control, the sequence of operation shall specify when outside air dampers can go to a minimum position.
  - **Units with CO<sub>2</sub> controls which serve only class room(s)** will be shut off during unoccupied hours when CO<sub>2</sub>, temp, and relative humidity are satisfied; and restarted on demand by any of those sensors. An occupancy sensor will also restart AHU. When CO<sub>2</sub> levels are satisfied, outside air dampers will be allowed to go to a minimum position, established by the TABB contractor that maintains positive building pressure. If extreme conditions prevent the system from maintaining all set points, the CO<sub>2</sub> level will be allowed to drift. The EMS will monitor points as required to detect failure to maintain any set point.
  - **Disparate Spaces:** Spaces of different uses (such as offices and classrooms) may only be served by the same AHU if CO<sub>2</sub> sensors or other approved controls are provided in adequate quantity and location to ensure code required outside air to all spaces.
  - **VAV Systems:** For VAV systems, individual CO<sub>2</sub> sensors will first increase the VAV air flow from its minimum when the space CO<sub>2</sub> level reaches 700 ppm and will be at its maximum flow when the level reaches 900 ppm. When any space CO<sub>2</sub> level exceeds 950 ppm (critical zone reset strategy), the outside air flow will be increases above its minimum setting and when the critical zone space CO<sub>2</sub> reaches 1,100 it shall be fully open.
  - **CO<sub>2</sub> Sensors:** CO<sub>2</sub> sensors shall be able to be calibrated or of the type with a guaranteed accuracy for 5 years.
- h) **Exhaust Fans:** Exhaust fan status and control shall be provided within the BAS except where safety requires independent control.



- i) **Relative Humidity:** RH sensors shall be located in representative spaces throughout the building. At a minimum there shall be two sensors per floor. They can be combined in a single sensor with temperature or in a combination sensor of temperature, RH and CO<sub>2</sub>.
8. **Sequencing:** Sequence will specify if fans run continuously or can be shut off. Supply, return, and exhaust fans shall be interlocked as required.
9. **Space Controls:** Individual spaces shall have means of ensuring acceptable temperature control (user adjustable thermostat and control device, appropriate zoning or other designed means). User adjustable thermostats should be limited to +/- 2 °F of building wide adjustable global space temperature set point, set initially at 72 °F. For any partition able spaces, duplicate sensors/controls will be provided for the divided spaces including temperature, RH and CO<sub>2</sub> as appropriate.
10. **Control Air:** For centralized air-handling systems, moisture-free instrument air is required.
11. **System Graphics:** Each building system shall be represented graphically. Pertinent information shall include, but not necessarily be limited to:
  - a) System components such as fans, coils, filters, ductwork, etc.
  - b) Control points including set points and/or ranges of operation, alarms, etc.
  - c) Location, including room numbers as applicable.
  - d) Embedded sequence of operation and mechanical drawings; make them accessible via hyperlinks on the main graphic page as well as specific to each AHU and floor plan.
12. **Wireless Controls Prohibited:** Wireless controls are not allowed in new construction or renovation. All controls shall be hard wired except for energy conservation projects.
13. **Feedback:** Outside air dampers shall have feedback of actual position to the building automation system, or other means of confirming operation.
14. **Positioning:** Outside air dampers shall have a full closed position as well as a minimum position for normal occupied mode.
15. **Configuration:** The “Hand” position of the HOA switch shall be configured so that after a fire the unit can run to evacuate smoke without the unit smoke detector tripping. Any connection to the building fire alarm system shall be hard wired, not through the DDC system.
16. **Matching:** Building automation systems (BAS) sensors used for energy monitoring shall be “matched” with a minimum accuracy of 1% so as to provide information suitable for billing.
17. **Vivarium:** In Vivarium and other spaces as specified, local temperature and humidity displays that are also the controlling sensors shall be provided. Critical safeties on HVAC systems shall be hard wired rather than controlled by the DDC system. Visual display of temperature and humidity shall be provided outside each room to minimize unnecessary entry into critical spaces by non-research personnel.
18. **Labs:** Laboratories and other spaces as appropriate shall have a means to completely shut off the supply air if exhaust air is lost to prevent a positive pressure in the space. This shall be through a hard wired connection rather than through the DDC system. Bubble or gas tight dampers on the supply air may be appropriate in some situations.
19. **Control Configuration:** Critical exhaust fans (Vivarium, BSL suites, rad hoods, perchloric acid hoods, etc.) that run continuously shall not have a start/stop function on the DDC system. Provide a manual hand/off/auto switch and failure alarm to the DDC. Where two fans are provided the “lead” fan will be in





the “hand” position and the “lag” fan will be in the “auto” position so the DDC system can start the “lag” fan automatically upon a failure of the “lead” fan.

20. **Emergency Power:** In buildings with critical loads, all necessary components of the HVAC, control, and communications systems shall be on emergency power. If emergency power is not available in the building the chilled water pump bypass valve (V-3) and cooling coil control valves on critical loads shall fail open on the event of a power failure to allow free flow from the distribution system; chilled water valves on non-critical loads shall fail closed.
21. **Smoke Detectors:** Smoke detectors shall have 3 sets of dry contacts for separate hard wired connection to the fire alarm system, the interlocked fan, and the DDC system.
22. **Dampers:** Automatic control dampers shall be furnished and installed unless they are part of factory-assembled equipment. Return fan should be controlled separately from supply fan using return plenum differential pressure sensor with atmospheric reference and adjustable set point to vary return fan speed. Return air damper will control mixing box pressure based on a differential pressure sensor with atmospheric reference and adjustable set point. The exhaust damper shall be controlled by building pressure sensor and set point. Exhaust damper is controlled by building pressure sensor and building pressure adjustable set point.

## 23 10 00 Facility Fuel Systems

### 23 11 00 Facility Fuel Piping

1. **Natural Gas:** Natural gas is available from Virginia Natural Gas (VNG). VNG shall be responsible for providing the meter, primary regulator and underground gas piping to the meter. The A/E is responsible for the design of all piping downstream of the meter. A separate meter of the thermal dispersion type should be installed and connected to the energy metering system via Ethernet interface device with local storage capability.
  - a) **Meter Requirements:** Coordinate the intended meter location, size and delivery pressure with the university and VNG. Provide a concrete support pad as required by VNG.
  - b) **Allowable Materials:**
    - **Within the Building:** Black steel with welded joints
    - **Outdoors Above Grade:** Plastic coated black steel with plastic wrapped joints. Welded or threaded joints
    - **Outdoors Below Grade:** Plastic coated black steel with plastic wrapped joints. Welded or threaded joints –or- approved plastic.
  - c) **Identification:** Piped gas systems shall be thoroughly identified and coded.
2. **Shutoff Valve:** In mechanical rooms, a shut off valve for natural gas shall be provided at the room entrance and at each individual gas appliance.



## 23 20 00 HVAC Piping and Pumps

### 23 21 00 Hydronic Piping and Pumps

1. **Swem Heating and Cooling Plant:** The Swem Regional Heating Plant provides chilled and medium temperature hot water (MTHW) to many of the university's academic buildings in the Swem quadrangle. When available, chilled and MTHW shall be used as the principal energy source.
  - a) Hot Water (MTHW):
    - **Heating Water Temperature:** Water temperature is supplied from the plant at 185 degrees during the heating season and reduced to 160 degrees during off-peak seasons.
    - **Heating Coil Selection:** Due to pipe size limitations, heating coils, re-heat coils and water heaters shall be sized for a 40 degree temperature drop between the supply and the return. Entering water temperature shall be selected based on the intended use.
  - b) Chilled Water:
    - **Chilled Water Temperature:** Chilled water shall be supplied by the plant at 42 degrees.
    - **Chilled Water Coil Selection:** Chilled water coils shall be sized for a 16 degree rise between the supply and return. Entering water temperature shall be assumed to be 45 degrees by the time it reaches the cooling coil.
    - **Chilled Water Decoupler:** If a chilled water decoupler is installed it shall have a check valve or manual valve installed to prevent chilled water bypassing the building AHUs.
    - **Chilled Water Bypass Valve Control:** Any chilled water bypass valve shall be controlled by the BAS and used only when the chilled water pumps are at their minimum speed.
  - c) **Controls:** Building controls that monitor or regulate flow of chilled or hot water from the plant to the individual satellite building shall communicate directly with the Swem Plant.
    - The building chilled water differential pressures set point shall be reset based on critical zone chilled water valve position.
    - The building chilled water valve shall be controlled based on secondary chilled water temperature being a user adjustable 1 – 2°F above the chilled water loop supply temperature
2. **North Campus Heating and Cooling Plant:** The North Campus Regional Heating Plant provides medium pressure steam and chilled water to many of the university's academic buildings in the historic campus. When available, steam and chilled water shall be used as the principal energy source.
  - a) Hot Water:
    - **Building Water Temperature:** Hot water generated from the central steam system shall be supplied to the building at maximum of 180 degrees.
    - **Coil Selection:** Heating coils, re-heat coils and water heaters shall be sized for a 20 degree temperature drop between the supply and the return.
  - b) Chilled Water
    - **Chilled Water Decoupler:** If a chilled water decoupler is installed it shall have a check valve or manual valve installed to prevent chilled water bypassing the building AHUs.



- **Chilled Water Bypass Valve Control:** Any chilled water bypass valve shall be controlled by the BAS and used only when the chilled water pumps are at their minimum speed.
  - **Chilled Water Coil Selection:** Chilled water coils shall be sized for a 16 degree rise between the supply and return. Entering water temperature shall be assumed to be 45 degrees by the time it reaches the cooling coil.
- c) **Controls:** Building controls that monitor or regulate flow of chilled or hot water from the plant to the individual satellite building shall communicate directly with the North Campus Heating and Cooling Plant.
- The building chilled water differential pressures set point shall be reset based on critical zone chilled water valve position.
  - The building chilled water valve shall be controlled based on secondary chilled water temperature being a user adjustable 1 – 2°F above the chilled water loop supply temperature.
3. **Pipe Installation:** Piping for domestic water and hydronic hot/chilled water systems shall not be installed in or under concrete slabs on grade, except where necessitated by building entrances or under sidewalks.
4. **Prohibited:** Chilled water distribution piping inside buildings shall not be polyvinylchloride (PVC) pipe.
5. **Piping:** Chilled water lines shall be wet tapped with resilient seat gate valve at connection point to main.
6. **Pumps:** Pumps shall be enclosed in a waterproof insulated metal box, constructed of minimum 18 gauge galvanized or stainless steel. Box shall be screwed to facilitate easy removal and reinstallation.
7. **Pump Drives:** Condenser water pumps shall have VFD's unless an engineering and economic analysis indicates that they are not feasible, or are not in accordance with manufacturers recommendations.
8. Valves:
- a) **Control Valves:** Valves controlling the flow of hot or chilled water to a coil or other heating/cooling device shall be pressure independent two-way valves. Three way valves are not allowed.
  - b) **Drain Valves:** Install drain valves in accessible locations at all low points in the piping system to permit drainage and servicing.
  - c) **Equipment Isolation:** All equipment including, but not necessarily limited to: heat exchangers; coils; convectors; fan coil units; pumps; boilers and air separators shall incorporate isolation valves to allow replacement without a total system drain down.
  - d) **High Performance Valves:** All non-flow controlling valves in hydronic systems shall have high performance lugged wafer butterfly valves with M-filled Poly Tetra Fluro Ethylene (PTFE) seat and seals and gear operator or high performance full port ball valves with carbon steel body, stainless steel ball and stem, and M-filled PTFE seat and seals on smaller lines.
  - e) Installation:
    - **Valve Stem Position:** Valves installed in horizontal piping shall have the valve stem at or above the center line of the pipe.
    - **Chain Operators:** Provide chain operators for valves 4" and larger, located 8' A.F.F. or higher. Extend chains to within 5' A.F.F.
  - f) **Zone Isolation:** As a minimum, isolation valves shall be provided on the supply and return for each of the following locations:



- At the main supply to each floor
  - At the base of each vertical riser
  - At each branch take-off from the piping main
9. **Dissimilar Metals:** Use bronze fittings when connecting piping of dissimilar metals.
10. **Flow Control Devices:** A flow control device shall be provided on the return side of each coil and radiant heating device.
- a) **Manual Flow Control Devices:** When manual flow control valves are selected, they shall be multi-turn flow regulating valves equivalent to a B&G Circuit Setter.
  - b) **Automatic Flow Control Devices:** Automatic flow control devices equivalent to Autoflow valves utilizing a variable flow spring loaded piston may be used in lieu of manual balancing devices. Automatic flow control devices do not require a balancing device in the bypass around the coil when three-way valves are used.
  - c) **Factory Assemblies:** Pre-assembled combinations of flow control devices, strainers, control valves and isolation valves to facilitate field piping are acceptable.
    - Units that contain combinations of control valves, strainers, isolation valves within one factory housing are prohibited.
11. **Air Venting and Purging:** Provide a system of air venting and purging for each hydronic system. Building hydronic systems connected to a regional heating or cooling plant shall not rely on the air separators located in the remote plant.
- a) **Air Vents:** Provide automatic air vents at the high point of the supply and return of each piping system. Each air vent shall be isolated with a ball valve for isolation once the system is vented. Specification shall require each air vent and isolation valve to be accessible for service.
  - b) **Air Separators:** Provide an air separator with a coalescing type with dirt separation equivalent to a Spirotherm Dirt Separator for each closed hydronic system. Specify with a drain valve and automatic air vent, compatible with isolation valve.
    - **Support:** support air separators independently of piping system.
12. Strainers:
- a) **Equipment Strainers:** Equipment strainers shall be placed upstream of each pump and control valve, including but not limited to chilled and hot water valves serving buildings and individual units like fan coil units, VAV reheat valves, bypass valves and control valves on build up AHUs.
    - **Blow Down Valves:** Equipment strainers shall be provided with a blow down valve, complete with a hose bib connection and cap.
  - b) **Building System Strainers:** Building systems (hot, chilled and condenser water) shall be provided with a set of strainers piped in parallel and valved to allow for individual removal without interruption of the building service.
    - **Blow Down Valves:** Building system strainers shall be provided with a blow down valve, complete with a hose bib connection and cap. For strainers larger than 1 ¼" the blow down shall be hard piped to the nearest floor drain. Drain size shall be full size of blow down outlet run the entire length.



- **Strainer Mesh:** Strainers shall be provided with both a coarse mesh for system start-up and a fine mesh for normal operations.
13. **Filters:** Each piping system shall be provided with taps and isolation valves to allow connection of a filtering system.
- a) **Permanent Sand Filters:** For heating and cooling plants, each hydronic system (hot, chilled and condenser water) shall be provided with a permanent sand filter for continual scrubbing of the individual hydronic system.
14. **Cooling Coil Condensate:**
- a) **Disposal:**
    - **Storm Drains:** Cooling coil condensate shall be piped to a storm drain where possible.
    - **Sanitary Drains:** If condensate cannot be run to a storm drain, pipe to a sink or sanitary drain. Provide an air gap fitting and p-trap where applicable.
    - **Roof Drains:** Roof top equipment shall run condensate to roof drains or gutters where available. Condensate shall not drip directly onto roofs.
  - b) **Condensate Pumps:** Pumped condensate systems shall not be used.
  - c) **Minimum Pipe Size:** Cooling coil condensate lines shall be nominal 1-1/4 inch minimum diameter, except for individual air handling units and fan coil units 1 ton and smaller may be reduced to 1”.
  - d) **Cleanouts:** Cooling coil condensate lines shall have cleanouts that allow access of all branches of the condensate drain system.
15. **Perimeter Heat:** Perimeter heat is needed at large windows and exterior walls, and shall be interlocked with AHU/zone control. Perimeter heat will normally be supplied from a closed building LTHW loop.
16. **Building Pumps:** Hot and chilled water distribution pumps shall be sized for N+1 capacity.

### 23 22 00 Steam and Condensate Piping and Pumps

1. **Steam Availability:** Steam is generated year-round at the Main Utility Plant. For buildings located in the Old Campus and Historic Campus, steam is available at 80 psig.
2. **Design Criteria:**
  - a) **Pressure Class:** All medium pressure steam distribution and condensate return piping systems shall be designed for 250 psig.
  - b) **Steam Traps:**
    - **Equipment Loads:** F&T traps with a bypass installed around the trap.
    - **Drip Legs:** Inverted bucket or bimetallic trap without a bypass.
  - c) **Test Ports:** Provide 1/4” test ports with ball valves on all steam traps. Locate the test port between the steam trap and check valve.
  - d) **Condensate Return:** All uncontaminated steam condensate, including condensate from clean steam humidification systems must be returned to the system.
  - e) **Condensate Pumps:** Specify pressure powered condensate pumps rather than electric where steam is available and there is no back pressure.



- f) **Strainers:** Steam strainers shall be installed horizontally so condensate does collect in them.
3. **Allowable Uses:** Steam may be used to generate building and domestic hot water or clean steam for humidification purposes where justified, or process use in laboratories and food preparation.
4. Prohibited Uses:
  - a) **Building Heat:** Steam shall not to be distributed throughout a building for heating purposes. Renovations of buildings with existing steam heat shall be converted to a hot water distribution system outside of the mechanical room.
  - b) **Building Humidification:** Where building humidification is allowed, steam from the central plant shall not be used directly for winter humidification.
5. **Heat Exchangers:** Heat exchangers generating potable hot water or clean steam shall be double wall construction and UL listed for the intended purpose.
6. Valves:
7. **High Performance Valves:** All steam, condensate, and MTHW systems shall have high performance lugged wafer butterfly valves with M-filled Poly Tetra Fluro Ethylene (PTFE) seat and seals and gear operator or high performance full port ball valves with carbon steel body, stainless steel ball and stem, and M-filled PTFE seat and seals on smaller lines.
8. Pipe and Fittings:
9. **Low Pressure (15 PSI and Lower):**
  - **Steam Pipe:** Minimum schedule 40
  - **Condensate Pipe:** Minimum schedule 80
  - **Fittings:** Cast or forged steel.
10. **High Pressure (over 15 PSI):** All high pressure steam and condensate fittings shall be class 300 malleable iron, cast steel, or forged steel (not cast iron).

### 23 23 00 Refrigerant Piping

1. **Materials:** Refrigerant liquid and suction piping shall be type "K" hard-drawn copper.
  - a) **Flared Fittings:** Main piping fittings for dryers, sight glasses, expansion valves and controls shall be flared.
  - b) **Silver Solder:** Copper-to-copper joints between compressor and condenser shall be made with silver solder. A nitrogen purge shall be maintained while soldering all joints.
2. **Insulation:** Suction lines shall be insulated. Where exposed to direct sunlight or physical damage protect insulation with aluminum jackets.
3. **Refrigerant Sensors:** Where sensors are required, refrigerant sensors, which can detect small leaks shall be used as opposed to oxygen deprivation sensors.

### 23 25 00 HVAC Water Treatment

1. Treatment



- a) **Standard Requirements:** The standards to be met by the Contractor in flushing, cleaning and treating the system.
    - **Initial Flush:** All HVAC piping systems and system related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove construction related deposits such as pipe dope, oils, loose mill scale, and other extraneous material.
    - **Equipment Cleaning:** Equipment shall be cleaned and/or boiled-out in accordance with the manufacturer's instructions.
    - **Filtering:** Existing piping systems shall be circulated and filtered to remove oxidation, scale and other built up particulates. Water samples shall be taken and tested to document particle counts.
    - **Central Plant Lock-Out, Tag-Out:** In order to prevent the contamination of central heating and cooling equipment and associated distribution systems, building hot and chilled water valves isolating the building from the central plant system shall be tagged and locked out by Facilities Management. The valves shall be opened only after the building system has been satisfactorily cleaned and treated.
  - b) **Equipment Bypass:** Equipment subject to fouling, such as flat plate heat exchangers, shall be designed with bypass loops to allow initial circulation and filtering of the piping systems without fouling the associated equipment.
  - c) **Chemical Formulation:** That the chemical formulation used shall be compatible with system materials;
  - d) **Owner Notification:** The Contractor shall notify the owner 30 days before the boil-out/cleaning of the system and the application of the chemicals are started.
  - e) **Independent Observation:** The Owners Water Treatment Consultant shall observe and monitor the boil-out/cleaning of the system and the initial charge of chemicals required for placing the equipment in normal service. The Owner and his Water Treatment Consultant shall continue monitoring and treating the water after initial treatment.
2. **Shot Feeders:** All building hot and chilled water systems shall be provided with chemical shot feeders for initial cleaning and continual maintenance of the hydronic loops.
    - a) **Central Plant Connected Systems:** After initial chemical cleaning of new and renovated hydronic piping systems, building piping systems that are open to a central plant shall be filled with clean water. Once ready, the building isolation valves shall be opened by FM. Adjustments to the central plant chemical concentration shall be made by FM at the central plant and charged to the project.
  3. **Contractor Responsibilities:** The Contractor shall be responsible for providing all equipment, fittings, tubes, valves, connections, labor, chemicals and miscellaneous hardware for the boiler boil-out, and for the flushing and cleaning of the piping systems.
  4. **Owner Furnished Project Funded Chemicals:** The chemicals and procedures to be used by the Contractor for the specified initial treatment shall be furnished by Facilities Management and funded by the project. The owner will take over all chemical treatments after the initial treatment by the contractor.
  5. **Mixing of Chemical Treatment Sources:** Two pipe systems and other configurations that will allow mixing of two or more chemical treatment sources shall not be used.



6. **Glycols:** Glycols and other heat transfer fluids shall only be used in limited systems such as heat recovery loops, or thermal storage systems that serve only a single central station AHU.

## 23 30 00 HVAC Air Distribution

### 23 31 00 HVAC Ducts and Casings

1. **SMACNA Requirements:** All duct systems shall be designed, constructed and tested in accordance with applicable SMACNA standards.
  - a) **Elbows:**
    - **Radiused Elbows:** Minimum centerline radius of 1 1/2 times duct width. Radiused elbows with a mitered throat are not allowed.
    - **Mitered Elbows:** Single width turning vanes for elbows less than 18" wide, double width turning vanes for larger elbows. Mitered elbows without turning vanes are not allowed.
    - **Transition Elbows:** Transition elbows that change duct size are not allowed.
  - b) **Take-Off Fittings:** In order to reduce pressure loss, rectangular take-off fittings shall be provided with a 45° entry. Round take-off fittings shall be bellmouth or conical. Straight taps are not allowed.
    - **Dampers:** All take –off fittings shall be provided with dampers for balancing.
  - c) **AHU Transitions:** Transitions from low to high velocity at outlet of air handling units shall be smooth and tapered. Outlet plenums that are the full size of the AHU or cooling coil, with small high velocity outlets, are not acceptable.
2. **Duct Liner:** Internally lined duct and fittings are not permitted.
  - a) **Exceptions:** The following provisions shall apply to the installation and use of duct liner when approved:
    - **Required Coating:** Acoustical duct lining shall be epoxy or Mylar coated.
    - **Installation:** All duct liner installations shall be installed with both adhesive and metal fasteners.
    - **Edge Treatment:** All edges (regardless of orientation) shall be sprayed with an epoxy coating to mitigate friability. Leading edges shall be protected with metal nosing channel or zee. Incomplete edge treatment is cause for fitting or ductwork to be removed.
    - **Dimensions:** Dimensions shall be listed as inside clear.
3. **Prohibited:** Pre-fabricated grease duct systems are prohibited.
4. **Wet Locations:** Exhaust ducts from wet locations such as showers or sculleries shall be aluminum or stainless steel construction. Seal joints water tight to prevent condensate from dripping.
5. **Diffuser & Register Plenum Boxes:**
  - a) **Independent Support:** Any plenum box provided with a diffuser, register or grille that is resting on the ceiling grid shall be supported independently of the ceiling grid.
  - b) **Return Air Plenums:** Return registers and grilles used to return air to a ceiling plenum shall be provided with a plenum box to minimize light transmission and visibility of utilities above the ceiling.
    - **Paint:** Paint the inside of the box flat black.





- **Balancing Damper:** Provide each return plenum box with a take-off fitting and balancing damper.
- 6. **Perforated Double Wall Ductwork:** Perforated double wall acoustical ductwork shall not be used where exposed to unfiltered outdoor air or moist conditions exist.
- 7. **Perforated Ductwork:** Perforated single wall ductwork shall not be used in lieu of return registers or grilles.
- 8. **Mixing Boxes and Blenders:** Mixing boxes, blenders, or equal are required where outside air and return air mix to prevent stratification.
- 9. **Cooling coil casings and drain pans:** Cooling coil casings and drain pans shall be stainless steel. All structural supports, etc. in air handling units immediately downstream of humidifiers shall be stainless steel.

### 23 32 00 Air Plenums and Chases

1. **General Exhaust:** Exhaust air must be fully ducted. Positively pressurized exhaust systems shall not be allowed to run in supply and return air plenum spaces.

### 23 33 00 Air Duct Accessories

1. **Fire Dampers:** Fire dampers shall be 100% free area type and shall be UL listed as dynamic use.
2. **Outside Air Dampers:** Outside and exhaust air dampers shall be low leakage type. Outside air and return air dampers shall be independently modulating. Specification shall state maximum allowable leakage under a given pressure. All outside air and return air dampers shall be fully modulating and controlled by the building automation system.
3. **Balancing Dampers:** Balancing dampers shall be installed at each floor take off.

### 23 34 00 HVAC Fans

1. **Point of Use Fans:** Individual exhaust fans in janitor's closets or single toilet restrooms shall not be used where central systems are available or reasonably achieved. If such individual exhausts are used, they shall be connected to BAS to provide status and on/off control unless the latter is prohibited per another technical standard.
2. **Outlet Manifolding:** Outlets of multiple exhaust fans shall not be manifolded together unless backdraft protection is provided.
3. **Face Velocity:** Chilled water coils shall be sized for a maximum face velocity of 475 feet per minute.

### 23 36 00 Air Terminal Units

1. **Two Way Control Valves:** All air terminal units provided with hydronic heating coils shall be provided with pressure independent two way control valves and discharge temperature sensor.
2. **Flow Ring:** All air terminal units equipped with damper controls shall have a flow ring.

### 23 37 00 Air Outlets and Inlets

1. **Prohibited:** Thermafusers are not allowed.
2. **Scheduled Information:** As a minimum, the following shall be scheduled on the drawings:
  - Throat Dimensions.



- Hood dimensions (Width, Length, Height).
  - Insulated roof curb, min. 12” high. Provide with cant strip when used with built up roofs.
  - Air flow (Max. CFM).
  - Pressure loss corresponding with specified CFM.
  - Bird Screen
  - Filters (if applicable)
3. **Outside Air:** Intemperate air shall not be supplied directly to occupied spaces or into the returns of fan coil units. Tempered outside air shall not be supplied to fan coil units but directly to the occupied spaces.
  4. **System Type:** Constant volume systems shall only be used where required by program or where variable volume air control is impractical. Constant volume systems shall have a means to pre-cool and dehumidify outside air before being mixed with the return air. A chilled water coil, heat recovery device or other method approved by Facilities Management may be used.

### 23 38 00 Ventilation Hoods

#### 1. Kitchen Hoods:

- a) **Wall Surfaces:** Wall surfaces adjacent to cooking equipment and hoods shall have the following characteristics:

- **Cleanability:** Wall finishes shall be non-porous, water resistant and designed to be easily cleaned.
- **Fire Resistance:** Walls and finishes shall be designed to be non-combustible.
- **Existing Conditions:** Where new cooking equipment and/or hoods are to be provided in existing facilities the adjacent walls and finishes shall be brought up to current standards. Walls and finishes adjacent to existing equipment do not need to be brought up to current standards unless the hood or cooking equipment are being changed as part of the project.

2. **Fume Hoods:** Hoods and hood exhaust systems shall be variable air volume with sensors and controls as necessary to modulate exhaust and make-up air flows.

- a) **Variable Volume Hoods:** Provide with appropriate sash controls to monitor and control the air flow airflow as required to maintain face required face velocities.

- **Alarms:** Provide a local visual alarm at the hood and an alarm to the BAS whenever the measured face velocity exceeds the specified range of allowable face velocities. The alarm shall require a manual reset.
- **Face Velocities:** Face velocities shall be between 80 and 100 fpm unless the manufacturer has certified the performance at a different face velocity or if testing in place using ASHRAE 110 determines a face velocity that ensures effective capture. All test reports shall be reviewed by EH&S.
- **Variable Volume Controls:** Control systems for variable volume fume hoods and the variable volume makeup air to the laboratory shall be sole sourced to Phoenix Controls. Phoenix controls shall be integrated with the BAS. All provisions outlined under “Controls” below shall apply.



- b) **Laboratory Air Changes:** If lab air changes must remain constant, a constant volume supply air system shall be used along with constant volume bypass type hoods.
- c) **Combined Exhausts:**
  - In laboratory buildings with fume hoods which combine fume hood exhaust with building exhaust, all exhausts from each lab shall be combined into a single duct and provided with an airflow measuring station before connecting to the building exhaust system.

## 23 40 00 HVAC Air Cleaning Devices

### 23 41 00 Particulate Air Filtration

1. **Central Station Air Handling Units:** Built up central station air handling units and related heat recovery devices shall be provided with a MERV 13 extended surface high performance mini pleat main filter.
  - a) **Filter Sections:** Filter section shall include:
    - A window
    - A light, operable from outside the unit.
    - DP sensors across filter tied into the building automation system.
2. **Packaged Air Handling Units:** Provide with MERV 11 extended surface high performance mini pleat filter.
3. **Heat Recovery Devices:** Filters shall be provided on both sides of heat recovery devices. A window and light shall be provided to allow viewing of filters without stepping into the exhaust air stream.
4. **Replacement Filters:** A complete set of filters shall be provided to the university following commissioning and acceptance.

## 23 50 00 Central Heating Equipment

### 23 52 00 Heating Boilers

1. **Burners:** All boilers shall have low NOX burners.

### 23 57 00 Heat Exchangers for HVAC

1. **Steam and Hot Water:** All hot water and steam heat exchangers shall have 90/10 copper/nickel tubes and brass tube sheets.
2. **Two Way Control Valves:** All hot and chilled water heat exchangers shall be provided with pressure independent two way control valves.

## 23 60 00 Central Cooling Equipment

1. **Chiller Technology:** Water cooled chillers shall be oil free, magnetic bearing, and variable speed unless equipment is not commercially available in the size range required.
2. **Automatic Cleaning Capability:** Water Chillers 400 tons and above shall be equipped with an automatic cleaning system.



3. **Meters:** Water chillers 400 tons and above shall be provided with individual electric meters (see Section 26 09 00 for specifications) or at a minimum, the chillers, pumps and cooling tower fans shall be metered separately from other equipment within a building or central utility.

### **23 61 00 Refrigerant Compressors**

4. **Protective Devices:** Installation shall be provided with necessary protective devices, including, but not limited to:
  - a) Electrical overload devices
  - b) Phase loss protection
  - c) Low suction and high head pressure cutouts
  - d) Low lube-oil pressure cutouts
  - e) Oil traps
  - f) Crankcase heaters
  - g) Anti-cycling timers and head pressure controllers.
5. **Capacity Control:** Schedules shall indicate the capacity for cylinder unloading and hot gas bypass for each compressor as applicable.
6. **Prohibited:** Water-cooled condensing units using domestic, potable water on a single-pass cycle are prohibited.

### **23 62 00 Packaged Compressor and Condenser Units**

1. **Protective Devices:**
  - a) See section 23 61 00 above
  - b) **Hail Guards:** Specification shall require hail guards and other optional features designed to protect the refrigerant coils from damage.
  - c) **Bollards:** Bollards shall be provided where subject to damage from traffic.
2. **Capacity Control:** See section 23 61 00 above
3. **Condenser Water:** See section 23 61 00 above

### **23 63 00 Refrigerant Condensers**

1. **Protective Devices:** See section 23 62 00 above
2. **Capacity Control:** See section 23 61 00 above
3. **Condenser Water:** See section 23 61 00 above

### **23 64 00 Packaged Water Chillers**

1. **Protective Devices:** See section 23 61 00 above
2. **Hail Guards:** See section 23 62 00 above



3. **Bollards:** See section 23 62 00 above
4. **Capacity Control:** See section 23 61 00 above
5. **System Volume:** Provide documentation that chilled water system meets manufacturer's recommendation for minimum system volume, (Gal/Ton).
6. **Condenser Water:** See section 23 61 00 above
7. **Chiller Technology:** Water cooled chillers shall be oil free, magnetic bearing, and variable speed unless equipment is not commercially available in the size range required.
8. **Water chillers 400 tons and above** shall be equipped with an automatic cleaning system.
9. **Metering:** Water chillers shall be provided with individual electric meters (see Section 26 09 00 for specifications) or at a minimum the chillers and pumps and cooling tower fans metered separately from other equipment within a building or central utility.
10. **BAS Integration:** Packaged water chillers shall be connected to the BAS in order to pass operating data and remote control capability.

### **23 65 00 Cooling Towers**

1. **Fan Blades:** Fan blades shall be aluminum.
2. **Variable Frequency Drives:** Fans shall be provided with direct- coupled variable frequency drives (VFD's).
3. **Water Filtration:** Each new and renovated cooling tower project shall include a side stream sand filter to continually clean the condenser water loop.
4. **Tower Construction:** Tower structural steel and sump shall be stainless steel. Access platforms can be galvanized steel or fiberglass.

### **23 70 00 Central HVAC Equipment**

#### **23 72 00 Air to Air Energy Recovery Equipment**

1. **Where Required:** Ventilation systems designed to precondition outdoor air prior to delivering it directly to occupied spaces or terminal HVAC equipment shall utilize an air to air heat recovery system.
2. **Central HVAC equipment** shall include wrap-around heat pipe technology when payback is 15 years or less.
3. **Heat Wheels:** Heat wheels shall not be used.

#### **23 73 00 Indoor Central-Station Air-Handling Units**

1. **Single Point Electrical Hookup:** All air handler units shall be provided with a single point of electrical hook up when appropriate to size or type. All other air handlers shall show all circuits and voltages necessary for fans, lights, etc.
2. **Freeze Protection:** Freeze protection shall be provided on all air handling units. Freeze stats shall stop the supply fan, close the outside damper, and open the heating coil valve.



3. **Two Way Control Valves:** All heating and cooling coils shall be provided with pressure independent two way control valves.

## **23 80 00 Decentralized HVAC Equipment**

### **23 81 00 Decentralized Unitary HVAC Equipment**

1. **Equipment Locations:** Wherever practical, equipment to be located above ceilings shall be located and serviced from corridors as opposed to offices, classrooms, laboratory ceilings or other occupied spaces.
2. **Monitoring:** Decentralized Unitary HVAC equipment including but not limited to fan coil units, space heaters, exhaust fans and perimeter heating systems shall be tied into the building automation system with the ability to remotely monitor / control the equipment.”

### **23 83 00 Radiant Heating Units**

1. **Perimeter Heat Requirements:** Perimeter heat is needed at large windows and exterior walls, and shall be interlocked with AHU/zone control. Perimeter heat shall be supplied from the building LTHW closed loop heating system.
2. **Two Way Control Valves:** All hot water radiant heating units shall be provided with pressure independent two way control valves.

### **23 84 00 Humidity Control Equipment**

1. **Steam to Steam Heat Exchangers:** See section 23 22 00 heat exchanger requirements utilizing central plant steam as the heat source.
2. **Water Pretreatment:** All humidity systems are to be supplied with water treated specifically for the purpose of feeding a humidifier. The treatment will specifically prevent scaling and corrosion of the humidifier and associated ductwork as well as consider the impact of chemical addition on air quality within the conditioned space.



## 26 00 00 Electrical

### 26 05 00 Common Work Results for Electrical

#### 1. Conduits:

- a) **Minimum Conduit Size:** Minimum conduit size shall be  $\frac{3}{4}$ ".
- b) **Connectors:** Steel compression or stamped steel set screw type connectors and couplings shall be used.
- c) **Empty Conduits:** All empty conduits shall have a 65-lb test polymer (or equivalent) pull string tied off at both ends.
- d) **FMC Use and Limitations:** Flexible metal conduit not exceeding 6-feet in length shall be used only for connections to lighting fixtures and equipment that is subject to vibration and/or movement per the NEC.
- e) **Conduit Installation:** All conduits shall be concealed in finished areas. Conduit shall not be laid on the ceiling system or attached to the ceiling suspension wire. Support from the building structure.
  - **Fire Alarm Devices:** Conduits serving fire alarm devices in exterior locations shall be connected to the bottom of the device box only to prevent moisture intrusion and build-up.
- f) **Surface Raceways:** Surface mounted metal raceways may be used for horizontal distribution of electrical and data cabling in computer rooms, computer classrooms and research laboratories. Pre-existing conditions of surface mounted wiring and conduit does not constitute permission to add surface mounted hardware and raceway.

#### 2. Wiring:

- a) **Wiring Installation:** All wiring shall be run in conduit, surface metal raceway or cable tray. Conduit from the communications or control wiring (under 50V) wall outlet box may terminate several inches above the ceiling where lay-in ceiling tile is used.
- b) **Metal Clad and Armor Clad Cable:** Metal clad and armor clad cable shall not be used for new construction or renovation where walls or ceilings are made accessible to perform the work. Metal clad and armor clad cable may be fished through existing hollow spaces provided it is not secured at any point that will be inaccessible upon completion of the project.
- c) **Conductors:** All conductors shall be copper with 75 °F insulation minimum.
  - **Power Conductors:** All power conductors shall be #12 AWG or larger. No more than eight (8) current-carrying conductors shall be run in a single conduit.
  - **Control Wiring:** Minimum control wires shall be #14 AWG
  - **Signal Wiring:** Minimum signal wire shall be no smaller than #18 AWG unless otherwise recommended by manufacturer.
- d) **Separate Neutrals:** All branch circuits shall have a separate neutral.
- e) **Grounding Conductor:** All new circuits shall have a green equipment-grounding conductor sized per NEC 250.



- **Re-Use of Existing Circuits:** When existing circuits are reused or modified the engineer shall verify by field investigation whether a grounding conductor is run with the phase wires. If no grounding conductor is present the project shall add one to all affected circuits.
- f) **Wire and Cabling (Telecommunications and Control):** Wiring and cabling run above an accessible ceiling shall be neatly bundled and attached to or independently supported from the building structure above. Wiring and cabling shall not be laid on the ceiling system or attached to the ceiling suspension wire. Support from the building structure.
3. **Identification for Electrical Systems:** Electrical equipment and circuits shall be marked and labeled for identification purposes in accordance with the NEC.
- a) **Nameplates:** Mechanically fastened laminated nameplates shall be provided on the exterior surfaces of all electrical equipment and shall include system voltage, phase and source of power and source location. See example nameplate wording in the following table.
- **Existing Equipment:** All existing electrical equipment that is part of the work of the contract and does not have a nameplate that meet this criteria shall be provided with one as part of the contract. This includes equipment where a new breaker is installed, connections are made or removed or any work associated with the equipment.
  - **Submissions:** Nameplates shall be submitted with shop drawings for approval.
  - **Text Height:** Main text height shall be ½” high and subtext height shall be ¼” high.

<p>Switchboard labeling:</p> <p>SWITCHBOARD SWBD-1 3000A MCB, 480Y/277V, 3PH., 4W SERVICE ENTRANCE RATED FED FROM 1500 kVA TRANSFORMER ON NORTHEAST SIDE OF BUILDING</p>	<p>Panelboard labeling:</p> <p>PANELBOARD H1A 600A MLO, 480Y/277V, 3PH., 4W FED FROM SWBD-1 CKT. 2 LOCATED IN MECH. RM. 1001</p>
<p>Disconnect Switches</p> <p>DISC. SWITCH – AHU-1 60A N/F, 600V, 3PH., 3W FED FROM SWBD-1 CKT. 2 LOCATED IN MECH. RM. 10</p>	<p>Motor controllers, (Starters, VFD, etc.)</p> <p>STARTER – AHU-1 NEMA 00, 600V, 3PH., 3W FED FROM SWBD-1 CKT. 2 LOCATED IN MECH. RM. 10</p>
<p>FACP</p> <p>FIRE ALARM CONTROL PANEL FED FROM PANEL LA-CKT. 5 LOCATED IN BASEMENT MECHANICAL ROOM</p>	<p>Panelboard labeling: Emergency Power</p> <p>PANELBOARD H1A 600A MLO, 480Y/277V, 3PH., 4W FED FROM SWBD-1 CKT. 2 LOCATED IN MECH. RM. 1001</p>





PULLBOX (PB-1) CONTAINS PANEL HA1 FEEDER FED FROM PANEL HA LOCATED IN MECH. RM. 10	PULLBOX (PB-1) CONTAINS CIRCUITS HA-1,3,5 FED FROM PANEL HA LOCATED IN MECH. RM. 10
Equipment Nameplate Example Wording	

- b) **Normal Power:** Labels for equipment served normal power source shall have a black background with white lettering.
  - c) **Emergency and Standby Power:** Labels for circuits served from a generator shall have a red background with white lettering and shall contain the word “Emergency” or Standby” in the description.
  - d) **Junction Boxes and Pull Boxes:** Junction and pull boxes shall be labeled using a black indelible marker indicating power source and circuit.
  - e) **Receptacles and Devices:** Receptacles and devices are to have an adhesive type label on the back of the cover plate.
  - f) **Emergency Light Fixtures:** Emergency light fixtures shall be identified by a red dot/circle on the frame.
4. **Phase Color Coding:** Conductor color-coding shall match the existing building convention. If none exists, the phase colors for 120/208V systems shall be red, blue and black. The phase colors for 277/480V shall be yellow, orange and brown.
5. **Demolition:**
- a) **Wire:** All wire shall be removed back to the last active device, junction box or panel board. All exposed and/or accessible conduits and boxes shall be removed.
  - b) **Floor Mounted Devices:** Where floor mounted devices are removed the floor slab shall be ground down and grouted flush.
  - c) **Telecommunication Systems:** When telecommunications systems are replaced, abandoned wire and cabling shall be removed with walls and ceilings restored to their pre-existing condition.

**26 09 00 Instrumentation and Control for Electrical Systems**

- 1. **Primary/Secondary Metering:** The University has buildings which are primary metered and others which are secondary metered. Buildings served from the Inner and Outer Loops are primary metered. All other buildings are secondary metered. All buildings will be individually metered with meters approved by the Associate Director, Central Utilities and located in separate panel with shunt blocks. These meters shall be connected to the energy metering system via a web interface capable of local data storage.
- 2. **Individual Building Metering:** Metering shall be installed at each building service equipment main switchboard. Any building not on the primary loop metering system and requiring a Dominion power meter shall have the meter installed outside of the building.
- 3. **Minimum Meter Requirements:** Metering shall be digital, with the following features as a minimum:
  - a) True RMS metering through the 31st harmonic



- b) Real-time readings for current, voltage, real power, reactive power, apparent power, power factor, frequency, THD and k-factor
  - c) Demand readings for current, power factor, real power, reactive power and apparent power
  - d) Energy readings for real, reactive power
  - e) BAC NET IP
  - f) 0.2% accuracy class
  - g) Alarm/relay functions
  - h) On-board data logging
  - i) Date/time for each min. /max.
  - j) Downloadable firmware
4. **Meter Accuracy:** Accuracy of meters shall be verified and corrected if necessary, within 10 working days of connection to utilities.

## 26 20 00 Low-Voltage Electrical Transmission

### 26 21 00 Low-Voltage Electrical Service Entrance

1. **Utility Ownership:** The University purchases electric power for its facilities from Dominion Virginia Power.
  - a) **Primary Feeders:** Typically Dominion owns and maintains all primary feeders and pad mounted transformers
  - b) **Secondary Feeders:** The University typically owns the secondary feeders.
2. **New Services:** New services shall be connected to the Dominion Virginia distribution system.
  - a) **Minimum Calculations Required:** Where new buildings are added to Dominion's primary feeders, or a substantial change to an existing structure is made, submit a calculation at the preliminary submittal showing the existing load on the feeder, new load and feeder capacity.

### 26 22 00 Low Voltage Transformers

1. **Interior Transformers:** Transformers located indoors shall be quiet type unless they are located in a mechanical room with a high ambient noise level.
  - a) **Dry Type Transformers:** Transformers shall be dry-type with the following characteristics:
    - Transformers shall meet or exceed the requirements of NEMA TP-1 for energy efficient transformers.
    - Windings shall be copper
    - Temperature rise of 115 °C maximum
    - HV BIL of 95 kV
    - A cast primary and either a vacuum pressure impregnated (VPI) or cast secondary is preferred
    - AA cooled with at least the provisions for FA cooling.



- b) **Liquid Filled Transformers:** As an alternative, a silicone or other less-flammable liquid-filled transformer (as defined by NEC 450-23) may be used indoors. The liquid shall be Factory Mutual approved.
2. **Isolation Transformers:** K-factor transformers shall be used where large quantities of harmonic producing loads are present. Associated feeders shall also be sized to accommodate anticipated harmonic loads.

## 26 24 00 Switchboards and Panelboards

1. **Electrical Room Requirement:** Building switches and switchgear shall be located in appropriate electrical rooms.
2. **Bussing Requirements:** Bussing shall be copper. Separate neutral and equipment grounding busses shall be provided.
  - a) **Prohibited:** Load centers are prohibited.
3. **Panelboard Circuit Directories:** Directories shall be provided for all electrical construction involving panel boards and switchboards. Directories shall indicate all loads, and their locations using final room numbers, served by each breaker. Spares shall be identified and left in the OFF position.
4. **Surge Protective Device Requirements:** Provide a Surge Protective Device (SPD) at the service entrance (as a minimum) for new buildings and major renovations.
  - a) **External Mounted 'SPD' Devices:** Externally mounted (SPD) devices only are permitted.
5. **One Line Diagrams:** A copy of the one line diagram shall be permanently mounted near the service entrance electrical gear. For renovation projects changes to the one line diagram shall be added and posted.
6. **Panelboard Spare Capacity:** All new panel boards shall have spare capacity (physical and electrical) for future use. Provide a minimum of four 1-inch conduits with pull wire stubbed out into an accessible ceiling space for new recessed mounted panel boards.
7. All switchgear shall be bottom fed.
8. Front-venting switchgear shall not be used.

## 26 27 00 Low-Voltage Distribution Equipment

1. **Ground-Fault Circuit-Interrupter Protection for Personnel:** In addition to code-required ground-fault circuit interrupters on main breakers, **ground**-fault circuit interrupters shall be used on all sub-main breakers in switchgear, set using selective coordination to trip prior to the main breaker.
2. **Minimum Device Duty:** All devices shall be 20A, heavy-duty specification grade devices (minimum).
3. **Prohibited:** Residential grade devices are prohibited.
4. **Receptacle Installation:** All 15 and 20 amp 125 volt general purpose receptacles shall be mounted with the ground pole in the UP position. Receptacles for dedicated equipment like refrigerators, dryers and special purpose outlets for other equipment shall be mounted with the grounding pole in the down position.
  - a) All stairwells shall have a simplex receptacle 20A-125V mounted at each landing (not at intermediate landings) for use by housekeeping.



5. **Wet or Damp Locations:** Provided 'in-use' type covers for outlets installed in wet or damp locations.

## 26 29 00 Low-Voltage Controllers

### 1. Motors:

- a) **Minimum Motor Efficiency:** All motors shall be high-efficiency type, with a service factor of 1.1 or better and shall meet or exceed the standards set forth in NEMA standard MG1-1993 revision 1 through 4, Table 12-10.
  - b) **Three Phase Motors:** Motors ½ hp and larger shall be 3-phase, using the highest available appropriate voltage. All such motors shall be equipped with permanently lubricated bearings.
2. **Motor Controllers:** All light duty and fractional horsepower motors, except light-duty fractional horsepower motors, shall be provided with motor controllers.
    - a) **Controller Requirements:** Controllers shall provide under-voltage protection when used with momentary contact control devices and under-voltage release when used with maintained contact control devices.
  3. **Phase Monitoring and Protection:** All three phase motors shall be provided with three phase monitoring and shall monitor and protect the motor from damage from phase loss, phase unbalance, phase reversal and phase sequence.
  4. **Variable Frequency Drives:** All motor variable frequency drives (VFD's) shall meet IEEE standard 519. Where multiple VFD's are fed from the same panel or MCC, the contractor shall provide individual disconnects for each VFD to facilitate service and a harmonic analysis, at that point, to show compliance with IEEE 519. Include analysis with drive submittals and provide an isolation transformer when necessary.
    - a) **Pulse Width Modulation:** VFDS shall be pulse width modulated (PWM) type.
    - b) **Bypass Circuitry:** VFDS shall be provided with by-pass isolation switches.
    - c) **Disconnects:** Provide individual disconnects for each VFD to facilitate service.
  5. **Disconnect:** A lockable disconnecting means shall be provided at all motor locations. Disconnects located out of sight from the VFD shall be electrically interlocked to prevent inadvertent damage.

## 26 50 00 Lighting

### 26 51 00 Interior Lighting

1. **Occupancy Sensors:** Occupancy sensors shall be used in rooms such as restrooms, single person offices, storage rooms, custodial or janitorial closets, etc. Provide multi-technology sensors in spaces as recommended by sensor manufacturers. Sensor layout and coverage shall be shown by the manufacturer during the shop drawing process and reviewed and approved by the engineer.
  - a) **Conference Rooms and Classrooms:** Occupancy sensors shall be used in conference rooms and classrooms.
  - b) **BAS Interface:** Occupancy sensors shall send a status signal to the Building Automation System.
2. **Multiple Circuits and Switching:** Multiple circuits/switching shall be provided in classrooms and other large rooms to permit reduced power consumption.



3. **Lighting Fixtures:** LED lamps shall be used for lighting. Lamp temperatures shall be 4000 °K.
  - a) **Fluorescent fixtures:** When approved, shall use T-8 or compact fluorescent lamps. Fluorescent lamps shall have a minimum CRI of 80. All fluorescent ballasts shall be electronic except in areas where the usage requirements take precedence. Lamps are to be the low-mercury content, “green tip” type, passing the EPA test for non-hazardous waste.
  - b) **Fixture Selection:** The use of 2’ x 2’ light fixtures is required.
4. **Exit Signs:** Exit signs shall be red LED type with diffused lens and battery back-up.
5. **Custom Fixtures:** Non-catalog and custom lighting fixtures shall not be used.
6. **Service Accessibility:** All fixtures shall be mounted so that they can be maintained safely without specialized equipment or procedures. Fixtures shall be wall mounted in stairwells so that maintenance can be accomplished with an eight-foot stepladder.
7. **Required Lighting Levels:** Interior lighting levels shall comply with the recommended foot-candle levels found in IESNA Lighting Handbook, most current edition.
  - a) **Mechanical & Electrical Rooms:** Lighting levels for mechanical rooms and electrical rooms shall be 20-30 foot-candles average maintained.
  - b) **Telecommunication Rooms:** Lighting level for telecommunications rooms shall be 50 foot-candles.
  - c) **Corridors:** The corridor lighting shall be dimmed or switched off to the extent that the code required minimum egress and emergency lighting illumination is always maintained.
  - d) **Stairways:** Lighting in stairways shall not be reduced from the design level at any time by switching or other means.
  - e) **Mechanical; Electrical & Telecommunication Rooms:** Mechanical, electrical and IT room lights shall have an emergency battery pack and shall be circuited to an emergency power circuit when available.
  - f) **Task Lighting:** The use of user provided task lighting is to be encouraged and maximized. The illuminance ratio for maximum to minimum light levels shall not exceed 10:1 in any occupied space.
  - g) **Equipment Illumination:** For safety reasons light fixtures will be located at or around equipment so that maintenance personnel will not obscure the required illumination.
  - h) **Fixture Support:** Recessed light fixtures are to be suspended from the structure. Do not support solely from the ceiling suspension system.
  - i) **Emergency Illumination:** Emergency illumination shall be provided by light fixtures which contain an integral battery ballast or fixtures that are connected to an emergency power system. Emergency only light fixtures (unit type / emergency backup unit equipment) shall not be used on campus.

## 26 56 00 Exterior Lighting

1. **Required Illumination:**
  - a) Means of Egress Illumination:
    - **Public Way Definition:** For the purpose of site lighting as required under this manual, the Public Way is defined as the nearest street or campus sidewalk.



2. **General Campus Lighting:** General campus lighting outside of the “Means of Egress Illumination” defined above shall comply with the following Illumination levels:

Exterior Illumination Requirements – Horizontal (Measured at Grade)		
Location/Area	Foot-candle levels	Remarks
Paths, Walks and Ramps	0.5 avg. & 0.125 min.	4:1 avg./min.
Exterior Steps	0.2 min. top to bottom	4:1 avg./min.
Roadways	Per IES Recommendations	
Parking Lots & Garages	Per IES Recommendations	
Exit Discharge (Normal)	Per VUSBC/IBC	
Exit Discharge (Emergency)	Per VUSBC/IBC	

3. **Fixture Type:** All new exterior lighting fixtures shall be university approved cut-off type, designed to meet Illumination Engineering Society (IES) standards for cut-off optics, unless otherwise directed.
- a) **Lamp Type:** LED luminaires
  - b) **Foot Candles:** All foot-candle references are average maintained values, unless otherwise noted.
4. **Pole Mounted Fixtures:**
- a) **Poles and Fixtures:** Poles and fixtures for the campus (excluding the Historic Campus) shall be provided by and installed by the contractor.
  - b) **Manufacturer and Model:** Except for the Historic Campus, the only acceptable pole and fixture for campus wide use are as follows:
    - **Luminaire:** Holophane (AR) Catalog #AR-175PM-MT-Z-A5-S-C; 100 watt System, 5000 series CCT, Auto-sensing Voltage (120-277), 50/60 Hz, Asymmetric Acrylic Refractor, bronze, spike
      - (1) **Lamp:** Shall be modified to accommodate LED lamp (Eiko certified green “LITESPANLED” LED replacement lamp # LED545WPT50KMOG-G8, 54 watts, 7800 lumens, 50,000 hours, 100-277 volts, EX39 extended mogul base) by the installing contractor.
    - **Pole:** Holophane Barrington Aluminum (BRA): Catalog #BRA-12-OTN-20-PRC-ABG-BZ, 12 foot octagonal tapered (cast) 0.375 wall, 20 inch base, 7 inch Post Capital, Anchor bolts, galvanized steel power coat paint finish, bronze.
5. **Installation Requirements:**
- a) **Recessed Lights:** Recessed lights shall not be used in masonry walls or stairs.
  - b) **Lighting Control:** Site lighting shall be photocell controlled in logical groups with hand-off-automatic switch at contactor.



- c) **Circuiting:** Site lighting fixtures are to be powered with underground direct buried copper wiring, insulation colored according to voltage; 120/208V – Black, red, blue; 277/480V- brown, orange, yellow.
- d) **Pole Numbering:** All pole and post-mounted lighting fixtures shall be numbered on the construction documents and on the erected fixture. Obtain fixture ID number and label size/style from Director of Operations and Maintenance.
- e) **Record Documents:** “As-built” or record documents plans for outdoor lighting shall provide a Utilities Lighting Chart with fields designating the following:
- Light fixture ID number (from Utilities)
  - Lamp type (adequate for ordering lamps)
  - Fixture Manufacturer and catalog/model number including all accessories.
  - Electrical feed (building name and number, and panel designation)
  - Watts (lamp and fixture wattage)
  - Voltage
  - Pole height
  - Pole Manufacturer and catalog/model number including all accessories.



## 27 00 00 Communications

### 27 05 00 Common Work Results for Communications

1. **Cabling:** All cabling run above the ceiling shall be plenum rated.
  - a) **In-Building Emergency Communications Coverage:** All new and renovated buildings shall be provided with an in-building emergency communications system complying with the current adopted VCC.
  - b) **Riser Diagram:** Provide a riser diagram of the system on the documents showing all interface points with other systems.
  - c) **Infrastructure:** The A/E shall coordinate system requirements with the owner selected vendor to provide a system of conduits, etc. to support the installation of cabling and equipment.
2. **Cable Television:** Cable television services shall be provided in university residential facilities and other buildings. The cable television system is owned and operated by the university.
  - a) **Cable Connections:** The cable connection is obtained from the university owned system and coordinated through the university PM.
  - b) **Conduit System:** Provide a system of conduits, outlet boxes, backboards, etc. to support the installation of cabling.
  - c) Provide a riser diagram of the system on the documents showing all interface points with other systems.
3. **Other Communication Systems:** Other special systems such as black board system for vending, intercom, audio or paging shall be provided on a project-by-project basis.
  - a) Provide a riser diagram of the system on the documents showing all interface points with other systems.





## 28 00 00 Electronic Safety and Security

### 28 10 00 Electronic Access Control and Intrusion Detection

1. **Building Entrances:** All building entrances for any new building, addition or major renovation shall have conduit, electrical boxes, and a power source to accommodate an electronic access system.
  - a) The design shall include requirements for the contractor to insure coordination of operation of the access system with any power operated doors and with the fire alarm system.
2. **Other Building Locations:** Installation of access control systems in other areas of the building (laboratories, vivarium, valuable collections, cash management areas, etc.) shall be considered on a project-by project basis.
3. **Monitoring:** Security alarm systems are monitored at either the university Police Station on Ukrop Way or by an off-site vendor.

### 28 20 00 Electronic Surveillance

#### 28 23 00 Video Surveillance

1. **Minimum Requirements:** At a minimum, provide a system of conduits, outlet boxes, backboards, etc. to support the installation of a security system.

### 28 30 00 Electronic Detection and Alarm

#### 28 31 00 Fire Detection and Alarm

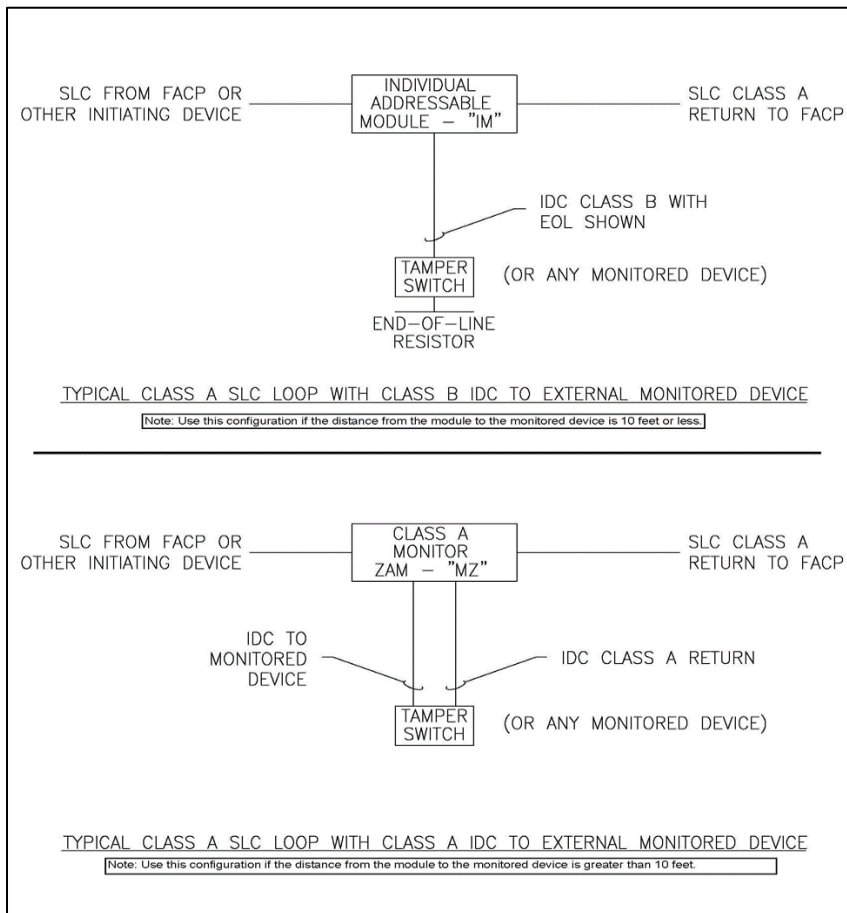
1. **Sole Source Simplex Fire Alarm and Detection System:** The University has standardized campus wide on a Simplex fire detection and alarm system.
2. **Reporting to Campus Police Station:** All new and replacement fire alarm systems shall report to the main panel at the university Police Station. The connection is net based and complete two-way communication is required for all alarms, trouble conditions, and tolling of the system.
3. **New Devices added to Existing Systems:** Where new devices will be added to an existing system, they shall match the types of, or be compatible with, the existing system. Devices added to an existing system shall be able to communicate with the existing system regardless of manufacturer.
4. **Panel Height:** Height of Fire Alarm Control Panel and annunciator LED/LCD readout/ display will be at 60 inches above finished floor.
5. **Hold Open Devices:** Door hold open devices shall be provided on all high traffic, public doors where there is not an established occupant. For sleeping room doors (and individual office doors), provide closure devices but no hold open device.
6. **Voice Alarm Message:** All voice alarm system messages shall use the following pre-approved verbiage and voice:
  - a) Evacuation Message Wording:
    - 10 seconds – or current whoops) followed by;
    - (pre-recorded phrase 161 – 3 times) “Attention, Attention, Attention” followed by;



- (pre-recorded phrase 163) “An emergency has been reported” followed by
  - (pre-recorded phrase 171) “You are to leave the building by the nearest exit or stairway”
- b) Total Evacuation Sounds will be:
- Whoops, message including “Attention .....Stairway”,
  - No whoops
  - Repeat message
  - (no whoops)
  - Repeat message
  - Then whoops continually until silenced.
- c) **Voice:** Female.
7. **Conduit Systems:** All wiring for new and replacement fire alarm systems, including detection devices, shall be installed in conduit.
8. **Conduit Requirement:** All wiring for fire alarm systems shall be installed in conduit except for renovation projects where the existing wiring is not run in conduit.
9. **Notification and Annunciation Circuit Classification:** All new and upgraded fire alarm system notification and annunciation circuits shall be class ‘A’ or class ‘B’ depending upon the following criteria.
- a) **Class ‘A’** circuits shall be provided for dormitories, large buildings, buildings with regular late night hours
- b) **Class ‘B’** circuits shall be provided for all other facilities.
10. **Class ‘A’ Circuits:** The following provisions and sketch SKF-1 apply only to those fire alarm systems which require class ‘A’ circuits. Additionally the circuits addressed by these provisions apply only to circuits for supervising the status of devices like fire pumps, kitchen hoods, tamper, pressure and flow switches, and similar devices. This provision does not apply to automatic detection device circuits which monitor devices like heat and smoke detectors.
- a) **Devices Requiring Fire Alarm Supervision:** Devices requiring supervision by the fire alarm control unit but which are not provided by Simplex (fire pump contact points, kitchen hood monitoring points, tamper and flow switches and similar devices) shall be monitored with Simplex Addressable Monitor Modules as described below.
- **Individual Point Monitoring:** Each monitored point shall be monitored individually; i.e. one tamper switch is one monitored point, one flow switch is one monitored point. For ease of maintenance and troubleshooting, multiple devices on one supervision circuit are not permitted.
- b) **Class ‘A’ Circuits Required by university Technical Standards:** For fire alarm systems requiring class ‘A’ circuits as determined by William and Mary Technical standards, utilization of the standard Simplex 4090-9001 Addressable Monitor Modules using a Class ‘A’ circuit for the addressable SLC, Idnet Channel and Class ‘B’ circuit to the monitored device is permitted as long as the monitored device is within 10’ of the 4090-9001 addressable module. If the monitored device is greater than 10’ from the addressable module, then a 4090-9106 type module and Class ‘A’ circuit is required.
11. Abbreviations:



- a) EOL – End of Line (Resistor)
- b) FACP – Fire Alarm Control Panel
- c) IDC – Initiating Device Circuit
- d) IM – Individual Addressable Module
- e) SLC – Signaling Line Circuit
- f) ZAM – Zone Adapter Module



*Sketch SKF-1*

- 12. **Smoke Detection Requirements:** In all new construction and all major renovations, smoke detectors shall be installed in rooms set up for sleeping and associated egress pathways from sleeping rooms.
- 13. **Elevator, Sprinkler and Fire Alarm Coordination:** Heat detectors shall be used to shut down elevator power.

### 28 34 00 Fuel-Oil Detection and Alarm

- 1. **Leak Detection:** The leak detection system shall be UL listed for the liquid it is intended to detect and shall be monitored by the Building Automation System (BAS).
  - a) **Auxiliary Contacts:** Provide auxiliary contacts as necessary to allow the BAS to monitor status, trouble and alarms.



## 31 00 00 Earthwork

### 31 05 00 Common Work Results for Earthwork

1. **Land Disturbance:** When required, submit an Erosion and Sediment Control Application with supporting documents in accordance with the current W&M Annual Standards and Specifications for Erosion and Sediment Control.
2. **Suitable Topsoil:** Material as defined by the project geotechnical report. In the absence of a project geotechnical report, topsoil that is free from refuse or any material toxic to plant growth and reasonably free from subsoil, stumps, roots, brush, stones, clay lumps or similar objects larger than 3 inches in their greatest dimension salvaged from excavation shall be stockpiled in a location designated by the university for reuse in the project.
3. **Suitable Fill and Backfill:** Material as defined by project geotechnical report.
4. **Surplus Materials:** Clean fill, other than that used for backfilling, may be disposed of on the grounds within the boundaries of the project site. All other surplus material (excavated material and construction debris) shall be disposed of by the contractor off-site legally.
5. **Hazardous Materials:** Specifications shall state that in the event hazardous materials are encountered in site work, work shall be stopped immediately and the university PM promptly notified.

### 31 10 00 Site Clearing

1. **Refuse Disposal:** All logs, stumps, brush, wood, and refuse shall be disposed of off the university grounds in an approved landfill. Consideration will be given to Contractor mulching logs, brush, and wood for use on campus where appropriate. On-site burning is prohibited.
2. **Plant Protection:** Trees, within the Construction Contract Limit Lines are to be protected with rigid fencing (wood or chain link) at or beyond the drip line to prevent damage by equipment and external construction activities. The selection of trees, shrubs, and planting beds within the limits of construction to be protected shall be coordinated through the Associate Director of Grounds and Gardens.
3. **University Maintenance:** Access to specific planting areas that need regular maintenance by university personnel shall be provided through the construction site.
4. **Soil Injections:** Tree root systems, which are likely to be negatively impacted by construction activities as identified in advance by the university Arborist, shall require a slow release liquid fertilizer injection throughout the entire root zone **before and after** the construction activities. Trees transplanted from the project require the same injections.
  - a) Trees not identified in advance for soil injection, but are believed to have sustained root system damage as determined by the university arborist, shall receive root injection after construction activities are completed.

### 31 23 00 Excavation and Fill

1. Trenching, Excavation and Backfill for Utility Installation:
  - a) **Exploratory Excavation:** Where underground project work is in close proximity to existing buried utilities or other existing underground improvements, the contractor will cautiously execute exploratory excavation(s) to verify exact horizontal and vertical positions of existing systems.



Exploratory excavation findings, in order to avoid conflict and maintain required separations and clearances may result in design adjustments to existing and/or proposed improvements

### **31 31 00 Soil Treatment**

1. **Termite/Insect Treatment:** A licensed professional shall treat all new excavations for termite and insect infestation. Specify under slabs, along foundation walls, around all openings and protrusions in slabs on grade.



## 32 00 00 Exterior Improvements

### 32 05 00 Common Work Results for Exterior Improvements

1. **Minimum Elevation:** The 100-year flood elevation shall be as depicted on the latest edition of the Flood Insurance Rate Maps, prepared by the Federal Emergency Management Agency. The minimum finished floor elevation and mechanical/electrical equipment pads must be at least 1 foot above the 100 year flood elevation. The 100 year flood elevation shall be noted on the project documents.
2. **Design Standards:** Storm drainage design and associated construction must be in accordance with the guidance noted herein and the Virginia Stormwater Management Handbook, latest edition.
3. **Surface Storm Drainage:** Grade the site to provide positive drainage away from the facility. Establish finished floor elevations at least 6 inches above finished grade at the perimeter of the building. Use spot elevations to establish positive drainage away from buildings and toward stormwater drainage structures. Ensure that the grading and associated stormwater runoff during construction and at completion of the project does not adversely affect surrounding sites.
4. **Roadways, Parking Lots and associated appurtenances** shall be designed in accordance with the Commonwealth of Virginia “Road And Bridge Standards”, latest edition, unless noted otherwise

### 32 12 00 Flexible Paving:

1. Unless modified by documented site conditions and geotechnical recommendations, flexible light duty pavement shall be designed and installed in accordance with the Geotechnical Engineering Report or as follows:
  - a) **Surface:** Asphalt Concrete, VDOT SM-9.0 A
  - b) **Base:** Asphalt Concrete, VDOT BM-25.0
  - c) **Sub-base:** Untreated Aggregate, VDOT 21A, Type II Compact to 95% Relative Density, ASTM D-698 (Standard Proctor)
  - d) **Placement and Compaction:** All asphalt pavements shall be placed and compacted in accordance with VDOT Road and Bridge Specifications.

### 32 13 00 Rigid Paving

1. **Dumpster Pads:** Reinforced concrete pavement pads are to be constructed for all dumpster locations. Sizes must accommodate the front wheel of the garbage truck when engaged in the collection process. Dumpster pads shall be designed and installed in accordance with the Geotechnical Engineering Report.

### 32 16 00 Curbs, Gutters, Sidewalks and Driveways

1. **Curbs and Gutters:** Curbs and gutters shall comply with Virginia Department of Transportation Road and Bridge Standards, latest edition. Care must be taken to match existing curb and gutter on campus and within the City of Williamsburg.
  - a) Projects located within the areas of campus designated as “Old” and “Historic,” new curbs and gutters shall be designed and constructed with materials to match existing aesthetics of nearby finishes.
2. **Sidewalks – General Requirements:** The minimum sidewalk width shall be 6'-0". Accumulated rain/storm water shall not be allowed to flow across or along sidewalks.



- a) **Fire Truck Use:** Sidewalks intended to be used for fire truck access shall be designed and installed in accordance with the Virginia Fire Prevention Code and the project Geotechnical Engineering Report.
- b) **Separation from Curb:** Pedestrian sidewalks shall be separated from curbing by a minimum 2 foot wide buffer strip measured from the back of the curb to the edge of the sidewalk.
3. **Concrete Sidewalks:** Sidewalks shall be a minimum 5" thick cast in place concrete installed over 6" compacted aggregate base and compacted sub-grade in accordance with the project Geotechnical Engineering Report.
  - a) **Finish:** Walks to be broom finished perpendicular to the direction of traffic flow.
  - b) **Expansion Joints:** Provide expansion joints where sidewalks abut existing structures and at a maximum of 30'-0" on-center along the length of the sidewalk.
    - **Construction:** Joint material shall be set ½-inch below the surface and the joint shall be filled with self-leveling traffic rated sealant. Joint material must not project above the surface of the sidewalk.
  - c) **Control Joints:** The slab between expansion joints shall be spaced equal to the width of the sidewalk at a depth equal to one-quarter of the thickness.
  - d) **Formed Construction:** Formed construction joints shall be provided at the end of each placement.
  - e) **Underdrains:** Sidewalk underdrains shall be installed in accordance with VDOT Road and Bridge Standards, latest edition.
4. **Concrete Driveways:** Construct in accordance with "Concrete Sidewalks" above.
5. **Brick Sidewalks:** Brick sidewalks shall be constructed on top of a concrete slab. The slab shall extend under the soldier course.
  - a) **Slab Construction:** See requirements for concrete sidewalks above.
6. **Exterior Steps and Hand Rails:** All exterior stairs shall be illuminated and shall have handrails on both sides regardless of the number of risers.
  - a) **Handrails:**
    - **Spacing and Location:** Where handrails would exceed 5'-0" center-to-center, an intermediate handrail is required. For monumental stairs, whether required fire egress exit ways or not, handrails shall be located along the most direct path.
    - **Posts:** Where post-mounted hand railing supports occur, careful consideration shall be given to the embedment of posts to minimize deterioration of the posts and/or the concrete slab or system into which it penetrates. Whenever this embedment occurs in a pre-cast concrete system specifications shall be explicit regarding galvanization of the embedded sleeve and any anchors (as a unit after any welding) prior to being placed in the form work.

### 32 17 00 Paving Specialties

1. **Pavement Markings:** Painted striped crosswalks shall be provided at all road intersections.



2. **Bicycle Lanes:** New or improved roads of sufficient width shall include bicycle lanes on both sides of the street. Demarcation of the bicycle lanes through striping and signage shall be consistent with established Virginia Department of Transportation standards.

## 32 30 00 Site Improvements

### 32 39 00 Manufactured Site Specialties

1. **Bollards:** Two types of bollards are approved for use at the university.
  - a) **Metal Bollard:** These bollards shall be ductile steel in construction, 6 foot in length, concrete filled and concreted in the ground at least 3 feet in depth. Decorative bollards will be painted Sherwin Williams Industrial Enamel Bronze tone. Caution bollards will be painted in traffic yellow for visibility.
  - b) **Wooden Bollard:** The wooden bollard shall be used where appropriate on the Historic Campus. Wooden bollards shall be painted to match Sherwin Williams Woodscapes Bronze tone flat finish.
2. **Signs:** New buildings and major building renovations shall provide permanent exterior signage in compliance with the established university standards.
  - a) **Construction Signs:** when approved, shall be limited to a maximum 4'-0" x 6'-0" sign erected at the contractor's expense. See the DCM for sign requirements.
3. **Bicycle Racks:** The design of all university facilities, or major site renovations, shall include adequate bicycle storage with permanently installed racks. Bicycle racks shall be the 9 bike wave (serpentine) style racks and may be mounted with an above-ground flange or in ground as appropriate for each location.
4. **Emergency Telephones:** New buildings, new parking lots and major site work projects shall provide the location(s) for emergency telephone(s) that are handicapped accessible and located on or near lighted walkways providing visibility and comfort in their use. The Campus standard emergency phone is manufactured by Code Blue.
  - a) **Supporting Utilities:** All utilities (power and telephone lines) and the foundation for the fixtures shall be installed under the project. Provide a foundation and mounting detail in the construction documents.
  - b) **Owner Provided Fixtures:** Facilities Management Operations and Maintenance will procure and install the fixtures.
    - Specifications shall state the requirements of the contractor. Facilities Management will be fully responsible for installation including necessary wiring and telephone cabling to a university point of connection.
  - c) **Emergency Power:** Power for emergency telephones is to be an emergency circuit where available. The conduit system shall have no access points between E-Phone locations. The handholes that are part of the E-Phone shall be used to make required connections and routing of conductors.
5. **Benches:** Benches will be university furnished and installed. Benches approved for use at the university are:
  - a) Manufacturers and Models:
  - b) Country Casual, "Monarch" #4613





- c) Kingsley Bate, “Hyde Park” #HP60
  - d) Gardenside, “Parkside” #2606
6. **Trash Receptacles:** Trash and ash urn receptacles will be university furnished and installed.
- a) **Manufacturer and Model:** The trash receptacles will be United Receptacle – Americana Series, color – architectural bronze, model number UN-MI36.

### 32 80 00 Irrigation

- 1. Irrigation systems are shall not be provided for new and renovated buildings. When irrigation systems are approved, water shall be supplied from wells or by recycling from underground storage tanks.

### 32 90 00 Planting

- 1. **Planting:** The selection of plant material and the planting and maintenance of trees, shrubs and herbaceous plants must be consistent with the current AAN American Standard for Nursery Stock.
  - a) **Approved Landscape Plans:** Planting shall be in compliance with an approved landscape plan.
  - b) **Plant Selection:** Prior to planting, all plant material must be approved by the Facilities Management Landscape Area Supervisor as healthy specimens of the specified planting.
  - c) **Planting Procedures:** The width of each planting hole shall be three times the size of the root ball. The depth of the hole shall be 2” less than the distance from the bottom of the root ball to the root collar. The bottom and sides of the each hole shall be scarified to encourage root development. Any soil or mulch covering the root collar shall be removed.
    - **Watering:** All Plant root balls shall be saturated with water at time of planting.
  - d) **Tree Planting:** To preserve the assets of trees and manage the assets of underground utilities, new trees shall not be planted:
    - Within ten feet of any existing underground utility lines with joints
    - Within five feet of any existing underground utility lines without joints (joints may occur when they are at least ten feet from the tree center in both directions).
    - Where new storm and or sanitary sewer piping alignment cannot be avoided within ten feet of an existing or new tree, use HDPE butt-welded pressure piping.
  - e) **Soil Injections:** Newly planted trees shall receive soil injections to promote root growth.
  - f) **Soil Preparation:** Soils in areas to be planted that are compacted above 85% maximum density shall be mechanically loosened to a minimum uniform depth of 24” below final grade.
    - Planting holes shall be excavated one day prior to planting and tested for soil porosity. Holes left open overnight shall be roped off for public safety.
    - Soil conditions, which are inadequate for sustaining the growth and development of plants, must be reported to the Facilities Management Landscape Area Supervisor and/or the Associate Director of Gardens and Grounds. Inadequate soil conditions must be addressed prior to planting.
  - g) **Planting Warranty Period:** Plantings shall be covered by a warranty period of one year.



## 33 00 00 Utilities

### 33 05 00 Common Work Results for Utilities

1. **Tree & Plant Protection:** Underground utilities shall be located so that construction will not damage or destroy the plants to remain. Utility trenching shall not be located closer than 1'-0" for each 1" in diameter, with a minimum of 5'-0" and a maximum of 20'-0" for trees to remain. Trenching near heritage trees and mature specimens shall be outside of the drip line of the tree.
2. **Utility Identification:** All underground pipe, including pipe under a building, shall be installed with trace wire taped to the top center of the pipe for future identification. The trace wire shall be extended to inline hand holes, valve boxes, appurtenant structures or manholes for easy accessibility. A secondary marker of nonmagnetic color coded warning tape shall be installed above each pipe, approximately 12" below finished grade.
3. **Tunnels:** All heating water, steam, and condensate mains shall be run in tunnels. Tunnels shall be 5' x 6' if pipes are run only on one side or 6' x 6' if pipes are run on both sides. Tunnel structure shall be designed for HS 20 traffic. Hot water branches to individual buildings may be direct buried provided piping systems are pre-manufactured double wall piping systems.
4. **Utility Sources:** All utilities to a proposed building site are to be supplied from university central distribution systems, unless the required capacity is unavailable and cannot be cost-effectively added to the system. Utilities not available from a central system shall be generated at the proposed building.
  - a) **Capacity:** New central hot and chilled water generating and distribution systems shall be provided with firm standby capacity in the form of N+1, where N represents the quantity of equipment required to generate or distribute the required hot or chilled water under full load conditions.
  - b) **Control:** Pumping systems shall be controlled using VFDs connected to the BAS. The pumps shall be equipped with a bypass line containing a check valve to allow the pumps to be shut down under low load conditions. No uncontrolled bypassing is allowed. Bypass valves if considered necessary should be clearly identified on the drawing set, described in the sequence of operations and shown on the BAS graphics. Pumping systems shall be provided with a simple lead/standby arrangement. A determination and findings report may be used to justify a lead/lag/standby arrangement, but such an arrangement shall not be used without prior consent by the university.
  - c) **Fuel Source:** Unless a life cycle cost analysis, provided with the basis of design justifies a firm gas system, new boilers shall be provided with dual fuel boilers capable of burning both natural gas and number 2 fuel oil. Fuel oil storage capacity shall be sized to provide a minimum of 4 days operation at full fire. This may require a separate meter for cooking and water heating, shall these systems use natural gas.

### 33 10 00 Water Utilities

1. **Pipe Mains:** Pipe mains shall be a minimum of 6" in diameter.
  - a) Minimum Ground Cover Required:
  - b) Water Mains – 36"
  - c) Water Service: - 24"
  - d) Fire Service: - 36"



2. **Pipe Material:** Underground water distribution pipe shall be asphalt coated, cement lined ductile iron, Class 52 or higher, with flexible restrained joints.
3. Water lines 2 ½” nominal diameter and smaller shall be copper type "K"
4. **Corporation Stops:** Corporation stops shall be installed while the main is under pressure and at a 45-degree angle to the horizontal plane.
5. **Entry Point into Buildings:** The entry point into buildings shall be with factory flanged ductile iron, Class 53 or higher.
6. **Fire Service:** Water lines used for fire service shall extend from the water main and be brought into each building independently from the potable water service
  - a) **Post Indicator Valve:** A post indicator valve (PIV) shall be provided for each building.

### 33 12 00 Water Utility Distribution Equipment

#### 1. Water Meters:

- a) **Where Required:** Water meters shall be installed to meter each building and irrigation system independently. The meters can be located within mechanical rooms or within freeze resistant valve vaults immediately adjacent to the building or well they serve.
  - **Deductive Sub-metering:** Provide separate deductive sub-metering for make-up water to Boiler, chiller and cooling tower systems.
- b) **Isolation and Bypass:** Meters shall be installed with isolation valves upstream and downstream for isolation purposes. A bypass that can accommodate full flow conditions shall be provided around all water meters and pressure reducing valves.
- c) **Strainer:** A strainer shall be installed upstream of the meter.
- d) **Meter Type:** Meters used for potable water shall be nutating disk type, all others shall be turbine type or ultrasonic transit time.
- e) **Compound Meters:** Meters for largely varying flows such as dormitories, shall be compound type meters and all others shall be turbine type, each being revenue grade, having a maximum inaccuracy of 1% of rate and span.
- f) **Construction:** Meters shall be constructed of brass or bronze.
  - **Accuracy:** All meters shall be revenue grade, having a maximum error of 1% of rate and span.
  - **Cumulative and Max/Min Capabilities:** Meters shall be capable of showing cumulative gallons used, and of measuring the anticipated maximum and minimum flow rates.
  - **Auxiliary Contacts:** Meters shall be connected to the energy metering system via suitable Ethernet interface device capable of local data storage.
- g) **Fire Protection Service:** Fire protection service shall be through a separate, unmetered service.

### 33 13 00 Disinfecting of Water Utility Distribution

1. **General:** New, relocated, and modified water mains and accessories shall be disinfected prior to tie-ins in accordance with AWWA C651.



2. **Repeat Testing:** If the initial disinfection fails to yield satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained.

### 33 20 00 Wells

1. **Back Flow Protection:** New wells or wells effected by the project work shall be protected by an approved backflow prevention device.
  - a) **Multiple Buildings:** Multiple buildings served by wells shall have a backflow prevention device installed at the point of water entry to each building. These backflow devices shall be in addition to the backflow device serving the well.

### 33 30 00 Sanitary Sewerage Utilities

- 1) Comply with standards and regulations of the Virginia Department of Health VDH (12 VAC 5-610) and the Department of Environmental Quality DEQ (9 VAC 25-790).

### 33 31 00 Sanitary Utility Sewerage Piping

1. **Minimum Pipe Size:**
  - a) **Lateral:** 4” Minimum Diameter, line from building to Collector.
  - b) **Collector:** 8” Minimum Diameter, sewer line between Manholes.
2. **Minimum Ground Cover Required:** 36”
  - a) Sewer piping shall not be located within areas of flooding or drainage channels.
3. **Crossing Potable Water Lines:** Sewers shall cross under water lines to provide a separation of 18 inches between the top of the sewer and the bottom of the water line. When local conditions prohibit this vertical separation, the sewer shall be constructed of cement lined ductile iron pipe using joint restraints and satisfy the requirements of Virginia Sewage Handling and Disposal Regulations (12VAC-5-610).
4. **Pipe Materials:** Pipe shall be push on joint Extra-heavy cast iron (CI), Class 50 ductile iron (DI), or SDR-26 PVC for gravity sewer. HDPE pressure pipe or solvent welded PVC, Schedule 40 shall be used for force mains.
5. **Minimum Slope:** Sewers shall be designed and constructed to give mean velocities, when flowing full of not less than 2.0 feet per second, based on Manning’s formula using an “n” value of 0.013. Sewer piping on a 20% slope or greater shall be secured with concrete anchors.
6. **Sanitary Service Lateral Connection:** Laterals shall follow direct alignment from building to collector.

### 33 39 00 Sanitary Utility Sewerage Structures

1. **Where Required:**
  - a) **Manholes:** Provide a sanitary sewer manhole adjacent to all buildings to which laterals from building are directly connected. Install manholes at the end of each collector, at all changes in slope, size or alignment; at all intersections and at distances not greater than 300 feet.
2. **Construction:**
  - a) **Sanitary Manholes and Manhole Frames and Covers:** Manhole frame and cover shall meet VDOT MH-1 standards.



- b) **Pipe Penetrations:** A secure bond between the pipe and manhole wall shall be obtained. Flexible insert gaskets shall be used to obtain a watertight joint.
    - At existing manholes install a sleeve for connection. Use flexible rings, mechanical clamps, grout and water stop for a leak-proof connection.
  - c) **Precast Wall Sections:** Shall be seated with flexible joint sealant for their full circumference. Lift holes, defects, joints between sections and frames and covers shall be sealed with nonshrink waterproof grout.
    - Precast manhole joints (inside and outside) shall be filled with non-shrink grout and finished smooth.
  - d) **Coatings:** Manholes shall be coated from inside with vapor/moisture penetration preventing epoxy coating, and from the outside with bitumastic /coal tar based waterproof coating.
3. **Minimum Size:** Manholes shall have a minimum 48” inside diameter with invert shaping.
  4. **Drop Piping:** Manholes with an invert change of 18” or two times the inlet pipe inside diameter, whichever is greater, shall be provided with drop piping outside the manhole.
  5. **Watertightness:** Manhole to receive a factory applied epoxy coating. Sections and grade adjustment rings to be set in butyl joint material. Manhole lift holes and joints shall be sealed with non-shrinking hydraulic cement grout with exposed interior surfaces sealed with epoxy field applied after grouting. Inlet and outlet pipes shall be joined to the manhole with a flexible boot type watertight connection that allows differential settlement of the pipe and manhole wall to take place.

### 33 40 00 Storm Drainage Utilities

1. **Design Standards:** Storm drainage design and associated construction must be in accordance with the Virginia Stormwater Management Handbook, latest edition.
  - a) **Inlets:** Inlets in paved areas shall be designed to accommodate a Rainfall Intensity of 4 inches per hour with ponding depth not to exceed 4 inches.
  - b) **Storm Sewer Conveyance Systems:** Storm sewer conveyance systems shall be designed to accommodate the rainfall frequency for the 10 year event using the Rational or Modified Rational Method.
  - c) **Runoff Calculations:** Runoff, Hydrologic Routing through impoundments, and natural and constructed channels shall use calculation methods based upon NRCS/SCS 24 Hour Rainfall, Type II synthetic hydrographs for the 1, 2, 10, 25 and 100 year events based SCS TR-20.

### 33 41 00 Storm Utility Drainage Piping

1. **Building Roof Drainage:** All building roof drainage, including external downspouts, areaway drains, and foundation drains shall be connected to the storm drainage system. Connections shall preferably be made to a manhole or a drop inlet directly. Where the preferred connection is not feasible or economically justified, the connection shall be to the storm sewer with a “Y” a maximum of 50-feet away from the building. Provide cleanout at each change in direction of any drainage piping.
2. **Foundation and Retaining Wall Drainage:** Perforated polyvinyl chloride pipe surrounded by #57 stone wrapped in geotextile fabric shall be used for all foundation and retaining wall drainage systems. Class III



reinforced concrete pipe, minimum 15” size per ASTM C 76, shall be used for all infrastructure systems. HDPE pressure or HDPE double wall corrugated pipe may be used for mains under 24”.

3. **Laterals:** Polyvinyl chloride (PVC) Schedule 40, solvent welded piping is permitted; for yard drains, 8” minimum through 12” maximum; for roof, area drains, and foundation drains, 4” to 6” as required for single drain lateral; and 8” to 12” maximum for multiple drain collector lateral.
4. **Minimum Cover:** Minimum cover on pipe shall be 24”. Slope of piping shall result in self-cleaning velocity (2-fps minimum) for the diameter of piping used. Storm sewer piping on a 20% or greater slope shall be secured with concrete anchors.

### 33 42 00 Culverts

1. All drainage culverts or conveyance systems shall terminate with either an end wall or end section where culverts and storm drains daylight.

### 33 44 00 Storm Utility Water Drains

1. **Grit/Oil Separation:** Provide grit and oil separation conforming to Virginia Department of Conservation and Recreation (DCR), Minimum Standard 3.15 at vehicle storage, parking and fueling facilities to prevent contamination of surface waters.

### 33 45 00 Storm Utility Drainage Pumps

1. **Prohibited:** Storm utility pumps shall not be used.

### 33 49 00 Storm Drainage Structures

1. **Area Drains:** Exterior drains located in patios, window wells, exterior stairs and other locations that could potentially back up and damage a building if they become plugged with leaves and debris shall have a minimum surface drain area of 144 square inches.
  - a) **Secondary Drains:** All area drains shall be provided with a secondary drain to minimize the possibility of water entering a building.
2. **Manholes**
  - a) **Where Required:** Manholes shall be required at any change of direction for main storm sewer piping and at intervals not exceeding 400-feet in a straight run.
  - b) **Minimum Size:** Manholes shall have a minimum 48” inside diameter with shaped flow troughs at bottom. Manhole frame and cover shall meet VDOT MH-1 standards.
  - c) **Joints:** Patch precast manhole joints with non-shrink grout inside and outside. Apply bitumastic/coal tar waterproof coating from outside.
  - d) **Pipe Connections:** Pipe connections to new manholes and inlets shall be with flexible rubber boots. At existing structure install sleeve prior to connection using flexible rubber boot.

### 3. Inlets and Catch Basins

- a) **Where Required:** Curb inlets shall be used for all surface drainage for roadways and parking lots.
- b) **Drop Inlets:**



- (1) **Minimum Size:** Minimum inside size for drop inlets shall be 24” with up to 18” pipe diameter and 4-foot maximum depth. Minimum inside size of drop inlet shall be 48” for pipe size larger than 18” pipe diameter or greater than 4-foot depth.
  - (2) **Grates:** Inlet grates shall be bicycle-safe and oriented with the long axis of the openings perpendicular to the direction of bicycle traffic. The tops of all structures shall be flush with the pavement surface.
  - (3) **Traffic Rating:** Inlet structure grating shall be heavy-duty traffic rated (HS-20), providing a minimum 24” clear opening for access.
- c) **Yard Inlets:**
- (1) **Grates:** All grates for yard inlets shall meet handicapped accessibility standards and shall be close mesh for pedestrian traffic to include narrow heels. Grate inlets shall be used for all lawn areas.
  - (2) **Pipe and Fittings:** Area drains and yard drains installed with minimum pipe size and cover shall use shallow cast iron fittings or heavy-duty HS 20 traffic rated PVC/HDPE fittings.
- d) **VDOT Standard Structures:** Virginia Department of Transportation (VDOT) standard structures are to be used.

## 33 60 00 Hydronic and Steam Energy Utilities

### 33 61 00 Hydronic Energy Distribution

1. **Pipe Materials:**
  - a) **Hot Water Pipe:** Pre-insulated double wall piping system
    - **Carrier Pipe:** Standard Weight
    - **Insulation:** Closed cell polyurethane
    - **Jacketing Material:** Steel with fusion bonded epoxy coating
  - b) **Chilled Water Pipe:** Pre-insulated double wall piping system similar to hot water piping, or single wall piping system below:
    - **4” and Larger:** pipe shall be asphalt coated, cement lined ductile iron, Class 52 or higher, with flexible restrained joints.
      - (1) **Entry point into buildings** shall be with factory flanged ductile iron, Class 53 or higher.
    - **Lines between 2 ½ “ and 4”:** Water lines between 2 ½” and 4” shall be black iron
    - **Smaller than 2 ½ ”:** Water lines shall be copper type "K".
2. **Valves and Valve Vaults:** Valves and valve vaults shall be required at each piping intersection to allow each individual branch to be isolated for service.
  - a) **Confined Access:** Valve vaults shall conform to V requirements for confined access. Piping, valves, ladders and access points shall all be arrange to allow service to occur without crossing over/under obstructions that might hinder a rescue effort. Valve vaults shall have two manways or be vented.



- b) **Damp Proofing/Water Proofing:** Depending on water table, specify appropriate damp proofing/water proofing requirements.
- c) **Electrical Components:** Valve vaults which house electrical components or electrically operated controls shall be provided with a sump pump, electrical service outlet and light.
3. **Minimum Ground Cover:** Hot and chilled water piping shall have a minimum of 36” ground cover.
4. **Bedding and Backfill:** See Section 31 23 00 Excavation and Fill

### 33 63 00 Steam Energy Distribution

1. **Pipe Materials:**
  - a) **Steam Pipe:** Pre-insulated double wall piping system
    - **Carrier Pipe:** Standard Weight
    - **Insulation:** Mineral wool & air space
    - **Outer Conduit:** Steel insulated with polyurethane foam and fiberglass or extruded HDPE jacket
  - b) **Condensate Pipe:** Pre-insulated double wall piping system similar to hot water piping, or provided as a second carrier pipe within the pre-insulated double wall steam piping system above.
2. **Valves and Valve Vaults:** Valves and valve vaults shall be required at each piping intersection to allow each individual branch to be isolated for service and where drip legs and traps are required for condensate removal
  - a) **Additional Requirements:** See 33 61 00 Hydronic Energy Distribution
3. **Minimum Ground Cover:** See 33 61 00 Hydronic Energy Distribution
4. **Bedding and Backfill:** See Section 31 23 00 Excavation and Fill

### 33 80 00 Communications Utilities

#### 33 82 00 Communications Distribution

1. The university owns its own telecommunications and cable television system and integrates its information technology and cabling for telecommunications under management by the Department of Information Technology.
2. **Code Blue Stations:** Communications distribution shall be provided for emergency Code Blue stations.
3. **Direct Buried Conduit:** All communications system wiring shall be run in direct buried conduit. Conduits serving Code Blue Stations’ shall not have any access points at grade.
4. **Cable Television:** Cable television connection is obtained from the university owned system as coordinated through the PM. Cable television services shall be provided in university residential facilities.
5. **Fiber Optic Requirement:** A fiber optic connection shall be provided for all new structures that have a fire alarm system.