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<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>A/C</td>
<td>Air Conditioning</td>
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<tr>
<td>ACT</td>
<td>Acoustical Ceiling Tile</td>
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<tr>
<td>ADA</td>
<td>Americans with Disability Act</td>
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<tr>
<td>AHU</td>
<td>Air Handling Unit</td>
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<tr>
<td>AFF</td>
<td>Above Finished Floor</td>
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<tr>
<td>AMCA</td>
<td>Air Movement and Control Association</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ASTM</td>
<td>American Society of Testing and Materials</td>
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<tr>
<td>BIM</td>
<td>Building Information Model</td>
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<tr>
<td>BMP</td>
<td>Best Management Practices</td>
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<tr>
<td>CD</td>
<td>Construction Documents</td>
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<tr>
<td>CFM</td>
<td>Cubic Feet per Minute</td>
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<tr>
<td>CPTED</td>
<td>Crime Prevention Through Environmental Design</td>
</tr>
<tr>
<td>CMU</td>
<td>Concrete Masonry Unit</td>
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<tr>
<td>CTI</td>
<td>Cooling Technology Institute</td>
</tr>
<tr>
<td>CW</td>
<td>Cold Water</td>
</tr>
<tr>
<td>DD</td>
<td>Design and Development Phase</td>
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<tr>
<td>DI</td>
<td>Deionized Water</td>
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<tr>
<td>DDC</td>
<td>Direct Digital Control</td>
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<tr>
<td>GFCI</td>
<td>Ground Fault Circuit Interrupter</td>
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<tr>
<td>GPF</td>
<td>Gallons per flush</td>
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<tr>
<td>EHS</td>
<td>Environmental Health &amp; Safety</td>
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<tr>
<td>EIFS</td>
<td>Exterior Insulation Finishing System</td>
</tr>
<tr>
<td>FDB</td>
<td>Fahrenheit Dry Bulb</td>
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<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
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<tr>
<td>FERPA</td>
<td>Family Education Rights and Privacy Act</td>
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<tr>
<td>FWB</td>
<td>Fahrenheit Wet Bulb</td>
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<tr>
<td>HDPE</td>
<td>High Density Poly Ethylene</td>
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<tr>
<td>HEPA</td>
<td>High Efficiency Particulate Air</td>
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<tr>
<td>HP</td>
<td>Horsepower</td>
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<tr>
<td>HVAC</td>
<td>Heating Ventilation/Air Conditioning</td>
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<tr>
<td>HW</td>
<td>Hot Water</td>
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<tr>
<td>IFC</td>
<td>International Fire Code</td>
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<tr>
<td>KUB</td>
<td>Knoxville Utilities Board</td>
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<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<tr>
<td>LVT</td>
<td>Luxury Vinyl Tile</td>
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<tr>
<td>MEP</td>
<td>Mechanical, Electrical, Plumbing</td>
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<tr>
<td>MRL</td>
<td>Machine room less</td>
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<tr>
<td>NC</td>
<td>Noise Criteria</td>
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<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
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<tr>
<td>OIT</td>
<td>Office of Information Technology</td>
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<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>PRV</td>
<td>Pressure Reducing Valve</td>
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<tr>
<td>PVC</td>
<td>Poly Vinyl Chloride</td>
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<tr>
<td>RH</td>
<td>Relative Humidity</td>
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<tr>
<td>SBC</td>
<td>State Building Commission</td>
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<tr>
<td>THEC</td>
<td>Tennessee Higher Education Commission</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<td>--------------------------------------------------</td>
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<tr>
<td>UTFS</td>
<td>University of Tennessee Facilities Services</td>
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<tr>
<td>UTK</td>
<td>University of Tennessee Knoxville</td>
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<tr>
<td>USGBC</td>
<td>United States Green Building Council</td>
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<tr>
<td>UTPD</td>
<td>UT Police Department</td>
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<tr>
<td>VAV</td>
<td>Variable Air Volume</td>
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<tr>
<td>VCT</td>
<td>Vinyl Composite Tile</td>
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<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
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<tr>
<td>USB</td>
<td>Universal Series Bus</td>
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1. **INTRODUCTION**

The “basis of design” standards and design preferences listed herein are for new capital construction on the main University of Tennessee Knoxville (UTK) Campus. Additions, renovations, off campus and auxiliary structures will be evaluated individually. Preferred manufacturers, where listed, are based on campus performance and service experiences. Additional manufacturers, considered as an acceptable substitute, will be evaluated individually.

All UTK Facilities Services (UTFS) “Design & Construction Guidelines” are located at: [https://fs.utk.edu/](https://fs.utk.edu/)

2. **BUILDING EXTERIORS**

2.1. **PREFACE**

In accordance with the Campus Master Plan, UTK buildings are designed in a collegiate gothic style consisting primarily of brick and stone exterior façades of which to represent a feeling of stability and permanence. Other prominent characteristics include the use of arches, punched openings, accentuated entrances and steep sloped roofs.

2.2. **DESIGN STANDARDS**

   a) **Face Brick** – “Campus Blend” manufactured by General Shale Brick, Inc.
      - Size: Modular
      - Joints: Concave
      - Bond: Running bond (see Flemish Bond preference below)

   b) **Mortar**
      - Color: Seashell/General Shale (GS)-CB1

   c) **Horizontal Construction/Expansion Joints**
      - Type: Sealant
      - Color: Match mortar color (Sika “Tan”)

   d) **Vertical Construction/Expansion Joints**
      - Type: Sealant
      - Color: Match brick color (Sika “Red #2CNS 75762”)

   e) **Natural Quarried Stone – Limestone**, supplied by INDIANA LIMESTONE Fabricators, Inc.
      - Color: Eureka Buff
      - Finish: Smooth (Other finish options considered on a building case-by-case basis)
      - Mortar/Grout Color to match stone color to be determined.
      - Sealant: Match stone color (Sika “Pearl Ash”)
      - Pattern: Coursed or random ashlar
      - Sandstone option (Considered on a building case-by-case basis)
f) Architectural Cast Stone – ROCKCAST, manufactured by Reading Rock, Inc.
   - Color: UTR 19 (former Baxter Cast Stone color)
   - Finish: Standard Acid Etched (Other finish options considered on a building case-by-case basis)
   - Mortar and Grout Color: Match cast stone color
   - Sealant: Match stone color (Sika “Pearl Ash”)
   - Coursed or random ashlar pattern
   - Approved Manufacturers: ROCKCAST & ARRISCRAFT (Others, considered on a building case-by-case basis)

a) Precast Concrete:
   - Used at parking garages and similar structures
   - Typically, not to be used in exposed exterior applications

g) Windows and Door Frames – Aluminum Framed Systems
   - Window type: Fixed (operable evaluated on a case by case basis)
   - Finish: High performance fluoropolymer factory finish
   - Color: Powder coated color to match stone, where provided. Clear anodized elsewhere Shale (Considered on a case-by-case basis)

h) Glazing – Insulating-Glass
   - Overall Thickness: 1 inch
   - Replacement from inside
   - Low-E Coating: PPG Solarban 60
   - Tint: PPG Solargray
   - Curtain-walls: (Evaluated on a case-by-case basis)
   - Limit or shade glazing from direct sun exposure

i) Building Envelope– Air and Water Barrier (above grade)
   - Energy efficient construction to control the leakage of air and water through walls
   - Breathable to allow walls and interiors to dry out
   - Self-sealing
   - Mold resistant
   - Applied to exterior face of sheathing or CMU/concrete backup walls
   - See preferences below

j) Below Grade
   - Add protection board to sheet waterproofing
   - Protect foundation drains
   - Indicate slope and discharge locations of foundation drainage in construction documents

k) Concrete Slabs/Floors/Sidewalks
   - Prevent excessive moisture vapor emission and alkalinity from damaging concrete
   - Topically applied sealant to seal, harden and density
• Crack control
• See preferences below

l) Roofs:
  • Steep Slope:
    o Terra Cotta Clay Tile, manufactured by Ludowici Roof Tile
    o Type: Interlocking Classic 16”
    o Color: Impressionist Blend #9, 40% terra cotta and 60% dark terra cotta
    o Alternate roofing material evaluated on a case-by-case basis
  • Low Slope:
    o SBS Modified Bitumen Roof Membrane
    o 1/4” per foot slope min.
    o 3-ply system
    o Cold-applied adhesive
    o Granular Cap Sheet: Light reflecting energy efficient color
    o Access by stair or elevator
    o Alternate roofing material: (Evaluated on a case-by-case basis)
      • EPDM: 90 Mil, reinforced, fully adhered
      • PMMA: Liquid applied systems
    o Fall protection at roof-top equipment, within 10 feet of roof edge

• Green Roofs:
  o Reserved for highly visible low slope roofs
  o Public access evaluated on a case-by-case basis
  o Irrigated system
  o Exposed roof drains
  o 3-year min. service and system warranty
  o Incorporate electronic leak detection system

• Roof Access:
  o Provide maintenance roof access at all roof levels
  o Prevent public roof access

m) Exterior Entrances:
• Provide mortise mechanical locking hardware in all exterior entrances and exits.
• Electronic access control prox. readers at entrances.
• “Fail-safe” operation, position indicators with control and monitoring capabilities.
• Auto door openers at public entrances
• Video security surveillance system. Reference Safety and Security Standard
• Key Box (Knox Box), where required by local fire department official. Per UL 1037 and current fire code (IFC) standards. Located on exterior of building adjacent entrance, containing keys to gain necessary access and accessible by a special master key in the possession of the local fire department.
• Key box provided and installed by contractor, with contents provided by owner

n) Vestibules
• Provide at all public entries (exceptions to be determined on a case-by-case basis)
• Walk-off flooring
o) Lightning Protection: (To be evaluated by project engineer)
   • Provide protection from lightning strikes in buildings 3 stories or higher or as
     deemed necessary.

p) Exterior Lighting:
   • Illumination of steps, parking, entrances and accessible routes
   • Building accent lighting (Evaluated on a building case-by-case basis)
   • Provide energy efficient fixtures except where security and safety is a primary
     concern
   • Utilize dark sky compliant lighting
   • Reference Campus Landscape Vision and Site Standards

q) Screening:
   • Screen mechanical, electrical equipment, trash and recycling storage containers
     and other equipment or objects, as required
   • Provide UTK standard fencing enclosure. Reference Campus Landscape Vision
     and Site Standards for enclosure types. (Alternate screening to be evaluated on
     a building case-by-case basis)
   • Lockable

r) Signage & Plaques:
   • Naming of building: evaluated on a building case-by-case basis
   • Building Identification Site Signage (Building name and 911 street address),
     plainly legible and visible by emergency responders from the street or road
     fronting the property, including backs of buildings that face alleys or roads.
   • Building Plaque: Required at new buildings named in honor of person or persons,
     per the State Building Commission (SBC) prescribed format and provided
     information.
   • Coordinate with campus signage standards and approvals

s) Energy Conservation and Sustainability
   • Per State of TN Sustainability and Energy Guidelines
   • TN High Performance Building Requirements
   • USGBC LEED certification (Determined on a case-by-case basis)

t) Site:
   • Reference Campus Landscape Vision and Site Standards
   • Inclusion of CPTED
   • Vehicle barriers (Evaluated on a case-by-case basis)
   • Stormwater retention, detention, re-use and drainage as required per campus
     stormwater standards. Reference Stormwater BMP manual
   • Emergency communication messaging as required by UT Police Department
     (UTPD)
   • Accessible parking
   • Accessible route from accessible parking/passenger loading zones/public
     streets/public sidewalks/public transportation to accessible building entrance
   • Fire truck access per current IFC and local fire department requirements
   • Water supply capable of supplying the required flow for fire protection
• Fire hydrant flow tests provide by Knoxville Utilities Board (KUB)
• Fire hydrant locations and hose lay limitations per current IFC and local fire department requirements
• Unobstructed exterior access to Fire Department Connections and fire protection system valves

u) Loading Dock (if provided)
• Fenced or concealed area
• Dock Height: 4ft. with leveler and ramp access. Ramp & stair if space allows.
• Equipment: Trash compactor and leveling equipment (Evaluated on case-by-case basis)
• Storage area for trash and recycle containers (See Recycling Standards)
• On-grade corrugated cardboard container (See Recycling Standards)
• Proximity & accessibility to maintenance areas, freight elevator, etc.
• Maintenance and service vehicle parking

2.3. DESIGN PREFERENCES

a) Exterior Insulation Finishing System (EIFS) is normally prohibited (exceptions evaluated on a case-by-case basis)
• Drainable system, if used.

b) Aluminum Storefront
• Preferred Manufacturer: YKK AP America Inc.

c) Insulated Glass
• Preferred Manufacturer: PPG Industries
• Butt joints glazing is not recommended. To be used only in limited applications where approved

d) Green Roofs
• 3-year, min. vender maintenance contract
• Preferred plant material: Sedums and grasses

e) Low Slope Roofs
• Preferred Manufactures: Siplast/Firestone/John Manville/Soprema
• 42” high parapets at low slope roof perimeters
• Consider restoring roofs instead of replacing where applicable
• Limit access by roof hatch, stair or elevator access preferred
• Liquid applied flashings preferred

f) Face Brick Bonding:
• Buildings: Running bond with Flemish bond every sixth course
• Site walls: Alternate running bond and Flemish bond courses

g) Accent Brick:
Contrasting color to mimic stone (considered as cost saving alternative to stone)
SAFETY and SECURITY

h) Vehicle barriers:
   • Planters preferred over bollards where appropriate

i) Waterproofing Preference (above grade)
   • Seamless elastomeric membrane for exterior sheathing, CMU & concrete, etc.
   • Single component, roller applied silane functional polymer
   • Preferred manufacturer/product: Prosoco, R-Guard Cat 5

j) Concrete Moisture Vapor Control:
   • OBEX Creteseal CS2000

k) Stone
   • Cast stone preferred over natural stone due to superior resistance to staining

3. SAFETY and SECURITY

3.1. PREFACE

Safety and security concerns should be considered in all aspects of site and building design. All buildings and sites are different with conditions and equipment constantly evolving. Safety and Security discussions with the entities listed below is critical in providing safe and secure environments. Key elements in the protection of people and property include:

- Physical barriers to protect building and exterior public areas from vehicle intrusion and CPTED recommendations
- Door access control
- Security video surveillance and monitoring
- Emergency alarm notification and messaging (Follow UTPD Emergency Alert System requirements)
- Emergency responders radio communications: 700-800MH Bi-Directional Amplifiers/Distributed Antenna System equipment for emergency responders and 400MH for maintenance radio communications. (OIT and UTFS shall determine individual building needs and requirements. Fire Marshal issuance of Building Certificate of Occupancy is dependent on Fire Department’s approval of emergency radio communications within the building)
- Cellular phone service BDA amplifiers and WI-FI
- Emergency management procedures (Consult with the Office of Emergency Management)
- Areas of severe weather shelter
- Active shooter precautions
- Suicide/Fall Prevention measures at parking garages, bridges, balconies, roofs and other locations as deemed appropriate
- Lab Safety

3.2. DESIGN STANDARDS
SAFETY and SECURITY

a) Site
   • Landscaping:
     o Designs will be reviewed by UTPD for inclusion of CPTED as a deterrent to crime.
     o Recommendations include the planting of trees and shrubs, the elimination of escape routes, the correct use of lighting, and the encouragement of pedestrian and bicycle traffic in streets.
   • Vehicle Barriers:
     o Provide at areas with high pedestrian traffic or public gathering areas.
     o Gathering areas or walkways must have separation preventing vehicles from driving into the area.

b) Access and Intrusion Detection Control System
   • Exterior Doors:
     o Provide door position switch sensors at all exterior doors – including those associated with terraces and roof access points.
     o Provide electronic door locks and proximity readers at all at-grade exterior doors with entrance hardware. If an entrance is composed of multiple doors or sets of doors, only one door or one set of doors needs to respond to a proximity reader.
   • Interior Doors:
     o Provide electronic door locks and proximity readers at Fire Control Rooms, OIT Communication and Network Rooms, and other secure locations deemed necessary by UTPD, administration and associated academic departments. Administrative approvals required for other than building entrance locations.
   • General Access and Intrusion Detection Control System:
     o Provide network systems with continuous uninterrupted power operation
     o Provide remote monitoring and reporting capabilities of fire alarm, access control and other critical systems by UTPD Central Alarm
     o Provide compatible software with existing Central Alarm systems. Coordinate system requirements with applicable access control vendor.
     o Coordinate access control system with UTFS, OIT and UTPD.

c) Video Surveillance:
   • Provide interior cameras at building entrances and exits. Provide other interior or exterior camera locations deemed necessary by UTPD and administration. (Campus administrative approvals are required for other than building entrance and exit locations).
   • Coordinate camera type and locations with UTPD and OIT.
   • Coordinate cabling and installation with OIT.

d) Emergency Messaging: Provide emergency messaging capabilities to exterior and interior building occupants from the campus emergency alert system over phone lines by way of:
   • Interior building speakers integrated through the Fire Alarm System with capabilities to receive and broadcast live messages from the UTPD campus emergency alert system.
   • Exterior building speakers with the capability to broadcast messages through a speaker system from the UTPD campus emergency alert system.
• Coordinate Fire Alarm messaging requirements with UTPD, OIT and UTFS Electrical Services
• Electronic messaging systems (monitors) will networked to receive messaging from the emergency messaging system.

e) Fire Alarm Systems:
• Provide Visual/Audible and Speaker (voice) fire alarm system
• Communications shall consist of a network connection to UTFS, Central Alarm and the building security panel.
• Redundant communications for life safety equipment, emergency management and notifications
• Capabilities to transmit messaging via text or email. (Example: Text message to designated persons as to location of detector that has detected smoke, etc.)
• Capability to receive and transmit live messages over telephone lines.
• Coordinate Fire Alarm system requirements with UTFS Electrical Services and system vendor.

f) Active Shooter and Intrusion Precautions:
• Location: Lobbies, corridors, atriums and open areas with access or viewing into rooms or spaces.
• Placement of interior glass to limit or prevent line-of-site viewing into rooms or spaces.
• Interior room design to provide an in-emergency area of concealment where viewing of occupants from adjacent corridors, spaces or rooms is prevented or greatly limited by screen walls, permanent furnishings, room configuration, window placement, etc.
• Doors to be solid-core wood door construction with narrow lite glass view panels if glass viewing panel is provided.
• Mechanical lockdown capability by room occupants: Provide office or dormitory function door lockset controlled by key in the outside cylinder and thumb turn on the inside to provide room occupant locking capability. Maintain exiting code requirements to include automatic release of thumb turn lock with one motion.
• Evaluate electronic locking capabilities in lieu of mechanical locking at classroom and assembly space doors. (Campus administrative approvals required)
• Network electric strikes and door position switch sensors to UTPD Electronic Security for monitoring and control. Coordinate electronic security with UTPD.

g) Environmental Containment Precautions: (Safeguards to prohibit the spread of contaminants)
• Locate outside air intakes above ground level where possible to minimize risks of contaminated outside air entry into the building.
• Provide outside air intake with HVAC emergency shut-off controls.
• Coordinate HVAC requirements with UTFS and emergency responders.
• Provide spill containment at hazardous material storage areas as required by code.
• Coordinate hazardous material requirements with Environmental Health and Safety (EHS).

h) Severe Weather Shelter Areas:
SAFETY and SECURITY

- **Description:** Designated space, within the building, for occupants to congregate in a natural disaster warning. (Not to be interpreted as a FEMA safe room)
- **Location:** Any area without exterior windows and below the top floor. Generally, the more interior and lower the level the better. Corridors, bathrooms, interior rooms and fire stairs without exterior windows are acceptable areas.
- **Capacity:** The combined size of the shelter areas per building shall be sufficient to hold the actual occupancy load of the building.
- **Signage:** Identify major shelter areas with permanent signage

i) **Emergency Power:**
   - Provide emergency backup power provisions for life safety equipment (emergency lighting, exit signage, elevators, fire alarm systems, communication systems, etc.) as required by code
   - Provide emergency backup power for safety/security (cameras, access control, emergency notifications, etc.) and any other equipment deemed necessary. (Provisions also required for other; i.e. “key research” equipment or systems)

j) **Exit Stairs:**
   - Provide geographical naming of exit stairs (i.e. “South West Fire Stair”)
   - Prevent access beyond level of egress when egressing from above
   - Prevent access to non-public roof, maintenance and utility areas, etc. by signage and mechanical locks

k) **Room and Door Labeling:**
   - Coordinate room names and numbering with fire/smoke detection and prevention systems, access systems, and with HVAC controls.
   - Rooms with multiple entrances shall have a single room name and number.
   - Room numbering per UTFS standards.

l) **Knox Key Box:**
   - Provide rapid access device for use by emergency personnel. Coordinate type, location and contents with EHS, the local Fire Department, UTPD and UTFS. Reference Building Exterior Standards.

m) **Other Requirements Evaluations:** (Based on building type, use and environmental conditions)
   - Fire suppression and fire alarm system requirements, type and coverage.
   - Emergency responder 700-800 MHz and campus 400 MHz radio signaling Distributed Antenna System.
   - Wi-Fi and cellular phone service Distributed Antenna System.
   - Coordinate all systems with UTFS, OIT, UTPD and emergency responders.

n) **Emergency Phones:**
   - Elevators: Provide dialup line programmed by UTK Telephone Services to ring at UTPD’s Central Alarm.
SAFETY and SECURITY

- Blue Phones: New Blue Phones or alternative emergency communication systems with outdoor speaker capability (Evaluated on a case-by-case basis).
- Evaluate the use of emergency communication devices at other areas as deemed necessary.

o) Fall Protection:
- Determine if additional fall or suicide prevention measures are deemed prudent at edges of parking structures, bridges, roofs, atriums and other potentially dangerous areas. (Evaluate on a case-by-case basis).
- Guardrail design shall be of such that climbing is difficult
- Coordinate additional precautions with UTFS, UTPD and UTK administration.

3.3. DESIGN PREFERENCES

a) Impact Resistant Construction:
- Where practical, provide hard wall, impact resistant construction of corridor walls and other walls adjacent classrooms, instructional laboratories, assembly spaces, open office suites, conference and meeting rooms or other public gathering rooms. (Consideration on a case-by-case basis).

b) Security Film:
- Provide security film at glass in doors and windows below 8’ above floor (Consideration on a case-by-case basis).
- Preferred glass security film: 3M Ultra 600 security film.

c) Reception Areas/Building Entries:
- Where possible, shield or enclose reception areas and gathering areas in open lobbies/atriums to provide some level of protection and/or limiting of visibility from intruder(s).
- Evaluate escape routes in case of emergencies.

d) Increased Height Guardrails:
- Consider increased height guardrails (48” min.) with vertical intermediate rails at atriums and other openings in public area circulation spaces where extra guardrail height would add a layer of fall protection. (Evaluated on a case-by-case basis).

e) Valuable Equipment:
- Where practical, locate rooms containing high value electronics or equipment on floors other than floors with ground level entrances/exits.

f) Security cameras and other OIT provided devices connections by OIT.
4. HARDWARE

4.1. PREFACE

Durability, maintainability, uniformity, availability and the ability to be easily maintained by UTFS are key factors in campus preferences. Variances from these standards may require extensive vetting and campus approval.

UTK campus Lock and Key division of UTFS is responsible for keying of locks. Any deviations from Lock and Key standards requires prior approval. Coordinate lock selections with Lock and Key.

4.2. DESIGN STANDARDS

a) Hinges and Butts – Manufactured by Hager Hinge Co., full mortise standard weight ball bearing hinge with flat pins
   - BB1191 – Exterior openings
   - BB1279 – Interior openings
   - Finish: ANSI 626 or US26D (Satin chrome plated)
   - Acceptable substitutes: Stanley, Ives

a) Locksets:
   - Mortise – Manufactured by Best Security Solutions. To be used in high use areas, exterior openings and where security is an issue, such as public corridors, public spaces, storerooms, utility rooms, etc. See “Design Preferences” section below for interior thumb turn lockdown capabilities at classrooms and other gathering areas.
     - 45H Series
     - Core Housing: 7 pin to accept Best cores
     - Rose Style: D-3 ½” convex
     - Finish: ANSI 626 or US26D (Satin chrome plated)
     - Lever Style: 14H lever design, ADA compliant
     - Acceptable substitutes: None

   - Cylindrical – Manufactured by Best Security Solutions. Shall be used at interior openings within areas protected by mortise locksets such as offices within a suite, etc.
     - 93K Series
     - Core Housing: 7 pin to accept Best cores
     - Rose Style: D-3 ½” convex
     - Finish: ANSI 626 or US26D (Satin chrome plated)
     - Lever Style: 14H lever design, ADA compliant
     - Acceptable substitutes: None

b) Interchangeable Cores and Rim Cylinders – Manufactured by Best Security Solutions. Cores and Cylinders will be provided to UTFS Lock & Key for keying & installation.
   - 1E Series
   - Finish: ANSI 626 or US26D (Satin chrome plated)
   - Acceptable substitutes: None
c) Exit Devices Wood & Metal Doors – Manufactured by Von Duprin, Inc.
   - Type: Rim, mortise or vertical rod (avoid vertical rods if possible. See “Design Preferences” section below).
   - 99 Series Panic Device Push Bar
   - 996L outside trim with 17 Breakaway Lever design
   - Finish: ANSI 626 or US26D (Satin chrome plated)
   - Acceptable substitutes: None

d) Exit Devices Aluminum Doors – Manufactured by Von Duprin, Inc.
   - Type: Rim or vertical rod (avoid vertical rods if possible. See “Design Preferences” section below)
   - 33A Series Panic Device Push Bar
   - Night Latch / Dummy Trim
   - Finish: ANSI 626 or US26D (Satin chrome plated)
   - Acceptable substitutes: None

e) Automatic Door Operators and Controls – Manufactured by Quad Systems LLC: Provide at all public exterior entrances. See Automatic Door Openers “Design Preferences” section below.
   - Quad 28k Series
   - EZ-7000 operator and associated ES500 control
   - Wireless connection between push button and automatic door operator
   - Low voltage connections from power supply cabinet to operator and beyond to electric strike, request to exit, card reader and door position switch, as required
   - Installed and adjusted in accordance with: ANSI A156.19, Low Energy Operation
   - Finish: ANSI 689 or Aluminum paint
   - Requires coordination with access control & fire alarm systems.
   - Push button location to be accessible when door(s) are in open position.
   - Capability to prevent transmission of opening signal from push button to operator during building closures and lockdown.

f) Overhead Door Closers – Manufactured by LCN Closers
   - 4111 Series at exterior openings
   - 4011 Series at interior openings
   - Finish: ANSI 689 or Aluminum paint
   - ADA compliant opening force

g) Push/Pull/Protective Plates – Manufactured by Hager Hinge Co.
   - 30S – Push plates
   - H33G – Pull plates
   - 193S Series – Protective plates: Beveled 3 edges, 8-inch high
   - Finish: ANSI 630 or US32D (Satin stainless steel)
   - Acceptable substitutes: Ives, Rockwood

h) Door Stops – Manufactured by Hager Hinge Co. (Wall mounted are preferred over floor mounted).
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- 236W: Wall mounted, wrought/concave
- 241F: Floor mounted, cast
- Finish: ANSI 626 or US26D (Satin chrome plated)
- Acceptable substitutes: Ives, Rockwood

i) Electric Strikes – Manufactured by HES, Inc. (Electric strikes are determined on a project by project basis. UTFS and UTPD should be consulted on their preferences).
   - 1006 Series: Used with mortise & cylinder locks
   - 9500/9600 Series: Used with rim exit devices
   - Finish: ANSI 630 or US32D
   - Acceptable Substitutes: Von Duprin, Inc. Programmed and monitored by UTPD Central Alarm Division
   - Allow egress in locked position
   - Rated for continuous duty
   - Compatible with UTK Security and Access Control system

4.3. DESIGN PREFERENCES

a) Door Height: 7'-0” preferred, taller doors considered on a case-by-case basis

b) Maglocks: Electrified panic hardware, electric strikes or electrified locksets are preferred over maglocks

c) Mullions: A center removable mullion is preferred at double doors to eliminate latching and vertical rod maintenance issues.

d) Multiple Single Doors and/or 3'-6” Wide Doors – Preferred over double doors to eliminate the need for a center mullion.

e) Automatic Door Operators and Controls: Provide auto openers at all ADA accessible public entrances. UTFS Zone Maintenance prefers to furnish and install automatic door operators and push buttons.
   - Requires construction documentation coordination and delineation of responsibilities.
   - Requires hard wiring of operator and connections by contractor.
   - Devices furnished and installed by owner.
   - Controller power supply cabinet, electric Strikes, request-to-exit, card readers and door position switches, etc.: Contractor furnished, contractor installed

f) Access Control: Prefer Access Control at all classrooms
   - Card readers on high value areas (computer labs, research labs, etc.)
   - Electrified hardware only without reader at general classrooms and other meeting rooms
   - Access Control at data rooms, server rooms, mechanical and electrical rooms to be determined
g) Keying of Doors with Access Control: Type of key to be determined to limit overriding of the electronic access control and resulting false alarms

h) Security Lockdown Switch: Need and use to be determined

i) Card Readers at Entrances: Programmed with ADA access to open automatic door operators

j) Double Door Panic Devise - Rim style panic devices are preferred over vertical rods.

k) Lockdown Capability for Classrooms, Meeting Rooms, Conference/Seminar Rooms, Labs, Auditoriums or other gathering rooms: Thumb turn dead bolt at the interior side, co-acting with exit device or lockset to unlatch with one operation.
   - 99L-2SI-XB11-979 Von Duprin Security Indicator at rim style panic device hardware for single and double doors with mullion.
   - 45H7AB Best Mortise Office deadbolt lockset with inside thumb-turn
   - 93KAB Best Cylindrical Entrance function lockset with inside thumb-turn

l) Pulls at Public Toilets – Hygienic door handle pull manufactured by SanitGrasp
   - SG-101
   - Finish: ANSI 630 or US32D (Satin stainless steel)

m) Mechanical/Electrical/Plumbing Rooms - High security equipment rooms to remain locked at all times
   - 45H Mortise Lockset with a Storeroom function.
   - Master keyed separately by UTFS Lock and Key for UTFS/OIT use only.
   - No electronic access control allowed.

n) Janitor’s Closet/Custodial and Maintenance Supply Rooms - To remain locked at all times. Assembly occupancy lockset function is determined on a project by project basis. On projects under Athletic facilities, frequent and immediate access during games or events should be considered when selecting lock function.
   - 93K Cylinder Lockset with Storeroom function
   - Master keyed by UTFS Lock and Key for UTFS Building Service/Maintenance use only

o) Roofs: Key access only
   - F80 Communicating function
   - Fire Marshall approval required
   - Master keyed by UTFS Lock and Key for UTFS use only

p) Public Toilets: Key locking ability on outside, always unlocked on inside
   - Classroom function
   - Master keyed by UTFS Lock and Key for UTFS use only
   - Ability to hold open door for cleaning with a kick stop or automatic holder if required by code
q) **Department Offices, Break Rooms, Conference Rooms, and Supply Rooms:** This includes interior department controlled spaces where locking control is desired at both sides.
   - 9K Best Cylinder lockset with an Office “AB” function
   - Keyed by UT Lock and Key as requested by department

r) **Magnetic Hold Open – Manufactured by Rixson-Firemark:** Used to ease access to different parts of a building where closed doors are not preferred.
   - FM 998
   - Finish 689
   - Activation of Fire Alarm or Sprinkler System will automatically release doors in egress path

s) **Access Control: Electronic Security System**
   - Used at public entrances and where electronic access is required for security, safety, department preference and/or scheduling of registrar controlled classrooms and for the reduction of issuance of keys.
   - All exterior doors to be provided with mechanical locking hardware. Electronic locking control is to be provided in addition to mechanical locks at entrances with a single door and at a min. of one door where entrance has multiple banked entry doors. Where electronic locking control is provided, only automatic devices are recommended to unlock doors.
   - Receive UTK administration and department approvals prior to providing at location other than building entrances/exits. Alternative locations to be evaluated on a case-by-case basis.
   - System manufacturer: Galleger/Cardax except CBORD @ Residence Halls & Dining. CBORD access system must coordinate with Cardax controllers to provide interface with Fire Alarm and Central Alarm Systems.
   - Readers: proximity/swipe card reader: Schlage Multi-Technology series, Model MTMS15, compatible with use by cell phones and preloaded with campus unique security code. No substitutes.
   - System shall fail in locked position. Activation of Fire Alarm or Sprinkler System will automatically unlock doors.
   - Provide position indicators. Monitored and controlled by UTPD Central Alarm.
   - Compatible with Fire Alarm System (SimplexGrinnell or approved others).
   - Post Installation: Provide approved names/times of operation to UTPD Central Alarm Division (by UTK departments).

v) **Continuous Hinges:** Provide at oversized doors

u) **Thresholds:** Heavy duty at high traffic doors

v) **Door Stiles:** 5” wide vertical stiles at entrance doors. ADA complying 10” high bottom stile where required.
5. **INTERIORS**

5.1. **PREFACE**

Durability, maintainability and function are key factors in Interiors construction and may take priority over other considerations. Alternatives to campus standards will be considered on a case-by-case basis.

5.2. **DESIGN GUIDELINES**

a) **Entrances:**
   - Vestibules with entrance matting/walk-off flooring system
   - Ceilings and walls: (Evaluated on a case-by-case basis)
   - Automatic door openers at public entrances and vestibules
   - Access control
   - ADA accessible at public entrances

b) **Lobbies/Atriums:**
   - Open, 2-story (minimum) spaces with natural light (Evaluated on case-by-case basis)
   - Enclosed or semi-enclosed reception area, if reception is required. Refer to [Safety and Security](#) Standards for safety precautions
   - Hard surface, slip resistant floors
   - Adjacent to vertical circulation
   - Seating as required
   - Electrical outlets for powered custodial equipment, as required
   - USB power charging facilities, as determined
   - Building and wayfinding signage
   - Recycle/trash receptacles
   - Wi-Fi coverage
   - Branding and theming, as determined
   - Maintenance and custodial accessibility to all fixtures/appliances/horizontal and vertical surfaces/windows/rails requiring regular maintenance or cleaning
   - Fire protection and smoke control as required
   - Ceilings and walls: Evaluated on a case-by-case basis

c) **Vertical Circulation**
   - **Passenger Elevators:**
     - Reference [Elevator Standards](#)
     - Adjacent Lobby/Atrium
     - ADA accessible
     - Type: Machine room-less (MRL), where applicable
     - Clear Cab Dimensions (min): 6'-6" wide by 5’ deep by 8’ high
     - Opening dimension: 3’-6” wide by 7’ high
     - Flooring: Elevator floor matting – vinyl/rubber
   - **Freight Elevator:**
     - Reference [Elevator Standards](#)
     - Adjacent or on grade connection to service entrance/dock
     - ADA accessible
- Service to all levels including basements, penthouses & utility tunnels
- Controlled access to non-public floors
- Clear Cab Dimensions (min): 8’ wide by 10’ deep by 10’-6” high
- Opening Dimensions (min): 6’ wide by 8’ high
- Flooring: Elevator floor matting – rubber/wood

- Monumental Stairs:
  - Adjacent lobby/atrium. Provided to encourage use of stairs
  - Material: Hard surface, precast terrazzo preferred (other options to be evaluated on case-by-case basis)
  - Tread nosing protection, as required
  - Adjacent power outlets for powered cleaning equipment
  - Adequate clearances to adjacent wall surfaces for maintenance and custodial access.

- Fire Rated Stairs:
  - Walls: Painted gypsum board, CMU, concrete or other smooth surface
  - Electrical outlets, as required, for powered custodial equipment
  - Ceiling: Acoustical Ceiling Tile (ACT) at top level
  - Floors: Exposed concrete with penetrating sealer and polyurethane coating
  - Stair tread nosing protection, as required
  - Egress and Fire Department roof access signage
  - Areas of refuge as required
  - Emergency Communications as required

d) Restrooms:
- Reference Restroom Standards
- Adjacent lobby/atrium at each public level
- ADA accessible
- Layout to prevent line-of-sight views into fixture areas
- Wall hung toilet fixtures
- Electric hand dryers with microbial wall protection
- Electrical power outlets for custodial equipment
- Occupancy sensor lighting controls
- Floors: Water resistant, durable and slip resistant with minimal joints
- Integral sanitary floor to wall/base transition
- Tamper proof hose connection
- Toilet accessories
- Floor drain(s), as required
- Walls: Ceramic tile at fixture wall, epoxy painted gypsum board elsewhere
- Ceilings: Epoxy painted gypsum board (Evaluated on a case-by-case basis)
- Doors: Solid core wood with no vision panel.
- Door hardware: Refer to Hardware Standards for sanitary hardware

e) All Gender Toilet:
- Provide a minimum of one “All Gender” restroom per building at main level or central location, as determined
- ADA Accessible
- Single occupant capacity
- Baby changing station
• Solid core wood door with no vision panel and privacy lockset
• “All Gender” room identification signage
• Sound attenuated walls
• Reference Restroom Standards

f) Drinking Fountains:
• Adjacent restrooms, breakrooms and elsewhere as required
• Locate in niche, recess or out of pedestrian traffic pathways
• Bottle filler/cooler combo type
• Reference Mechanical Standards for fixture types

g) Corridors
• Flooring: High traffic rated material
  o Cleanable without harsh chemicals or special equipment
  o Scuff and stain resistant
  o Color/Pattern: Medium to darker tones with dirt/stain disguising pattern
• Walls:
  o Prefinished block, painted gypsum board or other approved material
    (Evaluated on a case-by-case basis)
  o Corner guards, wall protection, marker boards, tack boards, displays, signage, poster rails, etc. as required (Determined on a case-by-case basis)
  o Glazing: Limited use. Refer to Safety and Security Standards for security concerns and applications.
  o Doors: Solid core wood or hollow metal as applicable
• Ceilings:
  o 2’x2’ ACT or exposed structure (Evaluated on a case-by-case basis)
  o Gypsum board soffits or other approved material (Evaluated on a case-by-case basis)
• Furniture:
  o Student seating (benches) outside classrooms with build-in or adjacent wall power outlets
  o Seating capacity: 20% of classroom occupancy
• Recycle/Trash:
  o Reference Recycling Standards
  o Provide disposal stations as required
  o Locate in niche or recessed area out of egress path

h) Custodial Closets:
• Located off public corridors, near restrooms, without entry through adjacent rooms
• Provide a minimum of one Custodial Closet per floor with a 50 sq. ft. minimum net floor area
• 3’-6” wide solid core wood or hollow metal out-swinging door with no vision panel and keyed separately for “Housekeeping” use only.
• Walls: Epoxy painted concrete, CMU or gypsum board
• Floors: Sealed and coated concrete or VCT.
• Fixtures: Floor sink and floor drain
• Ceilings: Exposed structure
• Reference [Custodial Rooms Standards](#) for furnishings, additional information, etc.

i) Custodial Equipment Room and Custodial Supply Room/Office:
• Provide two separate areas; one for storage and charging of equipment and one for storage of custodial supplies and office use.
• Located on the ground floor adjacent dock/service area with ADA access to freight elevator and all building levels
• Provide a minimum of one 120 square foot minimum custodial equipment room and one 180 square foot minimum custodial storage room/office per building.
• CMU, concrete or gypsum board epoxy painted walls.
• Heavy duty shelving and furnishing as required for supplies and office use.
• Double hollow metal out-swinging doors with no mullion or vision panel or single 3’-6” wide door keyed separately for “Housekeeping” access only.
• Reference [Custodial Rooms Standards](#) for furnishings, additional information, etc.

j) Recycling/Trash Storage Room:
• Adjacent dock/service area
• Ground floor location or covered exterior location
• 120 square feet, min.
• Level or ramped connection to freight elevator and exterior street elevation
• Concrete floor with hose connection and floor drain for wash downs
• CMU, gypsum board or concrete epoxy painted walls at interior applications, fenced if exterior location. Reference [Campus Landscape Vision and Site Standards](#) for enclosure type and requirements
• Exposed structure ceilings, non-painted.
• Cart/bin storage area as required for six 95 gal. carts, dollies and other equipment with maneuvering room
• Double hollow metal out-swinging doors with no mullion or vision panel and keyed separately for “Recycling” access only at interior locations. Swinging gate at exterior locations.
• Exterior on-grade cardboard collection dumpster or compactor, to be determined
• Reference [Recycling Standards](#) for additional requirements.

k) Classrooms
• General Classroom Requirements for all classroom types:
  o Assume flexible teaching environment (to be confirmed)
  o Solid core wood doors with narrow glazed viewing panel and capability to lock door from inside room. Reference [Hardware Standards](#) for lock type
  o Capacity: Comply with THEC regulations for room sizes
  o ADA accessible
  o Acoustical sound attenuation walls and 2’x2’ acoustical tile ceilings
  o Built-in recycle/trash station or designated floor area, for UTK provided bins located near classroom exits.
  o Audio/Visual equipment, as required (consult with [OIT on their standards](#))
  o Marker and tack boards, as required.
o Chair-rail wall protection, as required.
o Lighting capabilities for dimming and banking control.
o Electronic access control, as determined
o Interior door locking capabilities
o USB power charging outlets.
o Power in floors, as required.
o Wi-Fi coverage.
o Window treatment, as required.
o Student backpack storage casework, as determined.
o Wall mounted centrally networked clock, type to be determined, mounted on teaching wall.

• Small Classroom:
o Less than 50 occupants
o Movable seating: tables/chairs (determined on a case-by-case basis)
o Carpet/vinyl floors, painted gypsum board walls, acoustical tile ceilings
o Instructor station, as determined

• Large Classroom:
o Over 50 occupants
o Movable or fixed furniture (determined on a case-by-case basis)
o Podium
o Tiered or not tiered floor (determined on a case-by-case basis)
o Two exits, minimum with panic crash-bar hardware
o Door swing in direction of egress travel
o Finishes: determined on a case-by-case basis

• Specialty Classroom:
o Computer, studio and other type classrooms (determined on a case-by-case basis)

1) Labs:
• Teaching Labs/Class Labs: See “General Classroom Requirements” above for additional requirements
  o Capacity: Comply with THEC regulations for room sizes
  o Water and chemical resistant flooring
  o Movable and adjustable height tables and chairs
  o Chemical resistant countertops and table surfaces
  o Lab case work, lab sinks and lab equipment as required
  o Teaching station
  o Utilities, air, water, gas service as required
  o Audio visual and data, as required
  o Eye wash/safety shower, as required with floor drain, as determined

• Preparation Labs: (Teaching Lab storage and work area adjacent Teaching Labs)
  o Lab casework, lab sink and storage as required
  o Hazardous storage as required
  o Safety equipment as required
  o Access controlled area

• Research Labs:
o Water and chemical resistant flooring
o Lab tables, casework, lab sink and equipment as required
o Lab stools as required
o HVAC isolation, supply air and exhaust as required
o Utilities, air, DI water and gas requirements, as required
o Cylinder and equipment storage, as required
o Access controlled area
o Safety shower, eye wash and other safety measures as required
o Emergency power as required to protect research

• Chemical Stock/Storage Rooms:
  o Water and chemical resistant flooring
  o Shelving, cabinets, casework and equipment as required
  o Lab stools and work station as required
  o HVAC isolation, supply air and exhaust as required
  o Utilities, air, water and gas requirements, as required
  o Hazardous storage, as required
  o Safety equipment, cabinets and spill containment, as required
  o Access controlled area
  o Emergency power, as required
  o Fire rated enclosures, as required
  o Logistical controls and staging areas for dispensing and transportation of chemicals

m) Student Collaboration Rooms/Areas:
  • Definition: Informal study area, open or semi enclosed, adjacent public corridors, lobbies, etc.
  • Furniture and furnishings, as determined
  • Marker and tack boards, as required
  • USB power charging capabilities
  • Branding and theming, as determined

n) Offices:
  • Types: to be determined
    o Suites
    o Individual offices
    o Open office area
  • Area (net square feet) allowed per THEC:
    o Dean: 180
    o Associate Dean/Department Chair: 150
    o Faculty, Professor, Associate/Assistant Professor: 150
    o Faculty, other: 100
    o Professional Staff: 130
    o Staff Technician: 100
    o Graduate Teaching Assistant: 60
    o Graduate Assistant: 40
    o Undergraduate Student Worker: 10
  • Finishes, Furnishings and Furniture:
    o Carpeted floors, painted gypsum board walls, acoustical tile ceilings
    o Desk, cabinets, shelving, chair, visitor chair(s), side table as appropriate
    o Marker and tack boards as required
  • Doors and Windows:
o Solid core wood door with narrow glazed viewing panel with locking capabilities from inside room. Reference Hardware Standards for lock type
  o Window treatment as required

• Information Technology:
  o Wi-Fi coverage
  o Data and Power as required
  o Family Educational Rights and Privacy act (FERPA) compliant, where required

o) Conference/Meeting Rooms:
  • Carpeted floors, painted gypsum board walls, acoustical tile ceilings
  • Audio/Visual equipment, as required (consult with OIT on their standards)
  • Marker and tack boards, as required
  • Chair-rail wall protection, as required
  • Light fixture dimming capabilities
  • USB power charging outlets
  • Solid core wood door with narrow glazed viewing panel with locking capabilities from inside. Reference Hardware Standards for lock type
  • Window treatment, as required
  • Table, chairs and other furniture and furnishings, as required

p) Break Rooms:
  • Casework, as required
  • Solid surface countertops
  • Water resistant flooring
  • Equipment/Appliances furnished and installed by contractor, as determined
  • Power and plumbing, as required
  • Furniture, as determined
  • Clear floor space for trash, recycling and composting containers, as determined

q) Copy/Supply/File/Mail/Work Rooms:
  • Casework, shelving and storage requirements, as determined
  • Equipment: furnished by owner, as determined
  • Power, networking and space requirements, as determined
  • Clear floor space for paper recycling container
  • Size, as determined
  • ACT ceilings
  • Flooring, as determined

r) Storage Rooms:
  • Concrete or VCT flooring as determined appropriate
  • Solid core wood or hollow metal 3’-6” minimum wide out-swinging door as determined appropriate without view panels. 3’-0” wide doors at storage closets
  • Shelving/cabinets, as required
  • ACT ceilings
  • Size, as determined

s) Attic Stock Storage:
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- Location, as determined
- HVAC conditioned and secured space
- 400 square feet preferred minimum, to be determined on a building case-by-case basis
- Level or ramped connection to freight elevator and dock area

t) Utility (MEP) Rooms:
- Sealed concrete floor with floor drain(s) where appropriate. Other finishes to be evaluated where appropriate
- CMU or concrete painted walls
- Exposed structure ceilings
- Fire rated walls where required
- Sound and vibration attenuation where required
- Outside access and/or corridor access as required without passing through an adjacent room
- Solid core wood, hollow metal or overhead door as determined appropriate
- without view panels and always secure lockset. Reference Hardware Standards. Provide door sound seals where deemed necessary
- Keyed separately for maintenance access only
- Doors sized appropriately sized for equipment installation, removal or replacement. 3’-6” minimum wide out-swinging single door or door pair without mullion or overhead door as determined appropriate.
- Circulation space around equipment for maintenance, filter removal, emergency egress, etc.

u) Fire Command Center: (where required for high rise structures and buildings with assembly seating)
- Readily accessible from building exterior for fire department operations.
- Separated from the remainder of the building by fire barriers and horizontal assemblies
- 200 square feet area minimum with work space for emergency responders. Room to contain schematic as-built building plans and a work table
- NFPA 72 required features necessary to control and monitor fire protection and smoke control systems and building system controls

v) Fire Pump Room:
- Separated from the remainder of the building by fire barriers and horizontal assemblies
- Heated and ventilated area
- Secured area

w) Communication Satellite and Main Equipment Distribution Rooms: (See OIT Standards)
- Located as required for total building service with min of one main equipment room per building and one satellite equipment room per floor
- Size main equipment room as required and satellite rooms at 120 square feet minimum each
- Vertically stacked rooms in multi-floor applications
- Concrete or VCT flooring
• HVAC conditioned area
• Emergency power as required for equipment
• Coordinate location of communication equipment and overhead sprinkler piping to avoid equipment damage
• Keyed separately for “Communications” access only

x) Maintenance Office/Stock Room:
• Provide one office/storage areas per building for on-site maintenance personnel and supplies.
• 180 square feet minimum
• Adjacent dock/service area
• Furnished office and storage complete with desk(s), chair(s), table, file cabinet and shelving as determined.
• Power and data, as required
• Level or ramped connection to freight elevator and dock area
• Finishes, as determined

y) Vending Area:
• Open or enclosed area, off public main circulation area
• Provide a minimum of one vending area per building, as determined
• Water resistant flooring
• Size openings as appropriate for vending machine access, 3’-6” minimum
• Provide for a minimum of four vending machines. Evaluated on a case-by-case basis, depending on building size
• Power and networking capabilities, as required

z) Lactation Room:
• Provide a minimum of one per building at central location for employee use, as determined
• ADA Accessible
• Secure area with privacy lockset
• Solid core wood door with no vision panel and with 3 coat hooks on inside door face
• Sound attenuated wall insulation
• Water resistant flooring
• Dimmable lighting controls
• Countertop with utility sink and gooseneck faucet with minimum of 4’ clear work surface
• Toilet accessories as appropriate
• Lockable base cabinet and drawer
• Vinyl upholstered lounge chair
• Power and UBS charging above countertop and adjacent chair
• Wall mounted clock
• Waste container with lid
• Wi-Fi access

aa) Specialty Rooms/Area:
• Evaluated on a case-by-case basis
5.3. DESIGN PREFERENCES

a) Paint Colors:
   • Paint Color Selection: (Campus approval required)
   • Primary walls: Light reflecting non-white
   • Accent walls: UT Pantone 151 orange or other accent colors, as approved

b) Paint Type:
   • Water based acrylic latex, low odor/VOC
   • Epoxy at wet areas (restrooms, janitor’s closets, wet labs, food prep, breakrooms, etc.)

c) Paint Finishes:
   • Walls: Satin
   • Ceilings: Eggshell
   • Trim: Semi-gloss

d) Wall Protection:
   • Chair rail: Provide in rooms with movable furniture/chairs. Low profile vinyl preferred
   • Corner guards: Provide in corridors/rooms where equipment, carts, etc. where furniture is frequently moved (locations determined on case-by-case basis)

e) Wall base:
   • 4” high rubber/vinyl (other material considered on case-by-case basis)
   • Color: Coordinate with flooring (Campus approval required)

f) Sound Transmission: (Provide sound attenuation in walls at offices, classrooms, conference and meeting rooms, equipment rooms, and other locations as required)
   • STC rating: 50 minimum

g) Ceilings: (Provide maintenance access as required at all above ceiling controls, valves, filters, etc.)
   • Painted gypsum board: Limited applications (Reviewed on case-by-case basis)
   • Acoustical tile: 2’ x 2’, regular edged (Preferred ceiling material)
   • Grid: ¾” wide, prefinished, suspended grid. Centered in room
   • Exposed Structure: Painted, unless noted otherwise (Color to be determined)
   • Acoustical clouds or other ceiling systems (Evaluated on case-by-case basis)

h) Floors:
   • Preference for hard, easily cleanable floor finishes, where appropriate
   • Provide cleaning instructions for all floor finishes

i) Floor Types
   • Carpet:
     o Type: Tile, except where not recommended at stairs, ramps, etc.
     o Yarn: Type 6.6
• Anti-Microbial
• Stain resistant

• Tile:
  o Luxury Vinyl Tile (LVT): 20 mil wear layer, minimum.
  o Sheet, vinyl/rubber:
  o Vinyl Composite Tile (VCT):
    o Porcelain ceramic

• Concrete Finishes:
  o Polished
  o Sealed and coated

j) Door Vision Panels:
  • Provide fire glass instead of wire glass where practical
  • Bottom of glass at 43” max above floor level

k) Marker Boards:
  • Dry Erase Porcelain
  • Magnetic
  • Framed
  • Porcelain Color: Light Gray
  • Accessories: Marker Tray

l) Tack Boards:
  • Fabric, to be determined

m) Bulletin Boards:
  • Framed, lockable
  • Fabric, to be determined

n) Countertops:
  • Type: Solid Surface
  • Color: Non-white as determined

o) Cabinets:
  • Type: to be determined

p) Furniture:
  • Classroom and multi-purpose rooms: Movable and stackable where applicable
  • Offices: Non-white surfaces
  • Type: to be determined
  • Limit use of solid colors
  • No visible manufacturers tags

q) Furnishings:
  • Poster rails Corner guards
  • Other, as determined

r) Miscellaneous preferences
Vertically stacked restrooms, mechanical, electrical and communication rooms in multi-floor applications, where possible
Glass stairs and rails are not recommended due to maintenance and cleaning issues. Use of glass will require special approval.
Smaller offices preferred with minimal shelving and filing cabinets to discourage storage of paper supplies/materials
Larger flexible classrooms preferred for various teaching pedagogies and strategies

6. ELEVATORS

6.1. PREFACE

Where new equipment is provided for renovations or modernizations, the applicable standards will apply. Where it is required to retain existing equipment, said equipment shall be brought up to code and placed in like-new condition.

Vertical transportation systems and their respective performance criteria will vary by building type. In all new multi-elevator buildings an elevator analysis must be performed with target group identified and individual car criteria specified.

6.2. DESIGN GUIDELINES

Elevator core locations shall be coordinated with the horizontal traffic flow and with the means of ingress and egress. Passenger elevators must be located on a ‘major path of travel’ as required by the ADA.

Elevator lobbies should be designed to accommodate the movement of pedestrian traffic to other parts of the building. Should elevators face one another, the minimum width between entrances shall be 10 feet. Elements which create queues, such as exhibits, directories, etc., shall not be placed in elevator lobbies. Provide enclosed, fire rated elevator lobby where required by code.

Unless approved, wheelchair lifts shall not be used in new construction.

Types of elevators:

1. MRL
2. Geared traction
3. Gearless traction
4. Hydraulic elevators

Selection of elevator types shall be determined by an elevator analysis, based on the building layout, needs and number of floors, etc. as well as estimated equipment costs. The elevator capacity and quantity of cabs shall be determined via an elevator analysis study. At a minimum, platform sizes shall meet ADA access requirements and provide the capability of carrying a medical stretcher 24 inches wide and 78 inches long.

Elevator pits, if required shall be equipped with a sump pit. The sump pit shall have a metal grate level with the pit floor. Any drain or pump shall be piped to drain according to code.
a) Passenger Elevators:
- Adjacent Lobby/Atrium
- ADA accessible
- Type: MRL, where applicable
- Clear Cab Dimensions (minimum): 6’-6” wide by 5’ deep by 8’ high
- Opening dimension: 3’-6” wide by 7’ high
- Flooring: Elevator floor matting
- Provide protection mats for rear and side walls during construction and new mats upon completion.

b) Freight Elevator:
- Adjacent or on grade connection to service entrance/dock
- Service to all levels including basements and penthouses (with keyed switch access only)
- Clear Cab Dimensions (min): 8’ wide by 10’ deep by 10’-6” high
- Opening Dimensions (min): 6’ wide by 8’ high
- Flooring: Elevator floor matting

- Provide protection mats for rear and side walls during construction and new mats upon completion.

d) Passenger Elevators

The following table provides minimum acceptable elevator criteria to be used as a basis for design in the various types of campus structures:

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Peak Period</th>
<th>Traffic Flow</th>
<th>Average Interval (Seconds)</th>
<th>Minimum Handling Capacity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Offices</td>
<td>AM up-peak</td>
<td>One-way</td>
<td>25-30</td>
<td>12-13</td>
</tr>
<tr>
<td>Professorial Offices</td>
<td>AM up-peak</td>
<td>Two-way</td>
<td>30-35</td>
<td>8-10</td>
</tr>
<tr>
<td>Classroom Building</td>
<td>Hourly</td>
<td>Two-way</td>
<td>35-40</td>
<td>6-8</td>
</tr>
<tr>
<td>Housing</td>
<td>PM (dinner)</td>
<td>Two-way</td>
<td>35-40</td>
<td>6-8</td>
</tr>
<tr>
<td>Parking Structure</td>
<td>AM up-peak</td>
<td>Two-way</td>
<td>40-45</td>
<td>8-10</td>
</tr>
</tbody>
</table>
* Average Interval is the average-time increment between elevator departures from the terminal floor during a heavy-traffic period.

* Minimum Handling Capacity is the number of persons or percentage of building population that can be transported by vertical systems during this same period of heavy traffic.

e) Elevator Signage, Signals & Control Stations:
   • Text sizes, Braille requirements, pictographs, etc. shall comply with ADA standards.

f) Hoist-way Signs:
   • Floor Designations: Provide on both jambs in both 2” high tactile characters and braille. A tactile star to be provided at the main entry level.
   • Car Designations: Provide on both jambs immediately below the floor designation in both 2” high tactile characters and braille.

g) Signals:
   • Hall Lanterns: Provide at each entrance to indicate travel direction of arriving car. Illuminate up or down LED lights and sound tone prior to car arrival at floor. Car direction lenses shall protrude so that they can be seen from a distance.
   • Hall Position Indicator: Alpha-numeric digital indicator containing floor designations and direction arrows to indicate floor served and direction of car travel. Mount integral with hall lanterns at all floors.
   • Car Position Indicator: Alpha-numeric digital indicator containing floor designations and direction arrows to indicate floor served and direction of car travel. Locate fixture in car operating panel. When a car leaves or passes a floor, illuminate indication representing position of car in hoist-way. Illuminate proper direction arrow to indicate direction of travel.

h) Hall Control Stations:
   • Pushbuttons: Buttons shall be vandal-resistant. Include pushbuttons for each direction of travel which illuminate to indicate call registration. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency situation as part of faceplate. All code required and specified engraving shall be provided. Photo-etching or stick-on signage will not be accepted. Pushbutton design shall match car operating panel pushbuttons. Provide with LED illumination in flush mounted faceplates.

i) Car Operating Panel:
   • Provide car operating panel with faceplate, consisting of a metal box containing vandal resistant operating fixtures, mounted behind the car stationary front return panel. Faceplate shall be hinged and constructed of stainless steel, satin finish.
   • Suitably identify floor buttons, alarm button, door open button, door close button and emergency push-to-call button with rear mounted cast tactile symbols. Configure plates per local building code accessibility standards including Braille. Locate operating controls no higher than 48” above the car floor; no lower than 35” for emergency push-to-call button and alarm button.
   • Provide minimum 3/4” diameter raised floor pushbuttons which illuminate to indicate call registration.
   • Provide alarm button to ring bell located on car. Illuminate button when actuated.
• Provide keyed stop switch at bottom of car operating panel in locked car service compartment. Mark device to indicate “run” and “stop” positions.
• Provide a keyed switch for penthouse level access.
• Provide “door open” button to stop and reopen doors or hold doors in open position.
• Provide “door close” button to activate door close cycle. Cycle shall not begin until normal door dwell time for a car or hall call has expired, except firefighters’ operation.
• Provide firefighters' locked box as required by code.
• Provide firefighters’ Phase II key switch with engraved instructions filled red. Include light jewel, audible signal, and call cancel button.
• Provide lockable service compartment with recessed flush door. Door material and finish shall match car return panel or car operating panel faceplate.
• Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
  a. Inspection switch.
  b. Light switch.
  c. Two-position exhaust blower switch. Three-position exhaust blower switch.
  d. Independent service switch.
  e. Constant pressure test button for battery pack emergency lighting.
  f. 120-volt, AC, GFCI protected electrical convenience outlet.
  g. Stop switch.
  h. Switch to select either floor voice annunciation, floor passing tone, or chime.
  i. Card reader override switch.
• Communication System: Provide two-way communication between car, control room and Central Alarm. “Push to Call,” two-way communication instrument in car with automatic dialing, tracking, and recall features with shielded wiring to car controller in control room. Provide dialer with automatic rollover capability with minimum two numbers.
  a. “Push to Call” button or adjacent light jewel shall illuminate and flash when call is acknowledged. Button shall match car operating panel pushbutton design. Provide uppercase “PUSH TO CALL,” “HELP ON THE WAY” engraved signage adjacent to button.
  b. Provide “Push to Call” button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
• All Code required and specified engraving shall be provided. Photo etching and/or stick-on signage will not be accepted. Provide engraved or approved etched signage as follows with approved size and font.
  a. Phase II firefighters’ operating instructions on main operating panel above corresponding key switch filled red.
  b. Car number on main car operating panel.
  c. “Certificate of Inspection on File in Building Office” on main car operating panel.
  d. Car capacity in pounds on main car operating panel service compartment door.

j) Maintenance and Call Backs:
• Provide service for a period of 12 months after the date of substantial completion

6.3. DESIGN PREFERENCES

a) MRL elevators, where applicable

7. RESTROOMS

7.1. PREFACE

Durability, clean-ability, maintainability, accessibility and convenient locations are the key elements to good restroom design.

7.2. DESIGN GUIDELINES

Reference Interiors Standards for restroom finishes and other requirements

a) Fixtures:
   • Reference Mechanical Standards
   • Toilets shall be 1.28 gallon per flush (GPF), wall mounted
   • Urinals shall be 0.125 GPF, wall mounted
   • Lavatory (sinks): Integral counter or under-hung type at public restrooms, as determined
   • Hose connection with tamper proof controls
     ○ Others, as required

b) Accessories:
   • Soap Dispensers: (provided by UTFS and installed by contractor) shall be placed over the counter and between sinks.
   • Hand dryers shall be electric, except at single occupancy restrooms, labs and other approved locations
   • Hand Towel Dispensers, where approved: (Provided by UTFS and installed by contractor) shall only be placed in single stall restrooms with space for a waste receptacle under the towel dispenser location. Other locations evaluated on a case-by-case basis
   • Electric Hand Dryers: Provide a minimum of two low-profile electric hand dryers with wall guards and HEPA filters in each restroom. Evaluated on a case-by-case basis. See model preference below.
   • Shelving: An appropriate number of shelves with integral coat hooks shall be placed on a non-fixture wall for user item storage during restroom use. See preferences below.
   • Toilet Tissue Dispensers: Provided by UTFS and installed by contractor
   • Sanitary Napkin Disposal Containers: (Provided by UTFS and installed by contractor) Install at women’s and All Gender restrooms
   • Grab Bars, as required
   • Trash & Recycle containers: Provided by UTFS
   • Baby Changing Station, as needed

c) Accessory Locations:
• No accessories (e.g., hand dryers, towel dispensers, toilet paper dispensers, waste receptacles, etc.) shall be recessed or built-into the walls or countertops.
• Dual electric hand dryers shall be located side by side near the restroom entrance end of the sink run with one mounted at the required ADA height.
• Where hand towel dispensers are used, the dispenser shall be located near the far end of the sink run.
  o Provide clear floor space for trash/recycle containers near restroom exit for disposal on the way out of room.

d) Flooring:
• Flooring shall be water resistant with minimal joints or grout lines, where possible (e.g. poured floors: terrazzo or polished concrete)
• Floors shall drain to sanitary piped floor drains

e) Toilet Partitions:
• Graffiti resistant.
• Provide coat hook(s) at interior face of toilet stall doors. Where two hooks are provided, align vertically with lower hook at the required ADA height and the other above @ 5’0” AFF.
• Provide wall stop(s), if required at partition opening onto adjacent walls or surfaces to prevent wall damage by protruding coat hooks.
• See toilet partition type preference below in “Preferences”

f) Door Hardware:
• Reference Hardware Standards
• Provide hygienic door pulls at public multi-fixture restrooms
• Provide a door kick stop or automatic door holder to prop door open for cleaning

g) Countertops:
• Solid surface material
• Texture and color to minimize the showing of dirt and stains
  o Back and side splashes, as required

h) Baby Changing Station:
• Unibody construction
• 200 lbs. weight capacity
• Antimicrobial surfacing
• Child fall protection straps
• No wall-hung plastic units allowed

7.3. PROVIDED BY UTFS, INSTALLED BY CONTRACTOR

a) Paper Towel Dispensers, type dependent on current vendor contract
b) Soap Dispensers, type dependent on current vendor contract
c) Toilet Tissue Dispensers, type dependent on current vendor contract
Sanitary Napkin Disposal Containers, type dependent on current vendor contractor.
7.4. **Provided by UTFS, Installed by UTFS**

a) Waste containers
   - Reference Recycling Standards

7.5. **Design Preferences**

a) Public restrooms, other than single fixture restrooms, shall be provided with electric hand dryers instead of hand towel dispensers
   - Thin Air (TA-ABS) electric hand dryer with HEPA filter and antimicrobial wall guard

b) Provide Custodial Closets within close proximity of restrooms or access through restroom.

c) Provision for adequate electrical power outlets for powered custodial equipment use

d) Shelving Preference:
   - 24” Bobrick stainless steel shelves with coat hooks

e) Ceiling hung toilet partition preferred for ease of floor cleaning

f) No white countertop surfaces

8. **Recycling and Waste Stations**

8.1. **Preface**

Providing conveniently located and adequate number of recycling and trash stations, central storage room for recycling containers and outdoor cardboard collection areas are essential sustainability components for recycling and waste management.

UTK campus is a leader in Recycling and Sustainability with plans to implement a zero-waste-policy by 2030.

8.2. **Design Standards**

UT Recycling collects four main recyclable materials from campus buildings:

1. Paper
2. Cans/Plastic
3. Corrugated Cardboard
4. Food Waste (*Compost*)
5. Bottle collection, not provided at this time

   a) Paper:
      - Offices: Collected in 7-gallon blue containers (Furnished by UTFS)
• Classrooms/Lobbies/etc: Collected in 23-gallon blue Rubbermaid “Slim Jim” containers with slotted lid. These containers can be located in a cabinet or not as preferred by the designer, but at least one set must be included in each classroom, and if multiple entrances exist, preference is for one set per entrance. Cabinets should have 3 sections (Containers furnished by UTFS)

• Consolidated into blue 95-gallon rolling carts and stored in a central “Recycling” room or space outside the building that is designated for these bins to stay all the time (Furnished by UTFS)

• If consolidation bins are located inside the building, they are relocated, as scheduled, to exterior street level storage area/enclosure for UTK Recycling truck pickup and off-site disposal

b) Cans/Plastic:
• Offices: For offices with My Tiny Trash, Paper and Cans/Plastic collected together in 7-gal blue containers (Furnished by UTFS)
• Classrooms/Lobbies/etc.: Same as Paper above, but container is green with 2 round holes (Furnished by UTFS)
• Consolidated same as paper but container is green
• Relocated, if required, same as paper above.

c) Cardboard:
• Not collected in containers inside buildings unless a central recycling room is inside the building. If so, collection cart inside the indoor recycling room is a 1-yc tilt truck.
• Taken by building occupants or custodial staff to outdoor collection area/enclosure for UTK Recycling truck pickup and off-site disposal by custodial staff and relocated to outdoor collection area/enclosure for UT Recycling truck pickup and off-site disposal

d) Compost (Food, Organic, and Compostable Waste):
• Collected in a variety of containers, depending on volume, in areas where food is prepared or consumed such as coffee shops, kitchens, break rooms, residence hall trash/recycling rooms, concessions areas and food service areas. Also collected where plant materials and soil are generated such as greenhouses. Containers can range from a small bucket to a 35-gal rolling bin (Furnished by UTFS)
• Collected by kitchen staff and/or custodial staff and relocated to outdoor collection area/enclosure for UTK Recycling truck pickup and off-site disposal

e) Recycling/Waste Stations:
• Provide in lobbies, corridors, public exits, dining areas, breakrooms, kitchenettes, collaboration areas and other locations as required.
• Built-in or pre-manufactured cabinet recessed or offset from egress path. Cabinets are optional- containers may stand alone in the recess or offset without a cabinet
• If cabinets are used, a four-section cabinet containing four 23-gallon Rubbermaid Slim Jim containers, approximately 22” deep by 11” wide by 30” tall. Orientation of these containers can be changed depending on building design. Top of cabinet must be sloped to aid in visibility and prevent people from placing items on top of the cabinet (Containers furnished by UTFS)
• Hand-hold clearances required for placement and removal of containers
• If containers are in a built-in cabinet, the containers inside cannot be placed on carpet. Either the carpet should be eliminated underneath the cabinet, or the cabinet should have a smooth bottom surface for the container to sit on for ease in cleaning up spills.

• If cabinets are used, openings must be, left to right, for 23-gal sized containers: Paper recycling: 2.5-inch by 18-inch slot; Cans/Plastic recycling: 6-inch round; Landfill waste: 12-inch by 8-inch rectangle depending on orientation of the cabinet; Compost: 12-inch by 8-inch rectangle depending on the orientation of the cabinet. The Compost section must have a hinged lid on top with a handle or lip for opening it, and must be able to be locked from inside the cabinet so as to prevent usage if compost is not a current option in that building. This section could be open for an extra landfill container or left closed and used to store extra containers or cleaning supplies. Composting will be coming to all buildings in the very near future.

• Labeling for cabinets should be on a vertical surface, either on the front of the container or on the wall above them. Additional labels may also be placed in front of the holes on the slope of the container. Labels should read: “Paper Only”, “Cans/Plastic”, “Landfill” or “Compost.”

f) Recycling/Waste Stations:
• Provide in classrooms, meetings, copy rooms and other locations as required.
• Built-in or pre-manufactured cabinet recessed or offset from egress path. Cabinets are optional- containers may stand alone in the recess or offset without a cabinet.
• One station per entrance located inside room adjacent to exit door
• Three-section cabinet containing three 23-gallon, approximately 22-inch deep by 11-inch wide by 30-inch tall “Slim Jim” containers. Orientation of these containers can be changed depending on building design. Top of cabinet must be sloped to aid in visibility and prevent people from placing items on top of the cabinet (Containers furnished by UTFS)
• Openings and labeling: Same as Lobby/Corridor stations except eliminate the “Compost” section.

Recycling Storage Room: (See “Interiors Standard”)
• Use: Consolidation and storage for min. of six 95-gallon, approximately 30-inch by 32-inch by 48-inch high, 1 cubic yard tilt trucks, dollies and other equipment, as required. UTFS may opt to have a Recycling Storage Room inside or at loading dock. If UTFS choose to opt, the Trash Dumpster, Cardboard Recycling Area outside the building must accommodate these containers. The size and use of the building will determine the number of containers needed. The UTFS Recycling Supervisor must provide input on quantities needed.
• Hot and cold hose wash-down capability with sanitary sewer drain
• See “Interiors Standards” for room size and amenities

Compactors, Dumpsters, Cardboard Recycling and Exterior Consolidation Area:
• Compactors are the preferred method of collection for all waste and recycling materials and are ideally located outside the building.
• Compactor areas do not need to be covered, but if they are, a minimum of 18’ height clearance needed, unless compactor sits on top of the loading dock, then 14’ height clearance needed. If
• inside, ventilation and other needs as determined. Compactors normally sit on ground level and do not require being adjacent to a loading dock, but can be as needed.
  • Minimum of 60’ in front of the compactor required for truck access and hauling
  • Compactors may be used for landfill waste, cardboard recycling, mixed recycling, or compost. Size and use as determined by the use of the facility and the UTFS Recycling Supervisor.
  • Compactors require a sanitary sewer drain that captures any potential leakage so footprint of compactor is sloped so all liquid makes it to the drain(s). Compactor areas also require hot and cold water washout capabilities, and 3-phase power but voltage can be accommodating to what is available in the building.
  • If compactors are not used for all waste and recycling materials, dumpsters will be needed for some or all of the materials, and 95-gal carts will be needed for the remainder with adequate space to keep all of them in the area at all times. 95-gal carts can be stored on loading dock if desired. Hot and cold water washout and sanitary sewer drain required in or near this area.
  • Size and type of dumpsters and containers determined by facility and UTFS Recycling Supervisor
  • Enclosure size, as determined
  • Cardboard recycling collection may use front-load or rear-load dumpsters if not collected in a compactor, and may be on wheels so whole area must be level with no lips or bumps that impede movement of dumpster.

8.3. DESIGN PREFERENCES

a) Sloped top recycle station cabinet to prevent placement of items on tops

b) Preferred vendor for compactors, front-load dumpsters, and rear-load dumpsters is Baker Waste Equipment.

8.4. PROVIDED BY UTFS, INSTALLED BY UTFS

a) Recycle and trash containers

9. INTERIOR SIGNAGE

9.1. PREFACE

Interior signage shall comply with current Federal Department of Justice ADA Standards for Accessible Designs in State and Local Government Facilities.

9.2. DESIGN GUIDELINES

General interior signage requirements:

Permanent rooms and space signs, directional and informational signs, means of egress identification including signs at exit doors to fire separated exit passageways, if provided, exit stairways and areas of refuge, if required, shall comply to the following requirements.

a) Characters:
• Tactile (raised) lettering
• Lettering duplicated in braille
• Tactile characters shall be raised 1/32” minimum above background
• Raised characters shall be upper case
• Characters shall be san serif style fonts (fonts that do not have extending features called “serifs” at the end of strokes) and may not be in italic, script or decorative form
• Character height shall be 5/8” minimum to 2” maximum
• Character proportions, thickness, spacing and line spacing shall be per “ADA Standards”

b) Braille:
• Braille type: “Grade 2” (with contractions)
• Braille dimensions, capitalization and position shall be per “ADA Standards”

c) Installation height and location of signs for permanent rooms or areas:
• Mounting height for multiple character line signs: 48” minimum above finished floor from bottom of lowest (bottom line) tactile character and 60” maximum from the bottom of highest (top line) tactile character
• Mounting height for single character line signs: 48” minimum above finished floor from bottom of tactile character
• Location of signs at single doors shall be located on wall alongside door at the door latch side
• Location of signs at double doors with two active leafs shall be located on wall alongside right side door at the door latch side
• Location of signs at single and double doors with no wall space shall be located on the door if door(s) are without hold-open devices. Locate signs on nearest adjacent wall for doors with hold-open devices
• Locate signs beside doors centered in an 18” minimum x 18” minimum area measured from the door edge

d) Visual characters:
• Non-glare finish
• Lettering color contrast shall be as great as possible with background
• Campus Standard: Either orange on gray background or white on orange background
  o No UTK name or logo, except for Department identification signage

e) Fonts, Colors and Symbols: Reference Communications Branding Guidelines
f) Sign types and locations:
   - Exterior Building Identification:
     - Reference [Campus Landscape Vision & Site Standards](#)
     - Provide building name and (911 emergency responder) street address plainly visible from street or road fronting the property.
     - Locate the building sign adjacent the main entrance used by emergency responders. Provide secondary signs to identify rear or side entrances located on public streets and roads.

g) Building Public Entrances:
   - At buildings where not all public entrances are accessible, provide “International Symbol of Accessibility” signage at complying entrances.

h) ADA Directional Signage: (Route to nearest accessible element)
   - All directional signage to include the “International Symbol of Accessibility”
   - Provide directional signage to accessible entrances, restrooms, elevators, and exits at inaccessible building entrances, inaccessible public toilets, elevators not serving an accessible route and exits that do not have approved accessible means of egress.

i) Building Directories: (A guide identifying buildings areas and spaces)
   - Provide directories, as required
   - Exempt from ADA Standards
• Locations: Building entrance lobbies & elevator lobbies. Other locations as deemed necessary
• Content: Interchangeable, by department and/or building users. Content to vary depending on the location. General floor level identification of major spaces located at building entrances with specific room identification located at upper/lower elevator lobbies.
• Digital or printed content, to be determined

j) Wayfinding: (Signs providing direction to rooms or spaces)
   • ADA compliant
   • Located in lobbies, at top of monumental stairs, at elevator lobbies and in corridors at diverging paths.

k) Department Identification Signs:
   • Exempt from ADA Standards
   • Locations: Department lobby/reception areas
   • Adherence to campus branding standards and approvals

l) Interior Exit Stairs: (Signage at each exit stair landing level)
   • ADA compliant
   • Floor level & story of exit discharge identification
   • Roof access identification, if applicable
   • Located inside stair at 5ft. above floor and readily visible with open or closed door

Figure 2. Department Entry Sign
m) Exit Signs: Illuminated signage marking direction of exit travel
   • See electrical specifications.

n) Room Signs:
   • ADA compliant
   • Individual room identification name, as needed and number
   • Type as appropriate for building function

o) Room Occupant Load Sign (Required at Assembly Occupancies)
   • Maximum number of occupants allowed by order of the State Fire Marshal
   • Posted inside room in a conspicuous place near the main exit door

p) Other signs: (as required by the code authority)
   • Area of Refuge, if required
   • Hazard Identification, if applicable
   • Electrical rooms with control panels
   • Fire department connections (FDC) on building exterior
   • Control rooms for A/C systems, sprinkler risers & valves, fire detection, etc.

9.3. DESIGN OPTIONS

Three sign family options embodying the “Campus Brand”:

- **Basic Acrylic:** Most economical, for minor renovation projects and in-house production by UT Sign Shop or APCO.
  - Type: Plaque

- **Framed:** For renovations and new construction.
  - Provided by APCO. Type: “FullView”

- **Elevated:** For renovations and new construction.
  - Provided by APCO. Type: “Elevate”

*Figure 3. Basic Acrylic Signage*
Figure 4. Framed Signage
Figure 5. Elevated Signage
10. ROOM NUMBERING and FLOOR/LEVEL CONVENTIONS

10.1. PREFACE

A unique room number, along with a building number is the major key to access all facilities room data records.

UTK is responsible for assigning the appropriate unique building number for each building. The building number is not needed or used by the designer. It is for internal use only.

The architect will provide room number assignments and assign building levels for new buildings and or major renovations during the Design Development (DD) phase. A maximum of seven digits are allowed for room numbering. These assignments will be reviewed and approved by UTFS’s Project Manager and the Space Coordinator.

10.2. BUILDING LEVELS

The naming of each level is project specific and should be discussed during DD between the architect and UTFS’s Project Manager. The following general guidelines should be considered when determining the naming convention.

- Determining the building’s main entrance

Although there will be several entrances to any building, there is one that by design is considered the main entrance. The main entrance should correspond with the building address as identified per 911 listing. The floor level with the assigned main outside entry should be the building’s First Floor Level. Levels above will be numbered consecutively as Second Level, Third Level, etc.

- Determining floors and levels

Any building level below the First Level is considered a Basement Level and should be numbered starting as B1, B2, B3, etc. Ground Level nomenclature shall not to be used.

Some buildings may have a Mezzanine level in between two main floor levels. A Mezzanine level is named with the prefix ‘M’ followed by the level number underneath the Mezzanine.

An attic area is defined as a floor level below the roof, not accessible to the public with limited head height and primarily housing exposed roof structure. Attics were common in older buildings. Newer buildings with upper level mechanical Penthouses do not have attics. Attics, if used, shall be named using the prefix ‘AT.’

A level or levels above the public levels used for utility purposes is considered a Penthouse level and shall be numbered according to the level they are on as ‘PH1’, ‘PH2’, ‘PH3’, etc.

Parking Levels in a building that is not exclusively a garage (i.e. Administrative Parking Garage at Andy Holt Tower) should be numbered starting top down as P1, P2, P3, etc. Parking Garages should follow the same numbering as any other building.
10.3. ROOM NUMBERING

Room numbering should be discussed during the DD Phase and finalized during the CD phase.

- **Clockwise Numbering pattern and direction**

After the building main entrance has been established and the level numbering is identified, immediately begin counting rooms, spaces or areas in a clockwise direction. On the first level, start counting with the number 101; second level 201; third level 301; etc. Whole hundred numbers – 100; 200; 300; etc. shall not be used and are reserved for future use. The room, space and area numbering should continue in a clockwise direction around the level. Moving around the level clockwise, odd and even numbers shall be kept consistent with respect to right side/left side of corridor whenever possible. This is the preferred directional pattern numbering method.

Rooms in special floors such as basements will start their numbering with a prefix followed by the level, and then the room number starting with 01. For example, room B101 is room 01 at the B1 level.

- **Up/Down Numbering Pattern and Direction**

An alternate directional pattern numbering method is that of an up/down main corridor(s) scheme. This can be utilized in building renovations that have existing room, space and area numbering to remain in which new numbering needs to adapt to current conditions. It also may become necessary to use in buildings which the preferred clockwise directional method is just not possible because of a single corridor building or “non-racetrack” corridor and room layout. Immediately begin counting rooms, spaces and areas nearest the main entrance with the number 101; second level 201; third level 301; etc.
Whole hundred numbers – 100; 200; 300; etc. shall not be used and are reserved for future use.

Along the main building corridor, count room, space and area numbering down to the end of the corridor. If there is another main or secondary corridor, again work your way down, or back up (pending the layout) while continuing with numbering where it was left off from the main corridor. While numbering up/down corridors keep in mind, odd numbers shall be kept consistent with respect to right side/left side of corridor whenever possible. This alternate directional pattern numbering method should be consulted with UTFS Project Manager prior to use.

• **Stacked numbering pattern and direction**

Levels above and below the first level shall follow the same numbering pattern established on the first level. It is important to note that the above methods are without regard to general circulation spaces such as vestibules, corridors, stairs, lobbies, elevators and escalators. Those general circulation spaces are numbered independently as described later in this document. The numbering start point for each level must vertically correspond to the start point on the first level. Likewise, each respective level shall also vertically follow the previous level numbering pattern as close as possible in order to “stack” like numbers of rooms, spaces and areas from level to level as close as possible.

• **Suites and sub-rooms**

A sub-room is a single room inside a primary room. A group of rooms inside a primary room whose door opens into a public corridor is considered a “Suite.” Suites and sub-rooms within suites are numbered using the same process as rooms previously described, but with an alphanumeric suffix added to rooms within a suite.

For example, sub-rooms whose door opens from suite 305 should be numbered 305A, 305B, 305C, etc. A sub-room within 305A, should have a numeric digit added to the suffix, for example 305A1, etc.

Rooms within suites should be numbered clockwise using the same rules as when numbering primary rooms. For example, the first room from the main entrance to suite 305 would be 305A, second room would be 305B, etc.

• **Elevators, Stairs and General Circulation**

After the primary entrance has been established, immediately begin counting general circulation and/or elevators and stairs in a clockwise direction.

Stairwells shall by numbered starting with their level number, followed by ‘98’, ending with a letter suffix. These shall be numbered to be stacked on each floor. Numbering shall proceed clockwise, where possible. (For signage purposes only, the University may opt to add other designations such as Stair A, North Stair, etc. to assist in way finding. These should show on the architect’s drawings in addition to the ‘98’ numbering.)
ROOM NUMBERING and FLOOR/LEVEL CONVENTIONS

For example, a stairwell on the first three floors would have numbers 198A, 298A, and 398A. A second stairwell would be numbered 198B, 298B, and 398B.

Corridors and hallways shall receive numbering starting with their level number, followed by the '99' numbering representing circulation space, and ending by a suffix letter. Numbering will follow the same natural flow and pattern as the rooms. Numbering shall proceed clockwise from the main entrance, where possible. The first enclosed circulation area will be given the suffix ‘A.’ UTFS’ standards require only one room number for a corridor even if the corridor turns and flows in another direction on plan, unless separated by a door. Then the corridors will be considered two separate rooms and be numbered accordingly with the next suffix letter. For example, on the first floor, the corridors shall be numbered 199A, 199B, etc. Corridors on the second floor would be 299A, 299B, etc.

Hallways and corridors inside a “suite” area shall receive normal room numbering (i.e. not x99).

Elevators shall receive numbering starting with the level number followed by the ‘97’ number, ending with a letter suffix. These shall be numbered to be stacked on each floor. For example, an elevator shaft on the first three floors would have numbers 197A, 297A, and 397A. A second elevator would be 197B, 297B, and 397B. Numbering shall proceed clockwise, where possible.

**Skipping Numbers**

A certain quantity of numbers per level may be skipped as appropriate in order to reserve numbers for future subdivision or remodeling. Windows, columns and other structural features may provide clues to possible future partitioning. Care must be taken in regards to the quantity of numbers to be skipped. In most cases, no more than 96 rooms, spaces or areas per level can be labeled without having to change the entire nomenclature of the whole building. Meaning skipped numbers shall be considered pending the total current room count. As an example if a floor has 85 rooms proposed for said project then it is only possible to skip 11 numbers for said floor as the total room count should not exceed 96 whenever possible.

**10.4. ADDITIONAL CONSIDERATIONS**

Room, space and area numbers should be assigned prior to the beginning of door numbering. Room, space and area numbers should never include decimal places. Decimals are only used to designate doors.

Letters “I” and “O” should not be used to number any room as they may be confused with numbers.

Restrooms, Storage, Mechanical, Electrical, Elevator Machine Rooms, Custodial Closets,
Maintenance and Telecom/Data rooms shall be treated as any room, space or area and receive the same standard numbering nomenclature as previously described herein.

ADAPTING NEW AND EXISTING
In cases of building renovations or additions there will be rooms, spaces and areas that do not follow the current numbering standard or simply do not flow with the new renovation. Project stakeholders should determine if and how the renovation will adapt existing numbering to the new standard numbering in order for the building/level numbers to flow correctly.

UTFS’ preference is that medium to large renovation projects that encompass [40%-60%] of the total existing level area shall also include renumbering the portion of the level that is not under renovation in the overall project scope.

Smaller projects that incorporate minor renovation such as adding a wall or door, would not require the individual room, space, area or suite to be renumbered. Renumbering of minor renovations would be determined on a case by case basis.

In either of these circumstances, care must be taken in order to best provide the new numbering standards within the renovation as well as alter existing numbering to flow and follow the numbering standards implemented and around the renovated areas.
11. CUSTODIAL ROOMS

11.1. PREFACE

Providing conveniently located and an adequate number and size of custodial rooms are critical to the maintainability of a facility. Rooms for equipment storage/battery charging and central supply rooms with office area are to be provided in addition to custodial closets throughout the building.

11.2. CUSTODIAL AREA DESIGN GUIDELINES

There are three different types of custodial rooms required in each building:

1. Custodial Closets, minimum one per floor
2. Custodial Equipment Storage Room, minimum one per building
3. Custodial Supply Room and Office, minimum one per building

a) Custodial Closets:
- Reference Mechanical Standards for plumbing fixture types
- Size: 6’ x 8’ min with lockable 3’-6” wide out-swinging door
- Location: One per floor min (Evaluated on a case-by-case basis)
- Equipped with a corner floor sink for bucket filling/disposal
- Hot and cold water supply, spout with hose tread outlet and pail hook, hose and hose bracket, Mop hanger, rim guard and stainless steel wall guards.
- Broom/mop hangers located above the sink.
- Chemical proportion dispenser system mounted on wall above the floor sink (furnished and installed by owner)
- Open floor space for min of two 32 gal. containers or bins
- Min of four electrical outlets
- Heavy duty free standing steel shelving
- Occupant sensor light switch
- Door kick stop or automatic door holder to prop door open, as allowed
- Reference Interiors Standard for additional room requirements and finishes

b) Custodial Equipment Storage and Charging Room:
- Size: 10 ’x 12’ min with lockable 3’-6” wide out-swinging door (Complex or disjointed buildings may require additional equipment rooms)
- Usage: Central building custodial equipment storage and charging of floor scrubbers, sweepers, and other equipment
- Battery storage
- Floor sink and hanging system for mops and brooms. (Same requirements as Custodial Closets above)
- Electrical outlets as required for equipment charging; four electrical outlets min.
- Heavy duty free standing steel shelving, as required
- Door kick stop or automatic door holder to prop door open, as allowed
- Reference Interiors Standard for additional room requirements and finishes
c) Custodial (Central) Supply and Office:
   • Size: 12 ’x 15’ min (Complex or disjointed buildings may require additional rooms)
   • Openings shall be out-swinging double doors without a center mullion
   • Usage: Storage of building supplies and custodial office area
   • Floor sink and hanging system for mops and brooms (Same requirements as Custodial Closets above)
   • Electrical outlets and phone/data connections as required
   • Heavy duty free standing steel shelving, as required
   • Furniture: Desk & chair, visitor chair(s), file cabinet and book shelf, as determined
   • Door kick stop or automatic door holder to prop door open, as allowed
   • Reference Interiors Standard for additional room requirements and finishes

11.3. PROVIDED BY UTFS, INSTALLED BY UTFS

   Items provided and installed by owner:
   • Waste containers
   • Cleaning solution chemical proportion dispenser system

12. PROJECT CLOSEOUT SUBMITTALS

12.1. PREFACE

   Closeout submittals are vital to campus operations and to the maintenance of up-to-date construction records and plans. Proper submittal formatting facilitates storage, retrieval and use in future and current projects.

12.2. STANDARDS

   Provide the following to UTFS during the timeframe between Substantial Completion and Final Completion:

   a) The following should be submitted in electronic PDF format only, except for scaled paper set of record drawings:
      • Operation and Maintenance manuals and product data including:
        o Product or Systems supplier/installer contact information
        o Manufacturer and model numbers
        o Cut sheets
        o Service schedules and maintenance procedures
        o Control diagrams
        o Equipment diagrams and parts list
        o Color coded piping and wiring diagrams
        o Panel board circuit directories
        o Other, as applicable
      • Cleaning instructions for floors, surfaces, finishes, etc.
• Paint and finish color selections

• Reports:
  o Geotechnical
  o Environmental
  o Structural

• Other, as applicable

• Stormwater:
  o Operation and Maintenance Plan, if applicable
  o Notice of Termination (NOT) for the Pollutant Discharge Elimination System (NPDES) Stormwater permit

• BIM Execution Plan, if applicable

• Certificates:
  o Contractor Certificate of Substantial Completion
  o Fire Marshall Certificate of Occupancy (CO)
  o Elevator permit
  o Other, as applicable

• Warranties:
  o Vendors
  o Manufacturers
  o Subcontractors

• Maintenance Agreements

• Shop Drawings

b) Construction Record Documents:
• As-Built Record Drawings and Specifications in electronic PDF format
• As-Built Record Drawings and Specifications in paper format (full size, scaled drawings)
• As-Built CAD files (see preferences below)
• Record BIM Drawings, if applicable (see BIM guidelines)

c) Training:
• Systems and components classroom training sessions. Provide power-point of training material for reference (Coordinate with UTFS)
• On-site demonstrations
• Log of training sessions and attendees

12.3. DESIGN PREFERENCES

If utilized, provide As-built BIM format drawing files (300 level min.).
Paper sets shall reside within the buildings Maintenance Office. Archiving of electronic sets by UTFS archive division

Formalized training coordinated with UTFS Training Coordinator
13. MECHANICAL DESIGN CRITERIA

Specific requirements for mechanical systems are given in many of the individual space requirements for facilities. These requirements must be met. In the event that there is a conflict between the criteria listed in this document and the individual space requirements, the more stringent requirement shall govern. Requests to deviate from these criteria will be evaluated on a case-by-case basis by UTFS.

System selection must be based on functional performance, flexibility, reliability, life cycle cost, maintenance and service, and energy consumption. None of these items singularly should be the sole criterion for selection of the system. Selection of at least two manufacturers and model numbers for all major equipment items is sufficient. Indicate these selections in drawing schedules or specifications.

Building system flexibility and expandability are essential since occupancy of the building will vary extensively over its life cycle.

Equipment should be selected for long range operation and reliability targeting a 25-30-year service life. Practical, off-the-shelf technology is preferred. To the greatest extent possible, select electric motors for all mechanical equipment from off-the-shelf motor sizes for ease in replacement from typical motor suppliers.

Maximum energy efficiency is required. Equipment efficiency, proper insulation, and system control and operation are important parameters.

13.1. UTILITIES

13.1.1. SOURCE OF HEATING AND COOLING

Space and domestic water heating shall be provided from the campus steam distribution system, where available. Existing cooling plant capacity shall be used to the greatest extent practical. The designer should consult UTFS to determine if future cooling plant capacity may be required to service surrounding buildings.

13.1.2. OUTAGES

All outages shall be coordinated with UTFS. A written outage plan including start time, expected duration, and description of work shall be provided to UTFS a minimum of 14 calendar days ahead of the outage. If the work requires specialty or custom parts, such as high voltage termination kits, pieces of major equipment, etc., the availability of those items must be confirmed prior to scheduling the outage.

13.1.3. INTERFACE WITH OFF-CAMPUS UTILITY COMPANIES

All interactions with off-campus utility companies must be coordinated through UTFS’ Utilities Director. This applies equally to interactions during the design and construction phase of all projects.

13.1.4. METERING
All utilities shall be metered at the entry point to buildings. Consult UTFS on any requirements for additional submetering for specific uses. All meters shall be revenue-quality devices. Consult UTFS on the specific make and model of meters to be used, as there may be utility company requirements present. Irrigation water shall be metered separately from domestic water.

### 13.2. DESIGN CONDITIONS

Unless otherwise stated in specific building/space criteria, the following design conditions shall be used. These conditions also apply to the selection of all equipment.

<table>
<thead>
<tr>
<th>Indoor Design Conditions</th>
<th>Outdoor Design Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling: 72°F DB</td>
<td>Summer: 95°F DB; 80°F WB</td>
</tr>
<tr>
<td>Heating: 72°F DB</td>
<td>Winter: 0°F DB</td>
</tr>
<tr>
<td>Dehumidification: 50% RH</td>
<td></td>
</tr>
</tbody>
</table>

The indoor relative humidity should not exceed 50% RH. This may result in dehumidification as the primary driver for distribution or equipment design or selection.

Systems shall be capable of maintaining the indoor design conditions across all load conditions in all spaces. This is particularly important for spaces with highly variable occupancies or equipment loading.

### 13.3. VENTILATION REQUIREMENTS

The building ventilation system shall provide a minimum quantity of ventilation air consistent with physiological needs, exhaust make-up, and infiltration neutralization.

Buildings shall be positively pressurized relative to the outdoors. Laboratory spaces shall be negatively pressurized relative to adjacent public spaces such as hallways.

Ventilation air is to be introduced through the air handling units by activation of the minimum outside air damper when the supply fan is started.

### 13.4. AIR DISTRIBUTION

#### 13.4.1. DESIGN

Air distribution must be as uniform as possible with temperature variation in the space not exceeding 2°F. This applies across all load conditions, with particular attention being required for spaces with highly variable occupancies or equipment loads.

Maintaining the indoor relative humidity at or below 50% RH is very important. This may result in dehumidification as the controlling load.

Ducted return air systems are preferred. Plenum return systems shall be avoided. Mechanical rooms shall not be used as return or outside air plenums.

In ductwork layout, duct crossings, duct paralleling, duct backtracking, and other similar complicating features should be minimized when possible.
Noise levels should not exceed NC 35 for all occupied spaces other than classrooms and teacher spaces, where noise levels should not exceed NC 30. Sound and vibration control may be required for both equipment and duct systems.

Provide all blade dampers as opposed blade. This includes for airflow control applications and for open-close operation. All dampers shall be capable of closing “bubble-tight”.

13.4.2. **REGISTERS, GRILLES, AND DIFFUSERS**

Locate air outlets to provide a proper throw, drop, and spread at or above 20 fpm minimum and 75 fpm maximum room velocity. In general, the range of supply air outlet velocities should be 500-750 fpm, and return and exhaust inlet face velocities should be 300-500 fpm.

Grilles, registers, and diffusers should be selected for compatibility with room ceilings, walls, and finishes. Supply air should be introduced through round neck, louvered-face ceiling diffusers. Dampers, where provided with diffusers, should be radial type. Slot diffusers and light troffer diffusers may be appropriate for some applications.

Perforated ceiling diffusers or return or exhaust registers shall not be used. Avoid supply air diffusers with metal filler panels.

Ceiling return and exhaust air registers and grilles must be grid core type. Return air registers should be located near the exterior wall of the space served. Ducts serving return or exhaust air ceiling registers should be sized to accommodate the full face of the register. Do not provide round or flex duct to serve return or exhaust air ceiling registers.

13.4.3. **DUCTWORK**

Fibrous duct shall not be used.

Joints in low pressure supply air ducts located in unconditioned spaces, other than Ductmate® systems, must be sealed using Hardcast® pressure-less tape with RTA-50 adhesive, or a similar product.

Rectangular branch take-offs should be of 45-degree tap-in type. Splitter dampers, extractors, and scoops are unnecessary. Bellmouth fittings should be used for round duct take-offs.

Duct elbows are to be the full radius type, r/D = 1.5. Radius ells with square throats shall not be used. Where mitered 90 degree elbows are necessary, they should include factory-made turning vanes.

Provide manual volume dampers with minimum 20-gauge thickness blades in ducts where required for proper adjustment and balancing of airflows.

Medium and high pressure ducts must be factory-fabricated double-wall round or flat oval with factory insulation and perforated liner. Take-offs must be the conical type. Factory
MECHANICAL DESIGN CRITERIA

elbows must be full radius type, \( r/D = 1.5 \). Divided flow fittings must be provided where required. Joints should be sealed with Hardcast® pressure-less tape with RTA-50 adhesive, or a similar product. Specify ducts to be leak tested in accordance with SMACNA’s “Air Duct Leakage Test Manual”.

Flexible duct with 1" thick insulation should be provided to connect supply air diffusers to main or branch ducts. Include applicable duct pressure in the specifications. Duct length should be limited to 4 feet. Ducts must be installed without kinks or sags and supported with 3/4 in. wide metal bands. The minimum inside radius of any bend should be one-half the diameter of the duct.

Access doors or panels must be provided in ducts for access and inspection of filters, heating coils, sound attenuators, control dampers, fire and smoke dampers, humidifiers, air flow stations, and other similar system components. In addition, doors should be within reach of obstructions such as turning vanes and dampers and at approximately every 20 feet in long ducts for cleaning and maintenance if no other means of access is available. Doors should be as large as practical and be able to be opened or removed without the use of tools.

The location of inaccessible doors and other mechanical equipment, including valves, dampers, coils, VAV boxes, fan coil units, and other similar system components should be coordinated with architectural design. A minimum 24" x 24" access door should be included in inaccessible ceilings and walls as necessary for access to this equipment.

Branch ducts serving VAV boxes should be maintained at 2-1/2 duct diameters straight duct at the entrance to the box, and final connection aligned properly so as not to restrict air flow to the box.

Shot pins are not acceptable fastening devices for supporting ductwork and sheet metal specialties.

**13.4.4. AIR SIDE ECONOMIZERS**

All central air systems shall be designed to introduce up to 100% outside air for cooling whenever this use will result in lower energy usage. Design shall include motorized minimum and maximum outside air dampers, return air dampers, exhaust or relief air dampers and, where warranted for optimum economizer operation, a single relief or return air fan.

Where feasible, outside air shall be drawn in through wall louvers with relief air discharged above the roof or above intake louvers. Outside air intakes shall be protected by screens of corrosion-resistant material not larger than 1/2 in. mesh.

Return and outside air ductwork and dampers shall be arranged to achieve complete mixing of the two airstreams prior to entry into the air handling unit. Where complete mixing cannot be achieved, stationary blenders or baffles shall be provided.
Inline return air fans, where required, shall be the mixed flow type, belt driven, with lubrication fittings outside the fan housing. Provide fans with integral hinged access door for inspection and cleaning. Fans should be selected for an outlet velocity of not greater than 3000 fpm. Vane axial fans are not acceptable.

13.4.5. **VAV BOXES**

Variable air volume (VAV) boxes are to be the pressure-independent type provided with pressure taps and air flow curves for making air flow and pressure measurements. Air leakage through fully closed boxes must not exceed 2% of design air volume at 8 in. static inlet pressure. Total pressure drop should not exceed 0.5 in. wc. Boxes should be normally closed, have access doors, and a minimum 1 in. thick foil faced glass fiber liner or double wall construction.

Boxes with hot water coils should be provided for most applications requiring heating. The use of fan-powered boxes should be minimized. Fan-powered boxes may be considered for spaces with high heating requirements or where high minimum air flow rates are required.

Heating water coils should have minimum 0.02 in. thick tubes with 0.006 in. aluminum fins. Fin spacing should not exceed 12 fins per inch. Coil casings are to be insulated with fiberglass duct wrap where condensation may occur. PT plugs and drain valves should not be provided on piping serving VAV boxes with hot water coils.

Boxes installed above inaccessible ceilings should have adequate access regardless of finished appearance. The engineer is responsible for coordinating this with the architect.

Boxes, including hot water valves, are to be furnished with DDC controls. Controllers should be fully programmable. Air flow should be monitored and minimum and maximum set points adjusted from the DDC system. In addition, monitor box leaving air temperature.

13.4.6. **MECHANICAL VENTILATION AND EXHAUST**

Corrosion-resistant registers should be installed directly over sources of odor and moisture in sanitary facilities (toilets, locker rooms, janitor’s closets, etc.). Other spaces requiring ventilation should not be connected to sanitary exhaust systems.

In mechanical and electrical rooms containing heat-generating equipment (steam PRV stations, boilers, heat exchangers, chillers, switchgear, etc.), air should be introduced on the cool side of the room and exhausted on the hot side. Exhaust fans must be thermostatically controlled to maintain room conditions as required for proper equipment operation.

Exhaust air shall be ducted directly to the fan. Ceiling registers shall be connected independently by branches to the main ductwork to facilitate balancing and attenuate noise.

Exhaust fans shall be the centrifugal type, preferably directly driven, and selected for a wheel tip speed not to exceed 3500 rpm. Fans shall be isolation mounted and have corrosion-resistant gravity type backdraft dampers with blade edge and end seals. An accessible non-fused disconnect switch shall be installed in or adjacent to each fan base. Where available, the fan housing shall be hinged at one edge for access to motor and drive.
Fans shall be AMCA certified with motor starters with a “soft start”, or variable speed drives for motors larger than 10 hp.

Wherever possible, fans must be installed on building roofs or in mechanical rooms. Avoid installation above ceilings or other concealed or inaccessible locations.

Roof curbs should be of the sound attenuating type with a minimum height of 12 in.

Exhaust fans should be controlled by the DDC system or by interlocking with the respective air handling unit.

13.4.7. FIRE AND SMOKE DAMPERS

Fire dampers shall be U.L. labeled dynamic rated, curtain type dampers. Dampers shall be type “B” for low pressure and type “C” 100% free area for high pressure duct.

Smoke dampers shall be classified in accordance with U.L. Standard 555S.

13.4.8. AIR FILTRATION

Central air systems greater than 2500 cfm shall be provided with pleated media filters having an initial efficiency of not less than 85%, in accordance with ASHRAE Standard 52.2. Pre-filters in the 30% efficiency range shall be provided to extend the life of the higher efficiency filters.

Filter boxes or housings must be provided with a hinged access door on each side. All joints between filter segments and the enclosing ductwork shall be gasketed or sealed to provide a positive seal against air leakage. In large filter banks, provide 3 in. stiffening straps between filter frames vertically every second frame. A Magnehelic® gauge shall be installed across each filter bank.

Filters must be new and clean in all equipment at the time of final inspection. A complete, new spare set of filters for all equipment must be provided in addition to the ones inspected. Filters that were in use during the construction period will only be accepted with prior authorization by UTFS.

13.5. INSULATION

13.5.1. GENERAL

Insulation linings, coverings, vapor barriers, etc. and the adhesives used for applying them shall have a flame spread classification of not more than 25 and a smoke-developed rating of not more than 50 as tested in accordance with ASTM Standard E84. Insulation materials must be installed in accordance with manufacturer’s recommendations.

A vapor barrier should be provided on the exterior side of the insulation, which can serve as a finishing cover for the insulation.
13.5.2. **DUCTWORK**

All supply, return, and outside air ductwork and plenums in unconditioned spaces must be insulated, preferably on the exterior. Consult with UTFS where liner may be required for sound control, keeping in mind the NC criteria in section 6.1. Cold air duct components subject to condensation, including plenums, transitions, VAV box HW coils, fan casings, air flow stations, fire dampers, apparatus connections, and the top surfaces of ceiling diffusers must be insulated.

Ductwork other than internally lined or factory insulated is to be wrapped with minimum 2 in. thick glass fiber insulation with vapor barrier.

Specify ductwork manual volume damper handles, airflow station pressure ports, access door handles, duct mounted instrumentation, etc. to be left exposed or accessible above the insulation vapor barrier. Damper handles in externally wrapped ductwork are to be provided with stand-off brackets and locking quadrants to ensure the handle can be adjusted without disturbing the insulation vapor barrier.

Outside air ducts and plenums should be insulated on the exterior with glass fiberboard insulation.

Supply and return air ducts should be wrapped with glass fiber insulation. With the exception of exhaust to heat recovery devices or other high temperature exhausts, do not insulate exhaust ducts.

13.5.3. **PIPING AND EQUIPMENT**

All domestic hot and cold water piping, space heating and chilled water piping, rainwater leaders, refrigerant suction lines, steam and steam condensate piping, piping traced with heating elements, and A/C unit drain piping must be insulated.

All valves except pressure reducing valves, strainers, fittings, flanges, hydronic specialties, tanks, etc., including heat exchangers, condensate receiver tanks and associated piping, emergency generator mufflers and exhaust piping, and air release tanks shall be insulated. Chilled water pumps shall be insulated. Compression tanks and condenser water piping inside the building or in mechanical rooms should not be insulated. On condensate receiver tanks and piping, no connections or gauges shall be covered by insulation.

Glass fiber sectional pipe insulation is to be used for most pipe insulation applications. Glass fiber factory premolded fittings matching basic insulation equivalent to HAMFAB should be provided at all pipe fittings (tees and ells) and finished with glass fabric and vapor barrier mastic. Glass fiber blanket inserts with PVC covers are not acceptable for pipe fitting insulation. Fittings 8” and larger may be field mitered. Valves, strainers, flanges, etc. shall be covered with mitered insulation segments of the same type and thickness as adjoining pipe insulation.

Chilled water pump casings and large valves and strainers in steam PRV stations are to be insulated with custom made, field measured removable and reusable covers.
Piping below grade shall be factory, pre-insulated type, or be insulated with Foamglas® with Pittwrap® jacket. Piping exposed to weather and in manholes should be insulated with Foamglas®. Premolded fittings shall be provided at tees and ells. Piping with Foamglas® with Pittwrap® jacket to be bedded in sand and topped with approximately 2 feet of sand above the pipe.

Insulation of piping and fittings shall allow for thermal expansion and/or contraction, especially where bends or loops are present.

Prefabricated and pre-insulated steam piping shall consist of a steam service pipe, insulation, an air gap, and a jacket pipe which permits venting and draining of air gap area. Also include a temperature sensing line which can identify possible steam leaks in the system and their approximate location. This temperature sensing line should be run into a building, not terminated in a manhole. Steam piping insulated with Foamglas® with Pittwrap® should be pitched to drain condensate back to the steam vault drip leg.

Refrigerant suction piping and A/C unit drains should be insulated with flexible, elastomeric pipe insulation. Where exposed to weather, finish with vapor barrier jacket.

Air separators, and chiller evaporators, including flanges, are to be insulated with flexible, sheet-type elastomeric insulation.

Heat exchangers, hot water air separators, condensate receiver tanks, etc. shall be insulated with board-type heavy density glass fiber insulation and finished with canvas jacket. On condensate receiver tanks and piping, no connections or gauges shall be covered by insulation.

Insulated piping, valves, and fittings within 7 ft. of floors or work surfaces shall be finished with 0.016" smooth aluminum jacket, secured with sheet metal screws and 1/4 in. aluminum bands. Corrugated or textured jacket is not acceptable. Fittings, etc. must be covered with factory-formed aluminum elbow covers.

Insulated piping above grade exposed to weather and in manholes and tunnels shall also be finished with aluminum jacketing.

Protect insulation at each hanger and support point with a 14 gauge galvanized shield which extends up to the centerline of the pipe and is centered inside the pipe hanger. Minimum shield length should be 12”. Where glass fiber insulation is used on piping 3” and larger, provide a section of Foamglas® insulation between pipe and metal shield to prevent crushing of insulation.

13.6.1. DESIGN
Size hydronic piping for a general range of pipe friction loss of 1-4 ft/100 ft. A value of 2.5 ft/100 ft. represents the mean to which most systems are designed. Flow velocities should not exceed 8 fps (4 fps for 2 in. and smaller pipe) nor be less than 2 fps.

Piping runouts greater than 10 ft. in length should be a minimum size of 3/4 in.

Nominal pipe size shall be used to select and designate piping in the contract documents.

Chilled water systems should be designed for leaving water temperatures of 42-43 °F; hot water systems for 180°-190° F.

Chilled water coil temperature differential should be no less than 16 °F for central station and built-up equipment, and no less than 12 °F for terminal equipment. Hot water coil temperature differential should generally be 30 °F.

The systems should be variable flow with two-way control valves provided instead of three-way. Variable frequency drives are to be provided at the pumps. Chillers shall be capable of turn down when flow turns down.

For multiple chiller systems with variable primary flow, system shall be designed with the ability to maintain system flows when all chillers are not in operation.

Where the building is served by the campus distribution system, provide a strap-on flow meter with minimum 1% accuracy to meter the building flow. If a tertiary pump is needed, a control valve should be provided in the distribution system return line to control building return water temperature to the distribution system.

Process cooling systems shall include provisions for using the building’s domestic water supply as a redundant cooling source. The system shall automatically swap to this redundant source in the event of loss of flow or the loop temperature exceeding an emergency setpoint.

### 13.6.2. PIPING

Piping 2 in. and smaller shall be Type L, hard drawn seamless copper tubing with wrought copper, solder joint type fittings, ANSI B16.22. Elbows are to be long radius pattern. Solder shall be 95-5 type. “Tee pullers” shall not be used in place of tees on copper piping. ProPress® fittings are acceptable.

Piping 2-1/2 in. and larger shall be seamless black steel, Schedule 40, ASTM A-53, Gr. B, or A106 with welded or flanged fittings, ANSI B16.9. Elbows are to be long radius pattern. Field-fabricated fittings are not acceptable. Forged steel, gasketed flanges, ANSI B16.5, of the welded neck type are to be used at flanged connections. Slip-on type may be used on straight pipe. Flanges must be compatible with valve and equipment connections. Where a branch connection from a main or header is one half the main diameter or smaller, saddle-type, forged steel welding fittings may be used.
Aquatherm® and other similar piping products may be considered for specific applications after prior approval of UTFS.

Welding shall conform to ANSI Code for Pressure Piping, Section B31.1. All welds shall be of the single “V” butt joint type with optimum fusion and 100% weld penetration of wall thickness. Piping should be welded by the shielded arc type electrode-electric arc process. Butt joints should be made with split backing rings. In most cases, direct welded connections shall not be made to valves, strainers, equipment, etc. The contractor should be required to obtain certification of all pipe welders on the project, in accordance with Section IX of the ASME code.

Union or flanged connections should be provided at valves, equipment, etc. Provide dielectric unions at the junction of steel pipe and equipment with copper piping systems. Preferably, provide steel to brass to copper connections. Where size changes on horizontal lines, use reducing fittings having eccentricity down, bottom level. All piping take-offs should be made from the top of mains or headers. “Bullhead” tee connections on return piping shall not be used.

Specify adequate support for horizontal piping at intervals of not more than 7 feet for piping and tubing 1-1/2 in. and smaller and not more than 10 feet for piping 2 in. and larger. In addition, supports should be provided within 18” of all changes of direction, at all vertical pipes, and within 18” of valves 4 in. and larger or at other points of concentrated weight. Roller type guided supports should be provided where piping is subject to expansion. All pipe supports and hangers shall be those specifically designed for the piping materials being supported.

Provide adequate shields between pipe insulation and supports.

Shot pins are not acceptable fastening devices for supporting piping and hydronic specialties.

Specify identification for all piping to be snap-on or strap-on labels with flow directions, equal to that manufactured by Seton or Brady. Band color for chilled water and condenser water piping shall be green. Color for hot water piping shall be yellow. Adhesive labels or painted markings are not acceptable forms of piping identification.

Specify piping to be thoroughly flushed before it is put into operation.

**13.6.3. VALVES**

Ball valves of full port, two-(or three) piece body construction with soldered end connections and extended stems shall be used on hydronic piping 2 in. and smaller. Valves should have stainless steel balls and stem and be rated for 600 psig WOG, similar to Apollo 77-200.

Butterfly valves with lug-type body, bronze disc, EPT seat, and extended neck shall be provided on piping 2-1/2 in. and larger. Valves should be rated for “bubble-tight” service at 200 psig WP. Butterfly valves should also be used in condenser water piping.
Valves 6 in. and smaller should be provided with lever handles with infinite throttling and memory stops. Valves 8 in. and larger should have worm gear operator with hand wheel and indicator. Where gear operator is 10 feet above floor or work surface, provide chain wheel, chain, and guides.

Provide sufficient number of valves for proper isolation of the piping systems. In addition to equipment connections, valves must be provided at all major pipe branches, risers, at the service entry for each floor of a multi-story building, and at the entry to every laboratory, kitchen, equipment room, or other spaces with large quantities of piping connections.

13.6.4. AIR CONTROL AND DRAINS

Hydronic systems must be provided with air separation devices to minimize the amount of entrained air in the piping circuits. Manual air vents are to be provided at high points, wherever there is a change in elevation of the piping and at intervals of long runs of piping. Ball valves of 1/4 in. minimum size should be used for air vents.

Full-bladder type tanks are preferred for air confinement in the piping system.

Drain valves must be provided at low points in the piping system and where needed in mechanical rooms. Valves should be 3/4 in. ball type with capped, hose-end connections. Provide a drain valve, accessible from the mechanical room floor, on air separators and strainers and pipe to a floor drain.

The minimum pitch of hydronic lines shall be 1 in. in 40 ft. Piping shall pitch down to drain points and up to vent points.

13.6.5. SPECIALTIES

Strainers with 20 mesh screens should be provided at the suction of each pump and at other equipment recommended by the manufacturer, including control valves. Strainers larger than 1 in. shall be provided with a ball type blow-down valve and piped to a floor drain. Suction diffusers should be used in place of strainers on end suction pumps. The screens in pump strainers should be removed once it has been ascertained construction dirt has been eliminated.

Triple-duty valves should be provided on the discharge of pumps piped in parallel. Valves should be straight pattern, in-the-line type.

Balancing valves are not needed on the discharge of variable speed pumps.

Flow balancing valves, or circuit setters, shall be provided at each air handling unit coil, coil bypass line, terminal unit coil and at other locations in the piping where required for balancing and monitoring, including major branch lines. Provide with a metering kit. Size of valves should be specified or shown on the drawings. For variable flow systems, provide automatic flow balancing valves instead of circuit setters.
Hydronic system filters of either the full flow or bypass type should be considered where piping is to be connected to existing systems. Discuss with UTFS.

### 13.6.6. INSTRUMENTATION

Thermometers with wells shall be provided at the inlet and outlet of each chiller evaporator, condenser, and heat exchanger. Thermometers should also be provided on chilled water and hot water supply lines serving each mechanical room. Thermometers must be readable from the mechanical room floor or platform.

Thermometers shall be of the adjustable angle type with minimum 9 in. scales. Range shall be specified on the drawings. Thermometer wells shall be 3/4 in. N.P.T. with 2-1/2 in. extension neck for insulated piping. All wells must be thoroughly packed with a heat conducting compound.

A single pressure gauge shall be provided for each pump, piped from the suction and discharge flanges with isolation valves. Pump gauges are to be compound type. All gauges are to be 4-1/2 in. size and have an accuracy of 0.5% over scale range. All gauges are to be provided with impulse dampeners and needle or 1/4” ball valves.

Pressure-temperature fittings (P-T plugs) shall be provided at the inlet and outlet of each AHU heating and cooling coil, chiller evaporator and condenser, heat exchanger, and 2 in. and larger control valve. Provide one P-T test kit. P-Ts should not be provided on small terminal unit coils, including VAV box HW coils, fan coil units, etc.

Flow meters shall be a clamp-on design with no liquid contact. The meters must utilize the transit-time flow measurement technique employing the use of two transducers appropriate for the pipe diameters with which it is used.

All transducers supplied must have an accuracy of better than 1% of the flow reading. All calibration and transducer data must reside in a non-volatile memory chip located in the transducer junction box or flow meter.

Flow meters must compensate for temperature change as the system ramps up and down when flow conditions start and stop. Meters must work without any low-flow cutoff or dead spots.

The flow meter electronics shall be housed in a NEMA 2, 3R or better enclosure and must have the ability to indicate flow rate, flow velocity, mass flow, total flow, signal strength, signal quality, liquid sonic velocity, Reynolds regime (laminar/turbulent/transition). The meter shall be capable of outputting multiple 4-20ma, Voltage 0-1v or 0-10v, RS-232, binary output pulse or alarm for relay total and meter status. The meters shall have the ability to status alarm for fault conditions. The meters shall have the ability to set the 4-20ma to a settable status condition (i.e. 2ma for an alarm condition).

Provide flow and BTU meters to monitor flow and energy to each building and generally within each building. At a minimum, cooling water, heating water, and process water
systems should be monitored for both fluid flow and energy use throughout each building. This monitoring shall be connected to the DDC system for the building. Consult with UTFS regarding the need for additional flow and energy monitoring for specific spaces in buildings.

### 13.6.7. PUMPS

Pumps for hydronic systems should be flexibly coupled, bronze-fitted, centrifugal type with cast iron or steel bases with drain pans. Provide with internally-flushed mechanical seals rated for 200 F. Split case pumps are preferred for applications with higher flow rates.

Motor speed should not exceed 1750 rpm. Consider 1150 rpm pumps for high flow, low head applications.

Provide motor soft starters or variable speed drives for motors larger than 20 HP.

Condenser water pumps shall have stainless steel shafts.

Select pumps at best efficiency point. Overloading should not occur at any point on the pump curve. Flat-curve pumps are preferred over steep-curve pumps for HVAC applications. Select so that neither the largest nor the smallest impeller is provided. Resist the temptation to specify unnecessary head.

Locate pumps on ground or basement level mechanical rooms. Pumps shall be mounted at heights allowing service access (typically not more than 3 feet above standing surface) from the floor or equipment platforms without use of ladders or lifts. Carefully review the space available for installation and insure that the installation footprint as well as the access space required to service the pump properly is available.

Base mounted pumps must have the base filled with a non-shrinking grout. Pump couplings must be properly aligned.

Specify each pump to be provided with one spare set of bearings and mechanical seals.

### 13.7. STEAM SYSTEMS

#### 13.7.1. DESIGN

Steam systems should be the two-pipe type.

High pressure (approximately 125 psig) steam is the medium available from the campus distribution system for serving a building. Low pressure (0-15 psig) steam should be used for space and domestic water heating applications; medium pressure (16-60 psig) for process applications. Do not use high pressure steam for heating.

#### 13.7.2. PIPING

Steam piping shall be seamless black steel, Schedule 40, ASTM A-53 Gr. B, or A-106. Fittings shall be 150 lb. cast iron for low pressure piping and 250 lb. or 300 lb. cast steel for
medium and high pressure piping. Piping 2 in. and smaller shall have screwed joints. Piping 2-1/2 in. and larger shall have welded joints.

Condensate piping shall be the same as steam, except Schedule 80.

Pipe fittings, welding, supports, identification, and cleaning shall comply with the requirements described in Section 6. Flange gaskets must be spiral wound, metallic type. Where size changes occur on horizontal lines, use reducing fittings with eccentricity up, bottom level.

Provide adequate compensation for expansion and contraction. Anchors, guides, expansion loops and joints, etc. where required must be shown on the drawings.

When rollers are used, the piping saddles shall match or exceed the insulation thickness. When slides are use, a Teflon slide surface shall be integral to the slide design. All pipe supports shall be secured in position. Anchor and guide supports shall be cast into base slabs whenever possible. When supports provide only vertical support, they may be secured via stainless anchor bolts rather than being cast in place.

All supports and restraining devices shall be selected as part of the system stress analysis. These devices shall be suitable to sustain the static and dynamic loads of the system as defined in the applicable codes.

No anchoring systems which use insulation as a means of pipe restraint or support are permitted. Anchors shall be welded to the piping with full welds along the contact lines. Piping shall be pitched slightly from anchors towards steam vaults on each side of anchor points. All wear shall occur between saddles and roller or between guides and their contact points, with no wear at the piping.

Expansion joints shall be the tube type “Yarway” with single end or double ends, flanged or butt welded. Expansion joint design shall include packing glands with screw down plungers to force additional packing into the stuffing box. The additional packing is added, when needed, evenly around the expansion joints via the packing cylinders. The manufacturer’s instructions for installation and maintenance must be followed without exception. Bellows design expansion joints are not to be used on steam and condensate piping.

Steam and condensate piping shall pitch down to drains and up to vent points. The minimum pitch of steam lines shall be 1 in. in 40 feet. The minimum pitch of condensate lines shall be 1 in. in 20 feet.

Specify identification for all piping to be snap-on or strap-on labels with flow directions, equal to that manufactured by Seton or Brady. Band color for all steam and condensate piping shall be yellow. Include pressure on steam pipes. Adhesive labels or painted markings are not acceptable forms of piping identification.

Piping shall be flushed with water to remove loose debris prior to testing.
All steam and condensate piping shall be tested at a hydrostatic pressure of 225 psig for at least 4 hours without pressure drop. If any leaks are found and corrected, the test shall be repeated.

After testing, piping shall be cleaned by means of steam blow only prior to connection to the campus distribution system. Piping shall be steam blown 3 times, with a cool down between each blow, to thermal cycle the piping and release welding slag and bonded debris. The exhaust end of the lines being blown shall be muffled or quenched to maintain 85 dBA or less at a distance of 50 feet from the steam discharge point. Precautions should be taken to prevent materials blown from the end of the piping from settling on cars, buildings, or persons in the area.

All inline instruments or devices shall be removed and replaced with spool pieces as necessary prior to flushing, steam blowing, and testing. Replace all instruments and devices after successful test.

13.7.3. VALVES

Gate valves shall be provided on steam and condensate lines to isolate risers and branches from mains, and to isolate each piece of equipment, control valve, fixture, etc. Gate valves 6 in. and larger installed more than 10 feet above the floor shall be provided with chain wheel, chain, and guides.

Valves in low and medium pressure steam piping 2 in. and smaller shall be 125 lb. SWP ASTM B-62 bronze reversible type with solid wedge disc, tapered seat, rising stem, and screwed ends. Valves in 2-1/2 in. and larger piping shall be 125 lb. SWP ASTM A-126 iron body, bronze mounted with outside screw and yoke and flanged ends.

Valves in high pressure steam piping up to 100 psig shall be 250 lb. SWP. Provide 300 lb. cast steel valves, strainers, etc. on high pressure piping greater than 100 psig. Gate valves 6 in. and larger in high pressure piping shall have integral bypass and valve.

Provide steam distribution valves with weld-end connections.

13.7.4. SPECIALTIES

Strainers of 250 lb. SWP, (300 lb. if more than 100 psig steam) Y-pattern shall be provided upstream of all control valves, pressure reducing valves, steam traps, etc. Provide globe blowdown valves piped to the floor on strainers larger than 2 in.

Steam traps should be inverted bucket type. Steam traps must be positioned below the steam line for optimum drainage of condensate. The orifice sizes used in the traps shall be sized to suit system design conditions.

Traps shall be installed with isolation valves, unions, check valves, and a strainer with blow down valve.

Float and thermostatic traps may be used on any equipment where steam pressure may vary from maximum supply pressure to vacuum.
Size traps to handle two times the maximum equipment rating. Bypass lines are not required around steam traps.

All condensate from buildings and from trap discharge shall be routed to a vented flash tank and then a condensate receiver. Condensate is pumped from the receiver to the condensate return line. Condensate from a trap injecting directly into a pumped condensate return line is not permitted.

The condensate pump/receiver sets shall be duplex type provided with a float operated mechanical alternating switch, sight glass, and check and gates valves on each pump discharge line.

The condensate pump shall be rated for continuous operation of pumping 212°F fluid. Back pressure in the condensate line must be taken into consideration when sizing the pump set.

Provide pressure gauges on the discharge of each condensate pump, upstream and downstream of each pressure reducing valve, and on steam supply to heat exchangers. Gauges shall be 4-1/2 in. size and have a minimum accuracy of 0.5% over scale range. Provide each gauge with an iron coil siphon and needle valve.

Provide a clamp-on condensate flow meter to monitor steam flow for each building.

13.7.5. **PRV STATION**

High pressure steam from the campus distribution system shall be reduced to medium and low pressure for process and space and domestic water heating applications through a pressure-reducing valve station.

Reducing stations shall be single or two-valve, single stage type, complete with pressure reducing valves, pressure controller, air loading valves, relief valves, isolation valves, pressure gauges, and, where required, transfer valves.

Reducing and regulating valves shall be normally closed, air loading, diaphragm-operated type, 250 lb. SWP with cast iron body and stainless steel trim having “Stellited” renewable seat ring for entering pressures less than 100 psig. For pressures greater than 100 psig, provide 300 lb. cast steel regulating valve. Valves shall be selected so that a noise level of 90 dba will not be exceeded. Reducing and regulating valves 2 in. size and larger shall have flanged connections.

Locate PRV stations near exterior walls for access to ventilation air. Piping, flanges, etc. should be at least 12 inches from wall.

13.7.6. **CONVERTORS**

In most instances, where steam is available, a heat exchanger shall be installed to provide hot water for the building heating medium.
Heat exchangers shall be steam-to-water type of shell and U-tube construction, ASME labeled for 125 psig working pressure. A manufacturer’s data report for unfired pressure vessels is to be submitted to the University certifying that construction conforms to the latest ASME code for pressure vessels. The form must be signed by a qualified inspector who holds a National Board Commission.

Steam supply pressure to the exchanger control valve should be 10-15 psig and capacity based on a fouling factor of 0.001. Steam pressure downstream of the control valve should be about 80% of that upstream of the valve. A single (where capacity permits) F&T trap selected for a capacity of double the condensing rate should be provided.

Locate heat exchangers near exterior walls for access to ventilation air.

13.7.7. CONDENSATE UNITS

Units should have duplex, 3500 rpm pumps. Elevated tanks are preferred if condensate can be gravity-drained. Provide with tank thermometer and inlet strainer.

13.7.8. STEAM VAULTS AND TUNNELS

Steam vaults shall be sized to provide adequate and safe movement within the finished vault. This includes work clearances for operating and replacing valves, traps, or other components. A typical vault size is approximately 10 ft x 10 ft x 8 ft high internally with 12-inch-thick walls, with larger vaults being used as necessary to maintain working clearances.

Steam vaults to be constructed with two openings for egress, component removal and installation, and ventilation of the vault. Openings shall be sized to allow for the removal/installation of components. Openings are optimally located diagonally across the vault, rather than along a single side.

If required for valve operation or service, an access opening is allowed on the top of the vault in addition to the egress openings. Such access openings should have a water seal in place to keep water out when closed. Covers for the vault openings to be lightweight, lockable, and be able to withstand vehicle loads. Covers to be designed for steam vault applications and have stainless steel tags that bear the identification number of the vault.

Access openings to have galvanized steel ladders up to 6” below cover in lieu of cast in place steps. The steam vaults to be waterproofed by applying a sprayed on or rolled on membrane to provide overall water proofing. Special attention to be given to joints and penetrations where extra coats are needed to insure a water tight seal. Piping penetrations in the steam vaults shall use an approved “link seal” product to provide a water tight seal. The structural design of the vault walls, roof, floor, and re-enforcement of the vault to be designed by a licensed structural engineer.

Steam tunnels to have a minimum of 8 feet of head clearance, and 3 feet of clear aisle space for walking and carrying materials. They are to be cast in place and have egress openings approximately 300 feet in any direction. The walkthrough tunnels shall have natural ventilation with thermostat controlled fans to assist where needed. Fans are also to be
provided with a hand/off/auto switch. Water proofing of the walk through tunnels to be similar to that used for water proofing of the steam vaults.

13.8. HEAT TRANSFER EQUIPMENT

13.8.1. AIR HANDLING UNITS

Provide field-assembled or factory-fabricated, central station air handling units for mechanical systems. All unit sections should be of double-wall construction with 2 in., 3.0 lb. density fiberglass or foam insulation. For most applications, provide a perforated interior liner for the fan section. Provide units with positive draining, double wall stainless steel drain pans. Where coils are stacked, provide intermediate pans. Lay out units to permit servicing and repair of fans and filters and replacement of coils.

There should be access to each side of each coil. Where access cannot be attained through fan or filter sections, full sized access sections with hinged doors, preferably not less than 18" wide should be made available. Where space permits, hinged access doors should be installed on both sides of fan casings, access sections, filter sections, and mixing box sections. Screws or bolts are not acceptable for access to coils, etc.

Install units and field-assembled plenums on a minimum 4 in. high concrete housekeeping pad. Rails may be acceptable in some applications. If not provided with the unit fan, install on spring vibration isolators.

Specify opposed blade dampers for mixing boxes with air leakage not greater than one percent of the rated flow. In addition to the return air damper, provide one minimum and one maximum (for economizer operation) O.A. damper in the O.A. damper section.

Belt drives are to be sized for a minimum of 150% motor hp. Specify a minimum of two belts for the drives.

Fan bearings shall be grease lubricated, self-aligning ball, or roller type mounted externally and designed for 200,000-hour life. Bearing lubrication lines must be extended to an easily accessible location. Provide one spare set of bearings and belts for each fan.

Provide motor soft starters or variable speed drives for motors greater than 10 hp.

Include in the AHU schedule on the drawings total, external, and component (coils, filters, dampers, etc.) static pressure. Indicate whether or not the static pressure for the filters is included in or independent of external static. Total static pressure should be the sum of external and component static pressures.

Filter static pressure indicated should be the change-out pressure. A guideline for this is 3/4 of the distance between the published initial and final or terminal pressure drops. Another is no more than twice the initial pressure drop.

A thermometer of the proper range and size must be provided in the discharge duct of each air handling unit.
Air handling unit submittals shall include fan curves for maximum and minimum operating conditions.

**13.8.2. UNITARY SYSTEMS**

Unitary systems and their components shall conform as closely as possible to the criteria defined elsewhere in this document.

Unitary systems shall be provided with hot gas reheat for humidity control.

Unitary systems shall be equipped for standalone economizer operation.

Unitary systems shall be directly connected to the building DDC system.

**13.8.3. COILS**

Cooling and heating coils shall have minimum 0.007 in. aluminum plate fin secondary surface and 0.024 in. seamless copper tubing primary surface with not more than 11 fins per inch. Avoid spiral-type fin configurations.

The physical height of cooling coil sections should be limited to 45 in.

Select AHU chilled water coils for a minimum 16 F temperature rise and hot water coils for a 30 F temperature drop.

Cooling coils should be piped so that chilled water is supplied on the air leaving side and is returned on the air entering side. Arrange unions or flanges so that coils can be removed without removing any additional piping upstream of the unions.

In general, CW coil face velocities should not exceed 500 fpm.

Indicate coil pull space on mechanical room floor plans.

**13.8.4. CHILLERS**

Centrifugal water chillers shall be provided on projects requiring more than 200 tons. Compressors may be single or multi-stage, open or hermetic. Machines shall be specified to deliver water at a temperature of 42° F (with the exception of ice storage applications) with an evaporator temperature not below 32° F.

Chillers should have microprocessor-based controls compatible with the campus energy management system. Capacity control should be electronic and capable of modulation from 100% to 10% of rated capacity.

Evaporator and condenser tubes shall be 0.028 in. thick copper, smooth or enhanced.

Provide centrifugal chiller water boxes with davits or hinged doors to optimize service and cleaning of tubes.
Where required, provide R-123 chillers with a high-efficiency purge system, consisting of air cooled condensing unit, purge condensing tank, and pump-out compressor. The purge exhaust shall not exceed 0.05 lb. refrigerant per lb. of purged air.

Safety and operating controls shall include the following: current limiting overload device; evaporator and condenser pressure/temperature gauges; oil pressure gauge; temperature cutouts for low chilled water and refrigerant temperatures and high motor, compressor discharge, oil, and bearing temperatures; pressure cutouts for low oil and refrigerant pressures and high condenser pressure; oil pump switch; guide vane time delay switch; evaporator and condenser water flow switches; and pilot lights for safety circuit items.

The chiller system should include power factor correction capacitor to maintain minimum PF of 0.95 at loads between 40-100%, as well as motor soft starters or variable speed drives for motors greater than 20 hp. Noise suppression lagging on machines should be installed where noise level exceeds 85 dBA.

Chillers should be placed at ground level or basement mechanical rooms with sufficient clearance to perform maintenance, repair, and replacement of components, including evaporator and condenser tube bundles.

Factory start-up report must be provided before final acceptance.

Low ambient control shall be provided.

13.8.5. COOLING TOWERS

Cooling towers shall be induced draft, cross-flow, stainless steel construction with PVC fill and stainless steel or PVC louvers, complying with current CTI design standards. Counterflow towers are to be avoided. Fans are to be gear driven or direct drive, with a low turn down ratio for variable speed operation. Any belt drives require specific approval. Cooling tower submittals shall include CTI performance curves.

All steel panels and structural members, including the structural frame, hot and cold water basins, distribution covers, fan deck, and fan cylinder shall be constructed of Series 300 stainless steel and assembled with Series 300 stainless steel nut and bolt fasteners. All factory seams in the cold water basin shall be welded to ensure watertight assembly and welded seams shall be warranted against leaks for five (5) years. Stainless steel basins with bolted seams are not acceptable. The entire cooling tower, including fan motor, drive system, bearings, and structure, shall be backed by a comprehensive 5-year warranty.

Any fiberglass or plastic components are not acceptable.

Base design on entering and leaving water temperatures of 95 F and 85 F, respectively, with 80° FWB ambient temperature. Drift loss shall be less than 0.001%.

The location of the cooling tower on the project site should be coordinated with UTFS. The elevation of the tower basin and condenser water pump must be thoroughly reviewed to assure pump operation free of cavitation. Ladders serving cooling tower platforms and fan
decks must extend to grade or roof deck and comply with OSHA standards. Two ladders must be provided where needed for access to both sides of the fan deck. Handrails and service platforms should be installed as required by OSHA standards.

Provide sufficient heat in the basin and at the exposed piping to avoid draining during cold weather.

Provide a variable speed fan for condenser water temperature control. Maintain set point by varying the speed of the fan and positioning a 3-way diverting valve. (Bypassing to the tower basin is preferable). Interlock tower fans and condenser water pumps so that fans will only operate when pumps are operating.

Vibration limits shall be according to CTI Cooling Tower Manual. Vibration limits shall be achieved through the warranty period without any maintenance or remedial work other than normally scheduled maintenance and operation. Any vibration limit switches shall be field-adjusted to comply with CTI.

All taps and ports necessary for CTI testing shall be provided.

CTI testing for performance and capacity should be performed for field-erected towers. UTFS reserves the right to test all towers for capacity, performance, and drift during the warranty period. Corrections of any deficiencies noted during such testing shall be made the responsibility of the installing contractor.

Cooling towers shall not produce prominent tonal sounds that are audible in any of the surrounding buildings or areas.

13.9. TESTING AND BALANCING

The HVAC system design must incorporate means for balancing the air and water systems. Such means include dampers, temperature and pressure test connections, flow meters, and balancing valves.

An agency or subcontractor independent of the contractor is required to balance the air and water systems. This subcontractor should be AABC or NEBB certified.

Air side testing and respective adjustment should include the following:

1. Equipment and motor data.
2. Traverse air flow measurement of all main supply air, return air, outside air, relief air, and exhaust air ducts, especially those at AH units and ducted exhaust and return air fans.
3. Static pressure at entering and leaving points of each AH unit, exhaust, relief, or return fan, coil, filter bank, etc.
4. Entering and leaving air temperatures at AH unit coils.
5. Fan rpm and motor volts and amps. Fan curves for AH units and return and exhaust fans must be included in the report.
6. Air flow rate and pressure differential for each VAV box.
7. Air flow rate at each register and diffuser.
Water side testing and respective balancing should include the following:

1. Equipment and motor data.
2. Differential pressure and water flow rate at each AH unit, heat exchanger, chiller evaporator, and condenser, and at each flow meter, including flow meters serving terminal equipment (VAV boxes, etc.).
3. Entering and leaving water temperatures at AH unit coils.
4. Shut off head, full flow head, final head, and final flow rate at each pump. Pump curves must be included in the report, as well as motor voltage and amperage.
5. Entering and leaving pressure at each AH unit coil, chiller evaporator and condenser, and heat exchanger.
6. Include testing and balancing of domestic HW recirculating system.

The balancing report must include a drawing or sketch identifying each terminal unit and register and diffuser with respect to the spaces served. Each AH unit should also be identified, with test points indicated.

13.10. CONTROLS

Direct digital temperature controls (DDC) with electronic operators must be included for the mechanical systems. The two acceptable controls manufacturers are Johnson Controls and Siebe. If specific equipment or systems have their own controllers (for example, chiller plant controllers), these must be fully compatible with the DDC systems.

For buildings with existing DDC systems being expanded or partially renovated, the new DDC system shall match and expand the existing DDC system unless specifically directed otherwise by UTFS.

A new PC for DDC system monitoring is not required to be provided with each controls installation, but the software used for the DDC system shall be made available to UTFS.

13.10.1. GRAPHICS

Software graphics with pictorial representations of equipment and devices being controlled and actually displayed on the PC monitor must be provided.

13.10.2. CONTROL WIRING

In general, 24v control wiring should be furnished and installed by the control subcontractor. The electrical subcontractor should be responsible for furnishing and installing all 120v and above wiring and associated conduit, required starter coils, etc., as well as starters and control panels not within a packaged unit. This must be coordinated with the electrical engineer.

13.10.3. AIR COMPRESSORS

Where required, duplex control air compressors shall be high pressure, low dew point design with single ASME receiver of 30-gallon minimum capacity. Compressor unit shall be sized to operate on one-third on, two-thirds off time cycle. Provide automatic drains, vents, relief valves, manual valves, gauges, pressure regulators, filters, belt guard, control accessories, etc.
An alternator shall be provided to automatically start the second compressor if the first fails to maintain receiver pressure. It shall also alternate the order of starting the compressors to balance run time.

The compressor unit shall be mounted on a 4 in. concrete housekeeping pad with vibration isolators.

13.10.4. PNEUMATIC TUBING
Where used, seamless copper tubing shall be provided for all pneumatic lines. Tubing shall be Type M with either solder or compression connections. Polyethylene tubing may be used only inside equipment enclosures and at thermostat and operator connections with a 12 in. maximum length.

13.10.5. GAUGES
When manual gauges of any type are provided on air or water systems, gauges shall be provided with a valve cock installed below them to allow changing the gauge without shutting down the monitored service.

13.10.6. THERMOSTATS
Room thermostats shall be the electronic type compatible with the direct digital control system and equipped with communication ports. Thermostats must be provided with setpoint adjustment capability with a temperature scale indication in Fahrenheit gradations. Accuracy shall be ±1 F. The location of wall thermostats should not interfere with light switches.

All thermostats, including night low limits, etc., shall be indicated on the HVAC floor plans. Mounting height should be 5’-0” above the floor. Provide with appropriate guards where subject to damage.

13.10.7. HUMIDITY SENSORS
Humidity sensors shall be provided in each control zone. Wall and duct mounted humidity sensors shall have ±2% RH accuracy. Combination sensors, where required, shall have thin-film platinum type temperature sensors.

The location of wall humidity sensors should not interfere with light switches. All humidity sensors shall be indicated on the HVAC floor plans.

13.10.8. AIR AND WATER DP SENSORS/TRANSMITTERS
DP sensor/transmitters should be a 3-valve manifold assembly that will allow field test measurements to be taken without interrupting the BAS reading.

13.10.9. CONTROL VALVES
Valves 8 in. and smaller shall be equal percentage type ball valves. Provide electronic actuators with spring return.
Provide bypass valves for critical systems and all heating in air handlers.

**13.10.10. CONTROL DAMPERS**

Provide opposed blade dampers with air leakage not greater than one percent of the rated flow.

**13.10.11. TEMPERATURE CONTROL DRAWINGS AND SEQUENCES**

A schematic drawing showing applicable sequence of operation for each HVAC system, including AHU’s, chillers, cooling tower/condensers, boilers, heat exchangers, exhaust fans, etc. should be provided. Schematics and sequences must be shown on the HVAC drawings, not in the Project Manual. Sequences must be clear and concise, written as simply as possible.

Sequences for AHU’s should start with turning the unit on in the occupied mode, then describing the cooling control (with economizer if applicable), the heating control (if not sequenced with the cooling), air flow control if VAV, including RA fan control, if applicable, the operation in the unoccupied mode, the safeties, and ending with a brief description of desired points, etc. to be monitored. The following Temperature Control Sequence for Operation of AHU’s marked with an asterisk (*) shall be applied when applicable:

I. Start the Air Handler
   a) BAS
   b) Occupied Mode HOA Sw.
   c) Min OA damper*
   d) Smoke dampers*
   e) 100% OA damper*
   f) RA fan (economizer)*

II. Control the Temperature
    a) Cooling Coil
    b) Economizer*
    c) Heating Coil
    d) Air Flow*
    e) Dehumidification

III. Control the Preheat*
    a) F&B dampers*

IV. Control the Air Flow (VAV AHU)*
    a) RA fan (economizer)*

V. Safeties
   a) Freezestat
   b) Smoke Detectors

VI. Unoccupied Mode
    a) Temperature Setback
    b) De-energize*

VII. Monitor
    a) SA temperature
    b) SA Fan Status
    c) OA temperature and Humidity (global)
    d) Filter DP
e) RA temperature and Humidity (economizer)*
f) Preheat Temperature*
g) Duct SP (VAV AHU)
h) SA CFM*
i) RA CFM (economizer)*
j) Minimum OA CFM*
k) Space Temperature and Humidity (dehumidification control)*
l) RA Fan Status (economizer)*

Specify hydronic DP transmitters to be initially set up at 15 psig, then adjusted by TAB agency.

Show location of DP and SP sensor/transmitters on plans. Do not specify SP sensors to be located “2/3 length of SA duct”.

13.11. PLUMBING

13.11.1. DOMESTIC COLD WATER SYSTEMS

Domestic cold water service will be provided from a connection to the existing site main using pressure booster pumps if required. Domestic cold water will serve toilet rooms, mop receptors, general purpose sinks, wall hydrants, and other specific equipment as required. A minimum pressure of 25 psig should be maintained to operate water closet flush valves.

The incoming domestic water service shall be provided with two reduced pressure backflow preventers of equal size piped in parallel to protect the site system from contamination. Each backflow preventer assembly shall be provided with Y strainer and air gap. Test cocks shall face up. Isolation valves shall be provided before the strainer and after the backflow assembly. The strainer shall have a drain plug connected to the blow-off port for flushing.

System capacity shall be based on fixture unit values with appropriate code factors and actual equipment demands.

13.11.2. DOMESTIC HOT WATER SYSTEMS

Domestic hot water systems shall be provided with complete supply and return piping to maintain hot water at each appropriate fixture at all times. Hot water shall be distributed in the domestic hot water system at 120 F with service to lavatories, showers, general purpose sinks, service sinks, and other specific equipment as required. For requirements for higher temperature water, local booster water heaters should be provided with the equipment.

Hot water should be produced by steam-fired instantaneous hot water generators, similar to PVI COBREX units. System capacity shall be based on fixture unit values with appropriate code factors and actual equipment demands.

Provide circuit setters on branch recirculating lines at each floor.

13.11.3. SERVICE PIPING
Domestic hot and cold water piping shall be Type L hard drawn copper with wrought copper fittings or PEX-a piping and fittings. Water lines installed underground shall be Type K copper with wrought copper fittings. Joints shall be made with lead-free 95-5 solder. Press-type joints may be considered. HDPE piping may be considered for underground piping if the thickness is adequate for the loading from roads or vehicles.

Mechanically formed tee connections are not acceptable for piping tees.

Outside water mains shall be A.W.W.A. bell and spigot cement lined ductile iron (250 lb. class), provided with a coat of black asphaltum. Underground valves shall be in accordance with those A.W.W.A. listed for domestic water mains. HDPE piping may be considered for underground piping if the thickness is adequate for the loading from roads or vehicles.

All mechanical underground valves to be “Right Handed” with shut off clock-wise and opening counter-clockwise. Valves to be installed for ease of operation using a “T Handle” operator. Valves should be exercised periodically during construction to insure ease of operation.

Underground piping shall be specified with an adequate thickness to handle road and vehicle loads.

Service water piping shall be clean and free of gravel and debris once the installation is complete. Service water piping shall be tested and disinfected in accordance with applicable code requirements. Testing shall be completed by an approved, third-party testing lab.

Water hammer arresters shall be located in domestic water piping as necessary to eliminate noise and prevent possible damage to the piping system from excessive vibration.

An isolation valve for each water service main, branch main, riser, branch line serving a group of fixtures, and each equipment connection shall be provided. Valves shall be two (or three) piece, full port ball type with SS balls and stem for pipes 2 in and smaller and lug butterfly valves for pipes 2-1/2 in and larger.

Pipe hangers shall be those specifically designed for the piping and insulation materials being used. Hangers shall be spaced so as to prevent pipes from sagging between them. Hangers are required at every change of direction in the piping.

Piping identification shall comply with Section 8 in these design criteria. Specify identification for all piping to be snap-on or strap-on labels with flow directions, equal to that manufactured by Seton or Brady. Band color for domestic cold water shall be green and yellow for domestic hot water and hot return respectively. Fire protection shall be in red color, while natural gas should be yellow. Adhesive labels or painted markings are not acceptable forms of piping identification.

**13.11.4. SANITARY AND STORM DRAINAGE SYSTEMS**

A separate sanitary drainage, waste, and vent system shall be provided for all water closets, lavatories, service sinks, etc. Sanitary drainage shall be connected by gravity directly into
the site sewer system. Capacity shall be based on fixture unit values with appropriate code factors and actual equipment demands.

A stormwater drainage system shall be provided for all roof, clear waste, and area drains and connected into the site storm system. Particular attention should be paid to the University of Tennessee Illicit Discharge Policy when considering drain connections to the storm system.

Cleanouts should be provided for access to horizontal and vertical drain lines to facilitate inspection and provide a means of removing obstructions.

Pipe inside the building above grade shall be service weight coal-tar coated cast iron hubless type with DWV fittings and stainless steel multi-band couplings and neoprene gasket (CISPI 301) joints. Dry vent piping 2 in. and smaller may be Schedule 40 galvanized steel pipe with cast iron threaded drainage fittings.

Pipe inside the building below grade shall be service weight cast iron with bell and spigot ends with joints made with positive double-seal elastomeric compression-type gaskets. Galvanized pipe shall not be installed below grade.

Pipe below grade outside the building should be Schedule 40 PVC with cement joints in most instances. Cast iron piping shall be used for locations where pipe coverage is less than 4 feet in areas with traffic loading, locations where pipe coverage is greater than 15 feet before or after installation, and where crossing above or below water mains, other drain lines, and steam lines.

Piping should be pitched to drain at a minimum slope of 1/4 in. per foot for piping 3 in. and smaller, and 1/8 in. per foot for piping 4 in. and larger.

13.11.5. **GREASE INTERCEPTORS**

Grease interceptors shall be sized and installed in accordance with the KUB Grease Control guidelines.

13.11.6. **INSULATION**

Hot, cold, and chilled water and roof drain piping must be insulated to prevent energy loss and condensation. Insulation of cold and chilled water piping shall include an exterior vapor barrier. Insulation shall comply with Section 14.5.

13.11.7. **FIXTURES AND SPECIALTIES**

Plumbing fixture material should be of non-absorptive, acid resistant type. Provide a schedule on the drawings to indicate each type of fixture specified, including supply and waste sizes, trim, accessories, manufacturer and model number, etc. Schedules in the project manual are not acceptable.

A 1/4 turn ball valve shall be provided at each fixture. Each fixture, floor drain, or other equipment connected to the drainage system shall have separate traps installed as close to
the fixture as possible with a cleanout for each trap. Wall mounted fixtures shall be supported with floor mounted fixture carrier.

Water closets shall be wall hung for all new construction. Floor mounted can be considered in renovation applications with existing floor mounted water closets only with prior approval of UTFS.

Water-efficient fixtures are required. Sensor activated flush valves and lavatory faucets should be provided. Faucet temperature adjustment should be included where needed. Urinals should be 1/8 gal, low-flush type with battery operated flush valves. Water closets must be provided with batter operated 1.6 gal/flush or less valves.

Lavatory faucets for most applications must be selected for a maximum water usage of 0.5 gpm (60 psi).

Fire hydrants shall be a 3-way design with two hose connections and one pumper connections. The main valve opening shall be 4-1/2 inch unless otherwise required for a specific use. Hydrants shall be rated at 250 psig working pressure and 500 psig static test pressure.

**13.11.8. FIXTURE PREFERENCES**

The following is a list of the UTFS preferred manufacturer and, in some cases, the preferred model number for various plumbing fixtures. These preferences are not strict requirements, but shall be considered when selecting the basis of design and creating the design specifications.

- Backflow Preventers: Wilkins
- Fire Hydrants: Mueller Super Centurion 250 3-way
- Domestic Water Pumps: Grundfos
- Floor and Roof Drains: Zurn
- Wall Hydrants: Zurn
- Sump Pumps: Zoeller
- Sanitary Sewerage Pumps: Zoeller
- Instantaneous (Tankless) Water Heaters: PVI COBREX Double Wall
- Water Closets and Flush Valves: Zurn with 1.1 gpf
- Urinals: Zurn with 0.125 gpf
- Mop and Service Sinks: Zurn
- Kitchen Sinks and Faucets: Symmons, Elkay, and Zurn
- Sinks: Elkay
- Lavatories and Faucets: Zurn
- Safety Showers and Eye Washes: Bradley
- Thermostatic Mixing Valves: Symmons for point of use, Bradley for emergency fixtures
- Water Coolers: Elkay with Bottle Fillers
- Shower Valves and Showers: Symmons
- Shower Bases: Comfort Designs with 10-year warranty

**13.12. FIRE PROTECTION**
The building shall be fully sprinklered with automatic wet pipe sprinkler systems being the primary type of fire suppression. Dry pipe sprinkler systems must be utilized in spaces subject to freezing. The wet sprinkler systems on each floor should take their water supply from a fire protection standpipe system, creating a sprinkler/standpipe system.

The water supply shall be provided by connections to the site water system. A fire department connection shall be provided at the building.

The sprinkler system design shall comply with applicable editions of and NFPA Standard 13. The installing contractor is required to provide a sprinkler system layout sized by hydraulic calculations. Design documents, however, must comply with the State Board’s minimum criteria for fire protection sprinkler design.

A Class I wet standpipe system shall be provided to supply fire department hose valves and the sprinkler systems on each floor. Design shall comply with applicable editions of NFPA Standard 14.

All fire pump couplings shall be metallic. Elastomeric pump couplings are not allowed.

Flexible sprinkler head fittings similar to Aquaflex may be provided if acceptable the State Fire Marshal.

13.13. LABORATORY SYSTEMS

13.13.1. LABORATORY AIR PRESSURIZATION CONTROL

For laboratories with fume hoods or defined air pressurization requirements, provide a system to control air pressurization. This system shall control the supply air, hood exhausts, general exhaust, and any other exhaust air flows. This system shall not include temperature control devices but shall receive inputs for temperature controls from the building DDC system.

13.13.2. LABORATORY WATER SYSTEMS

Laboratory area sinks, cup sinks, and required equipment drainage will be collected into a separate acid waste system in the building and discharged into a neutralization basin before being discharged into the site sanitary waste system. Acid waste piping shall be fire-retardant polypropylene with heat-fusion joints.

Laboratory grade purified water shall be provided where required for general laboratory uses such as laboratory testing, rinse water, and wash water. Purified water shall be distributed in a continuous loop system. Any dead legs to fixtures shall be minimized. Piping and fittings shall be beta-polypropylene with socket welded joints. Valves and supplies must also be of materials that will not contaminate the purified water before the point of being used.
The water purification system shall be provided by a third party vendor contracted by UTFS. Space in a mechanical room shall be provided with necessary power and supply and return piping connections for the equipment skid. The specific sizing of this equipment will be based on the design demand calculations and the required purity, so careful coordination during the design process will be required.

The use of domestic water for process cooling is prohibited except for emergency backup.

**13.13.3. LABORATORY COMPRESSED AIR**

Where building programs indicate a need for laboratory compressed air, duplex multi-stage oil-free scroll air compressors shall be provided. Compressor discharge pressure shall be based on programmatic requirements, but not below 125 psi. Compressor unit shall be sized to operate on one-third on, two-thirds off time cycle. Provide automatic drains, vents, relief valves, manual valves, gauges, pressure regulators, filters, belt guard, control accessories, etc.

Provide a desiccant air dryer at the compressor discharge to maintain a system dewpoint of -40F.

The compressed air system shall be equipped with an ASME-rated buffer tank at the outlet of the air dryer.

An alternator shall be provided to automatically start the second compressor if the first fails to maintain receiver pressure. It shall also alternate the order of starting the compressors to balance run time.

The compressor unit shall be mounted on a 4 in. concrete housekeeping pad with vibration isolators.

**13.13.4. LABORATORY VACUUM SYSTEMS**

Where building programs indicate a need for laboratory vacuum systems, duplex multi-stage oil-free scroll vacuum pumps shall be provided. Vacuum pressure shall be based on programmatic requirements.

Provide an ASME-rated buffer tank at the inlet to the vacuum pump.

The vacuum pump shall be mounted on a 4 in. concrete housekeeping pad with vibration isolators.

**13.14. CONTRACT DOCUMENTS**

The contract documents must be easy to interpret without a great deal of study and instantly convey a clear picture of the design philosophy of the systems. Isometric drawings or sketches are not acceptable.

All floor plans should show room numbers and names, and column lines.
Plan drawings should graphically illustrate a scale and a north arrow with the preferable method representing both true north and building north.

Mechanical plans must show all ductwork and duct fittings to scale. With the exception of flexible runouts, ductwork should not be single-line. Standard drafting conventions should be used for turns, joints, changes in size, drops or rises, crossings above and below one another, etc. Section views showing where ductwork appears to conflict with other ducts, piping, structure, electrical, etc., especially in corridors should be included.

The mechanical plans must show size and air quantity for each diffuser (neck and face size), register, and manual balancing damper on the plan. An air distribution schedule must be provided. Indicating size and air quantity range on the schedule does not remove the requirement to show this information on the plans.

For VAV boxes, mechanical plans or schedules should show minimum air quantity desired, taking into consideration box capability, space outside air requirements, and minimum air motion in the space served. Sound data should be included.

All piping and show flow directions on all hydronic piping should be identified. Piping should be shown on the same plans as the ductwork if feasible.

All mechanical rooms shall be drawn at ¼” scale. Show space for coil pull on floor plans. Provide 1/4” longitudinal section view of all AHUs including piping, walls, ceilings or top structure, etc. A section, not an elevation, is required. Show duct thermometers in section views.

The mechanical drawings or schedules should indicate the filter thickness or depth of each filter type in all equipment. The design or change-out static pressure must also be indicated for each type filter. Do not simply show the initial and final pressure but indicate the range of the differential pressure gauge across the filters on the project plans.

Simplified piping schematics of all hydronic systems with two or more chillers, boilers, or heat exchangers should be included at the appropriate scale.

A one-line, simplified schematic diagram of the chilled water or hot water system where two or more chillers or boilers or heat exchangers, including existing equipment, are included in the hydronic system should be included. The drawing should indicate how the various components relate to one another as well as pumps, control valves, air release tank, two-pipe changeover valves (if applicable), and flow meters. Show flow direction. Avoid line crossings. Do not show gauges, thermometers, isolation valves, strainers, and other minor piping components.

Specifications should be concise, complete, brief, and correct. Two manufacturers and model numbers are sufficient. Only the necessary information should be extracted and used from specifications produced by manufacturers. Thoroughly edit specification sections for the specific project and include appropriate product and installation descriptions. Remove inapplicable sections and paragraphs from typical standard specification sections, etc. Unedited specifications will not be accepted.