

RADFORD UNIVERSITY

Facilities Planning
and Construction

DESIGN AND CONSTRUCTION STANDARDS

Revised April 2019

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GENERAL POLICIES

Overall Philosophy

- **It is Radford University's (RU) intent to maximize the design potential of every campus project, in terms of supporting the programmatic intent of the project while respecting the overall campus planning and in-place construction. Major overarching themes include institutional identity, architectural theme, energy efficiency, accessibility, durability, cost-effectiveness, flexibility, adaptability, and compatibility with the current RU Master Plan.**
- These standards are intended to offer basic guidance to designers where Radford University (RU) has specific preferences relating to materials, methods, and other aspects of project design and construction.
- These standards indicate many areas that require discussions between RU and the designer prior to final decisions. Designers are encouraged to initiate these discussions as soon as practicable during the design process.
- These standards are intended to be a living document, such that designers should feel free to offer alternate opinions for discussion relative to their use.
- These standards do not override any requirements of current applicable codes and regulations.
- These standards do not override or waive procurement processes specified in the current Construction and Professional Services Manual (CPSM) or the Virginia Public Procurement Regulations.
- Any deviation from these standards must be brought to the attention of RU as early in the design process as possible.

Overall Design Standards

- All design and construction shall be in conformance with the current Construction and Professional Services Manual, including Notices and other guidance from the Division of Engineering and Buildings.
- The AE shall be responsible for the professional and technical accuracy and coordination of all designs, drawings, specifications, cost estimates, and other work or materials furnished. The AE shall perform a Quality Assurance review of the working drawings prior to submitting the working drawings. See CPSM Appendix Q for Checklists and guidance for QC/QA reviews and coordination of plans and specifications.
- Specific manufacturers and products as listed in these design standards are intended as the basis for design features and capabilities, unless specifically stated as proprietary. Proprietary items shall follow all CPSM procurement requirements. Typically, specify three manufacturers or equal.
- Construction and renovation projects shall be designed and constructed consistent with the energy performance standards at least as stringent as the US Green Building Council's LEED Silver rating (including the use of Virginia forest products with alternate certifications). Green Globes and the United States Environmental Protection Agency/Department of Energy's "Energy Star" rating systems may also be used to demonstrate sustainable design compliance.

- At a minimum, energy performance shall conform to currently adopted Virginia Energy Code and ASHRAE 90.1.
- Accessibility requirements must comply with current code. See VUSBC for referenced codes. When the code allows a range of heights/distances, design to the average to provide construction tolerances.
- Space standards shall be in accordance with current guidelines of the CPSM. Unique spaces shall be discussed with RU prior to final space allocations.
- RU abides by Green Seal Housekeeping program.
- In the design of all campus facilities, consideration shall be given for trash room, recycling room, and/or maintenance closet space requirements on each floor. Provide housekeeping with a storage space in addition to their closets. Housekeeping closets shall be accessible from outside toilet rooms.
- Consult with RU on the locations and provisions for vending or other public devices or equipment.
- For IT and AV, consult with RU Network Services for specific project requirements. In general, power and raceways, cable, jacks, and terminations shall be designed by the A/E and reviewed and approved by RU Network Services. Installation shall be directed and approved by RU Network Services.

Building Siting and Massing

- The current Campus Master Plan should be used to guide overall building placement, circulation plans, pedestrian corridors, utility corridors, and many other overarching campus goals and themes.
- Efforts should be made to create exterior gathering and collaborative spaces with designs for both new facilities and renovated buildings. Relationships to existing buildings and exterior spaces should encourage interaction among students, faculty and staff.
- In general, building heights should be limited to three to four stories, with a cornice or roof edge at 40 to 50 feet above grade. In some areas of campus, sloping topography can be used to increase building volume without negatively impacting the overall campus environment.
- Where possible, buildings should be topped with sloped visible roofs.
- Buildings should be designed with a clearly identified main entrance, supported by both the façade and site/landscape design.

Exterior Building Materials

- Building design shall reflect RU's overall Georgian theme, and shall respect other buildings on campus. Specific building materials and details for building components shall be discussed early in the design process (e.g. fenestration, texture, color, handrails, etc.).
- The use of brick, precast/stone accents, and slate as major building materials is encouraged, particularly on the main campus. More modern building materials may be more appropriate at the perimeter of campus.

Site and Landscape Elements

- Existing open green spaces should be maintained to the maximum extent possible.
- Exterior furniture and lighting to match existing with respect to style, color, and materials. Provide signage at all building and site entry points to match existing.
- Service areas and exterior equipment to be screened and set back from public view, using architectural appropriate materials.
- Vehicular traffic and parking shall be set back from the street and incorporate plantings/screening as appropriate. Parking shall be located in general along the campus exterior edges.
- Proposed plantings and vegetation shall be discussed with the University prior to final construction/installation for suitability of materials and execution.

Room numbering

- New buildings
 - If joining an existing building, the floor numbers shall match.
 - Number rooms sequentially in a clockwise manner.
 - Use consistent prefix/suffix, three digits maximum.
 - Review room numbering with RU early in design, before it's too difficult to change the room numbers.
- Renovations: Consult with RU and consider renumbering the entire building; coordinate with BAS numbering.

Deliverables

- All specifications shall be per latest CSI Division format, printed on front and back, and show the full project title, State project number and date on front cover.
- RU shall be provided with the appropriate number of hard-copies of all documents as required for submittal to BCOM at all project submittals. RU shall also be provided with one half-size hard-copy of all submittal materials for our archives.
- RU shall be provided with electronic files in pdf format for all deliverables for all BCOM submittals.
- RU requires that all project plans and specifications be prepared on software compatible with AutoCAD latest release and Microsoft Word. Three-dimensional REVIT files shall be converted to two-dimensional AutoCAD files for RU records.
- All CAD files shall include polylines to enable space area calculations.
- A copy of CD(s)/DVD(s) containing all required as-built information is to be provided to RU at the end of the project. Information shall include native editable AutoCAD files and pdf's for drawings, and native editable Word files and pdf's for specifications.
- RU requires that one hard-copy set of half-size plans of standard sheet size (i.e. 24" x 36", 30" x 42", etc.) and one hard-copy of bound specifications be provided to RU at the end of the project.
- Any software, equipment, and training used by the A/E or Contractor for project design and/or construction shall be provided to RU.
- Logo Graphic Identity: All branding and color selections shall be carefully reviewed with RU.

Bidding Instructions

- The owner reserves the right to require bonds on performance and labor materials on projects less than \$500,000.
- Follow the Construction and Professional Services Manual (CPSM) latest edition for sample newspaper advertisement. Use Invitation for Bid sample for inclusion in Project Manual.
- Prior to advertisement, Radford University will select bid dates.
- Plans and specifications are to be provided to Southern Graphics in Roanoke VA for availability for purchase. Plans and specifications are to be distributed to Valley Construction News, Roanoke, VA, and McGraw-Hill/Dodge, Richmond, VA. Coordinate format of documents with RU.

Construction Administration

- Shop drawings – RU requires a minimum of two sets of approved shop drawings to be submitted to RU during the course of the project. RU also requires a complete set of all approved shop drawings to be submitted in pdf format at completion of the project.
- Punch List – RU requires the final inspection punch list to be submitted in pdf format at completion of the project.
- O&M Manuals – RU requires a complete set of all approved O&M manuals to be submitted in hard copy and pdf format at completion of the project.
- All pdf submittals shall be organized and indexed for easy search, and shall be readable by future versions of applicable software.
- Pre-Construction Meeting: Pre-construction meetings shall be held for each project, scheduled and conducted by the AE. Topics to be covered as discussed and agreed with RU Facilities and Planning and Construction staff.
- Monthly Progress and Pay Meetings: Monthly progress meetings to be scheduled and conducted by the AE. Timing should allow review and approval of pay applications.
- Commissioning /Training: The University will typically hire an independent third party commissioning agent to perform the prescribed scope of services. The contractor will support the process as required. Satisfactory completion of all activities are required for substantial completion. The contracts shall provide all training required for all building systems operations.

CONSTRUCTION GENERAL REQUIREMENTS

Radford University strives to preserve overall existing campus operations and appearance, along with the safety of all students, faculty, and staff, while allowing construction and renovation activities to occur.

Safety - The Contractor bears sole responsibility for the safety of his or her employees.

The Contractor is expected to take all steps necessary to establish, administer, and enforce safety rules that meet the regulatory requirements of the Virginia Department of Labor and Industry (VDLI) and federal and state Occupational Safety and Health Administration (OSHA) compliance requirements. These regulations include, but are not limited to:

Title 29 of the Code of Federal Regulations (CFR) Parts 1910, Occupational Safety and Health Administration (OSHA) Standards for General Industry,
Title 29 of the Code of Federal Regulations (CFR) Parts 1926, Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry.

The Contractor bears sole responsibility for communication of safety-related information and requirements to his or her Subcontractors. Contractors shall assure that their Subcontractors comply with the requirements outlined herein.

Contractor Activities:

- No work shall begin until a pre-construction meeting is held that addresses fencing of construction areas, construction traffic, parking of contractor's vehicles and work hours.
- Contractor shall provide a 1-week notice and work plan for any work which will impact campus. Notice shall include impacted areas and systems, durations and timelines, and required support from the university.
- Contractor's workers shall not interface with students. Inappropriate behavior from any worker will result in an immediate dismissal from the project.
- Vehicles shall not be parked on sidewalks for any period of time that blocks egress from a building. Contractor shall obtain all required permits for vehicle access and parking on University property.
- Construction sites shall be secured for safety at the end of each day.
- Contractor shall work with RU to coordinate service and pedestrian access to affected adjacent buildings and major pedestrian walkways.
- Work schedules are subject to quiet times for student exams and other University function. Jack-hammering and other excessive noise shall be limited and may be restricted.
- Equipment shall not drive or park on grass lawns or sidewalks. Sidewalk access may be allowed if cleared first with the University. Equipment that leaks any fluids will not be allowed on campus.

- Any vehicle or equipment that travels over University sidewalks, providing permission is granted, shall first place protective mats over the sidewalk surface to protect against tire marks and stains.
- Any damage to University property, such as residue from leaked fluids on sidewalks or pavement, tracks in grass areas, or damage to trees, shrubs, sprinkler systems, signs, light-posts or any other University property shall be removed, replaced or repaired before final payment.
- It is intent of the University for the campus to appear as good as or better than before the start of each construction project.

Confined Spaces – For projects involving access to confined spaces, include the following in the specifications:

“Contractors are expected to comply with Virginia’s Confined Space Standards. This includes provisions for atmosphere testing, employee training, permits and rescue procedures.”

Hot Work Requirements – Contractors shall provide a schedule of any proposed hot work, along with copies of contractor permits and certifications, for hot work within occupied buildings. Examples of hot work include the use of open flames, compressed gases, or supplied fuel for cutting, grinding, welding, soldering, or torch-applied roofing.

Energized Electrical Work Requirements – Contractors shall provide a schedule of any proposed energized electrical work, along with copies of contractor permits and certifications, for any work to be performed on energized systems and/or components.

Hazardous Materials – Contractor shall meet all OSHA, CFR, ANSI, and other regulatory requirements for handling and disposal of hazardous materials. Coordinate these activities with the University.

Disposal Permit – The contractor shall secure a disposal permit prior to demolition or construction. The permit will be issued through the office of Facilities Planning and Construction. Disposal costs, at the local landfill, shall be paid by the contractor unless otherwise specified. Contractors are expected to comply with state and local regulations concerning the disposal of hazardous material or chemicals. The exception to the above mentioned disposal permit would be disposal of inert debris (concrete, brick, etc.) which may be disposed of in the City of Radford or neighboring jurisdiction. A copy of written approval from the receiving jurisdiction authority shall be forwarded to the office of Facilities Planning and Construction. For smaller projects, contractors shall provide reporting of weights for all disposed waste materials.

Public-Right-of-Way Permit – The contractor shall obtain through the Owner a City of Radford permit for activities within public right-of-way. The contractor shall provide to the owner details (drawings, specifications, etc.) of activity, value of executed work, traffic control, and flagging requirements and other pertinent information particular to the proposed work. The contractor shall provide a bond in the amount equal to the value of the work in the right-of-way naming the City as obligee.

SITE CONSTRUCTION

Seeding and Sodding – Consult with RU for current specific project requirements. The university prefers that the documents require the contractor to place sod at all disturbed areas at the end of the project, and to be responsible for watering and maintenance during the establishment period.

Site Preparation for Sod

- All ditches shall be back-filled and compacted in six inch lifts.
- Prior to sod installation loosen topsoil to a minimum depth of six inches. Remove stones over one inch in any dimensions, sticks, roots, rubbish, and extraneous matter.
- Grade areas to a smooth, free-draining even surface such that disturbed areas blend with the existing grade.
- Backfill against a sidewalk should be even with top of sidewalk.

Cleaning – Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair all damages resulting from construction and seeding operations. Pressure-wash all paved surfaces.

Acceptance – All areas with sod will be inspected at completion of installation and accepted subject to compliance with specified materials and installation requirement.

Concrete Walks

- Air entrained concrete type A3 with fibermesh, typical. WWF not required.
- Walks eight feet or wider or subject to vehicle traffic shall be six inches nominal depth. Fire access walks shall be twelve feet wide. No walk shall be less than six feet wide.
- Grades of walks and ramps shall be in accordance with ADA handicap standards. Avoid handrails where grade allows.
- Adjoining sections at expansion joints shall be doweled. Broom finish surfaces and tool edge joints including control joints.
- Walks shall be sealed with a curing compound and protected from weather for 24 hours.
- Provide flared edges of minimum 8 inches at perpendicular intersections.
- Consider maintenance vehicle traffic, both trucks and carts, when laying out walks.

Pavers – Type, material, color, and style of any proposed paver materials shall be reviewed with RU prior to final selection.

Site drainage – For all hardscape near buildings, design and construct the hardscapes such that they drain away from the building. Use yard drains in lieu of trench drains.

Plant selection

- Involve RU in the plant selection process. Use zone 6a or hardier plants, requiring minimal watering. We do not want any marginally hardy plantings. Perform an in-person design review with RU's Facilities Department.
- Protect existing trees on construction sites to the drip line, with posts and American wire fence.

Signage

- Exterior accessibility signage shall be mounted on pre-drilled metal channel sign posts at a height per ADA Standards for Accessible Design. Base of sign post shall not hold water. Properly fill voids from core drilling so the base of the sign does not rust.
- Emergency phones may be required for new sites; coordinate with RU for standard manufacturer/model and proposed locations. They require power and data.
- PIV and FDC connections: RU confirms locations with Radford City Fire Department. Coordinate proposed locations with RU.
- RU provides a building sign and parking lot designation signs. Consult with RU for location and base requirements.

Piping Marking – Exterior buried piping shall be clearly marked with identification tape. Tape shall be placed approximately 12 inches above the top of piping.

Bike Racks – Confirm bike rack selection and sizing with RU during design. Varsity Bike Dock is preferred basis of design.

Stormwater Management – RU operates a Virginia Erosion and Sediment Control Program (VESCP) and Virginia Stormwater Management Program (VSMP) through Annual Standards and Specifications (AS&S) as approved by the Virginia Department of Environmental Quality (DEQ). This document provides general guidelines for ESC and SWM plan preparation and is regularly updated to reflect amendments to ESC and SWM law. For the latest version, please visit our website at www.radford.edu/stormwater .

All projects shall comply with RU's Annual Standards and Specifications for ESC and SWM, the Virginia Erosion and Sediment Control Law, the Virginia Stormwater Management Act, associated ESC and SWM regulations and the Virginia Stormwater Program Permit regulations. An ESC plan, narrative and supporting documentation shall be prepared and submitted to Facilities Engineering for review for any project which disturbs 10,000 square feet or more, or is considered part of a larger common plan of development. A stormwater management plan, narrative and supporting documentation shall be prepared and submitted to Facilities Planning and Construction for review for any project which disturbs one (1) acre or more, or is considered part of a larger common plan of development.

CONCRETE

Concrete slabs – See walks above.

Exterior Slab Concrete – Shall be air entrained concrete type A3 with fibermesh. WWF not required.

Precast Concrete Sample Panels – Provide adequate sample panels to establish acceptable standard for all exposed architectural precast concrete. Sample panels shall be approved by RU prior to the initiation of architectural precast concrete work.

MASONRY

General – Masonry work shall meet all code requirements for cold-weather placement.

Brick – Shall be selected on a per building basis, per mock-up. Following are some examples of brick and mortar colors used on campus:

- Peters Hall – Standard Old Virginia Pastel Mingle Shades by Salem Brick Co. and Webster Brick No. 305 Roanoke.
- Muse Hall – Webster Brick # 554 from Factory 10, Summerset, Virginia.
- Hurlburt Hall – Old Virginia Brick mix reds/darks BLD624SMBMTC.
- Kyle Hall – Old Virginia Blend, Modular Colonial full range, Monticello and Heritage.
- CHBS – Raleigh Court light weight modular 6035005776.
- Center for the Sciences – Old Virginia Brick – full range wire-cut, red/brown flash.
- Reed/Curie – Raleigh Court lightweight modular 6035005776.

Brick mortar – Shall be softer than the bricks. Flamingo ASTM C270/C73 types. Settlement cracks should crack mortar not bricks.

Cap stones – See standard details in Appendix A.

- Cap stones shall have a drip edge integral to the stone. The stone shall overhang the wall 1” minimum on both sides. Do not design the cap stone to be flush with the exterior façade.
- Cap stones shall have full thru wall flashing that extends out of the wall. It will be visually hidden by the overhanging cap stone.
- Rebar shall be galvanized.

Efflorescence – Take all required measures to avoid efflorescence.

Weeps – Review requirements with RU.

Flashings – Stainless steel.

Masonry Sample Panels – Provide adequate sample panels to establish acceptable standard for all exposed masonry work. Sample panels shall include weeps, flashings, precast or other decorative elements, air barriers, and other materials to demonstrate the complete assembly as well as finish and quality of work. Sample panels shall be approved by RU prior to the initiation of masonry work.

METALS

Metal Rails

- Shall be in compliance with ADA when used as handrail. Square stock may be used as guardrail only. All rails shall be steel, primed and painted to match other campus rails, unless otherwise indicated or pre-finished. Powder coating is preferred.
- Fully grout base of handrails if core drilled into concrete. The base of the handrail shall have positive drainage away from the handrail.
- Handrail height – When ADA provides a range of acceptable heights – design to the middle of the heights to provide the maximum construction tolerance.

WOOD AND PLASTIC

Exterior Trim – Fypon type exterior trim is preferred basis of design in lieu of wood trim, where appropriate. Install in strict accordance with manufacturer’s guidelines.

Sheathing – Minimum $\frac{3}{4}$ " thickness wood sheathing.

THERMAL AND MOISTURE PROTECTION

Insulation

- All concealed spaces in exterior walls in excess of ½ inch in width shall be insulated.
- Provide jackets to protect insulation in high-traffic areas and as otherwise appropriate.
- Steam appliances and fittings shall have removable Kevlar blankets on all exposed equipment.

Roofing

- Shingle roofing –50 year slate with ice guards as required.
- Membrane Roofing – Fully-adhered EPDM.
- Provide walkway pads for access to roof mounted equipment.
- Review with RU any proposed fall protection on accessible roofs.
- Provide large access hatch for maintenance; extend stair to roof preferred.

DOORS AND WINDOWS

Doors and Hardware

- Standard interior doors – Shall be red oak or birch plain sliced, A W1 premium grade.
- Closet doors in Residence Halls – Use track bypass style.
- Locksets – By Best Lock Corporation (preferred basis of design). List first when naming manufacturers and have schedule reflect Best in specifications. Provide Best 9K37 series with 15D lever handles and S3 strokes. Keying shall match existing campus-wide system. Permanent core and keys shall be sent to owner by Best. The owner will install permanent cores and return construction cores to Best Lock. Finish shall be 626 (satin chrome) typical in new construction; verify existing in building renovation projects, often satin bronze. Locksets generally shall be cylindrical in lieu of mortise. Provide Best 7-pin interchangeable core cylinders at all locations. Mark each core in a concealed place on the core (when the core is installed). Provide brass construction cores at all locations for use during construction. Locks shall be ANSI A156.2, Series 4000 Grade 1, with a minimum three-year factory warranty. Latch throw shall be a minimum of 9/16 inch. Provide ¾ inch throw anti-friction latch bolts at exterior doors and fire doors, where specified. Provide 3 cut keys per each core.
- Classrooms and assembly areas (conference and meeting rooms) – Shall have dormitory function push button inside to secure door – must be locked with key when leaving - locksets. Locksets shall generally be cylindrical in lieu of mortise. Provide special thumb-turn or lever when required for egress. Acceptable products include:
 - Best 9K-T
 - Yale 5400LN
 - Sargent Lever Lock
- Exit Devices – Rail-type preferred (no crossbar-type) with mullion rather than vertical rod:
 - Russwin 736
 - Corbin 372
 - Von Duprin (prefer “33” Type II)
- Mullions – Double doors shall have removable mullion. Use keyed mullions in lieu of concealed rod devices. Key removable mullions with electric strikes requiring quick-connect wire harnesses. Confirm door and frame preparation requirements with campus card access system.
- Pairs of doors – The gap between back of the rail and the glass shall be covered and not void the warranty of the device. Coordinators for pairs of labeled doors shall be avoided. Furnish one trim handle set per pair of doors to prevent chaining of doors.
- Entry doors – Consult with RU for card entry access requirements. Use heavy-duty electric strikes.
- Closers – LCN Series 4011 or 4111 adjustable hydraulic back check, parallel arm mounting preferred, with a five-year warranty. Provide spring-cushion feature on exterior doors and doors without stops. Hold-open type closers shall be equipped with a T-handle device. Through-bolts with hex nuts are preferred for the closer arm or bodies when mounted on wood doors.

- Power door operators – heavy-duty type such as Horton 4000 Series (preferred basis of design), prefer on single door. If installed on a pair of storefront doors, provide double header with operator attached to both doors. Provide center button at vestibules.
- Door stops – Specify concave wall stops with blocking in lieu of floor mounted stops, where possible.
- Exterior doors – Provide one door in banks of doors with keyed entry – shall not be the same door that has card access. Trim can only be used on doors that swing in the same direction. Provide two surface rim devices with keyed mullions for pairs of doors that provide egress. Use aluminum full mortise geared continuous hinges. Use flush handles that cannot be chained, cabled, or tied together. Exiting doors do not need pulls.
- Rated doors – Provide wall-mounted magnetic hold-opens. Use aluminum full mortise geared continuous hinges.

Window Frames – Aluminum heavy commercial grade. Style and operation to match existing in all projects requiring replacements (unless otherwise approved). Baked enamel or finish coating color to match campus standard paint color.

Glazing – Insulating low E glass, typical, factory fabricated unit, 1 inch air space. Maximum of 17.5 percent of exterior wall area shall be glazed, unless otherwise approved.

FINISHES

Acoustical Ceilings – Lay-in 24 inch by 24 inch ceiling tile (preferred). Use of tegular edge tiles must be approved by Radford University prior to inclusion in project specifications; 770 Armstrong is what we stock in the storeroom. Use standard 15/16” grid, no slim-line or other custom grid unless approved by RU. Bulkheads shall be constructed of gypsum drywall.

Ceramic Tile – Preferred floor and wainscot in toilet areas. Sanitary cove base, typical on ceramic and quarry tile areas. Epoxy grout required.

Resilient Floor Tile – Use 12 inches by 12 inches by 1/8 inch typical, with alternating pattern. Owner will supply floor finish, and contractor shall install 4 coats (this applies to VCT). Coordinate with RU for patterns and finishes for LVT products.

Base – Rubber, four inches high, cove ½ inch minimum depth, unless otherwise approved. Specify roll lengths where practical. Base in carpeted areas to be installed following carpet installation. Do not specify preformed corner or end pieces.

Stair Treads – Rubber, full width of stair, with reinforced rubber nosing.

Painting – Semi-gloss finish typical on all trim and wall paint in all kitchen, toilet, and wet areas. Semi-gloss finish also typical on all trim and wall paint in all high-traffic areas, such as corridors and stairs. Eggshell finish typical on wall paint in all other areas. Primer coat shall be a different color than final paint coat. Sherwin-Williams is RU’s preferred basis of design for color selection. RU must be provided the opportunity to visually inspect the prime coat prior to the installation of the first coat of paint.

Carpet – Interior Designers shall coordinate with Radford University for their basis of design for carpet selection. Contractor to furnish and install base and carpet. Use walk-off style carpet at entry areas to satisfy LEED requirements.

SPECIALTIES

Fire Extinguisher Cabinet – Semi-recessed with ten pound canister capacity. Larsen’s Manufacturing Company is preferred basis of design.

Toilet Partitions – Floor supported (including urinal screens) overhead braced. Solid plastic partitions by Santana, Scranton, PA (manufactured from recycled material) is preferred basis of design. Doors to be self-closing.

Toilet Accessories

- Show locations/elevations as required to demonstrate accessories do not conflict with ADA requirements, doors, or other installed devices.
Tissue Dispenser – JRT, Jumbo roll dispenser. Handicap shall have two roll dispensers with non-restricted flow. Dispenser shall be furnished by the owner and installed by the contractor.
- Liquid soap dispenser – Provided by owner, and installed by contractor. We use bagged foam soap.
- Towel dispenser – Surface mounted minimum capacity 800 foot roll provided by Owner, contractor installed.
- Floor basins – Housekeeping closets, rigid, molded PVC or terrazzo.
- Mirrors – will have shelves. Tilt mirrors in handicap accessible location not desired. Mount standard mirror at appropriate height. Recommended 18”x 36” standard mirror size.
- Napkin disposal units - Shall be owner furnished and contractor installed in Women’s or Unisex bathrooms.
- Provide coat hooks on the back of stall doors.

EQUIPMENT

(Reserved for Future Use)

FURNISHINGS

Window coverings – Consult with RU for method of procurement and installation of window treatments. Discuss any proposed specialty treatments with RU.

Signage – ADA and other code-required signage shall be in the construction contract; consult with RU on standard styles, colors, etc. Discuss room signage with RU during design.

SPECIAL CONSTRUCTION

(Reserved for Future Use)

CONVEYING SYSTEMS

Elevator Power Mechanism – Roped hydraulics are not acceptable.

Elevator Cabs – Stainless steel is preferred basis of design. Use brushed finish to hide scratches. Hard surface floor shall be used. Use a flexible floor covering so it does not crack. Rubber dots style flooring works well. Provide tamper-proof light fixture. If an elevator key is needed to restrict access to an area, BEST IC core is required (as opposed to a special elevator key).

MECHANICAL/PLUMBING/FIRE SUPPRESSION

General Access for Maintenance Items

- Provide access doors for all maintenance items above inaccessible ceilings and into inaccessible walls.
- Coordinate locations of all valves, cutoffs, and other maintenance items with ceilings, piping, conduit, and supports to allow accessibility.
- In areas with structure significantly higher than the ceiling elevation, place equipment as close to ceiling as possible for accessibility.

Piping

- Labeling shall be color coded in accordance with American National Standards Institute (ANSI) A13.1-2007.
- Below grade is to be bell-and-spigot with neoprene gasket.
- Interior sanitary shall be cast iron with no hub connections or PVC.
- Run-outs for hot water loop shall be minimized to 5 foot maximum.
- Penetrations – utilize UL-rated penetration assemblies.
- Automatic air vents – should be installed in the highest points of the system.
- Protect potable water with RPZ cross-connection.
- Steam lines –
 - Direct burial of steam lines is not permitted. A concrete walk-thru tunnel is preferred basis of design, with 6" – 8" minimum height and 3'-0" minimum clear width.
 - Install steam traps on a low pressure steam system so that return is by gravity to receiver.
 - Prefer to have steam condensate lines located so return will be gravity to steam tunnel, so that a condensate pump is not required.
 - If steam condensate pump is required, a steam driven pump shall be used. (50 psi in the summer and 90 psi in the winter).
 - Install test port and strainer on all steam trap lines (high and low pressure).
 - No galvanized fittings on steam lines.
 - Meter shall have a 50/1 turndown. Provide power source as required for meter. Varis is RU's preferred basis of design. Consult with RU, as owner will furnish and contractor install meters to ensure we get the appropriate meter.
 - Provide thermal and acoustic protection to other spaces. Use removable Kevlar insulation blankets.
 - Provide jackets to protect insulation in high-traffic areas and as otherwise appropriate.
 - Reducing station shall have 1/3 – 2/3 arrangement.
 - Identification - Stencil letters and arrows on pipes, valves, and equipment (do not use snap-on markers or pressure-sensitive markers). Engraved plastic-laminated signs and markers must be glued and screwed or pop-riveted to equipment.

- Pressure Relief Valves- pipe pressure relief valves outside of mechanical room per ASHRAE standards.
- Provide properly sized drip legs.

Sprinkler Systems

- Hydraulically designed wet-pipe automatic system. Dry-pipe systems in attic areas are acceptable where subject to freezing. Provide RPZ where connected to water service. The designer of the sprinkler system shall be responsible for water flow tests.
- Provide sprinkler protection for all exterior porches, patios, or other outside occupied spaces with overhangs greater than 4'-0".
- At exterior sprinkler drain a piped drainage method shall be provided. We do not want large holes in the ground next to the sprinkler drain.
- No fire pumps. There are many methods to design around fire pumps. Investigate all options and consult with RU before specifying a fire pump.
- No plastic sprinkler pipe. Occupied renovations may be an exception, as approved by RU.
- Flex heads are acceptable, but limit lengths to 6 feet maximum.
- Provide low-point drains within 50 feet of building drainage system.

Valves – Consult with RU if not using these valves for these purposes.

- Globe or proportional valves for controls applications.
- Ball or butterfly valves for water. No gate valves.
- Gate valves for steam.
- Provide zone valves in chilled, heating, and dual temperature piping.
- Provide adequate isolation valves for maintenance, including all main line connections, all laterals, and all equipment connections.
- Provide all valves in easily accessible locations.

Ice Storage Tanks – Calmac preferred basis of design.

Water Heaters – Leslie packaged instantaneous water heater with thermostatic mixing valve is preferred basis of design.

Fixtures

- Lavatories - Shall be wall hung, enamel cast iron. Single lever fittings for lavatories in residence halls to be short handle type.
- Water closets - Wall hung standard.
- Urinals - Shall be 1/8 gallon. No waterless urinals.
- Flush valves - piston manual.

- Plumbing fixtures - Use American Standard, Toto, Kohler, and Eljer as preferred basis of design. Use Sloan, Zurn, and Delany flush valve as preferred basis of design. Use American Standard, Kohler, Chicago Faucet, Eljer, Speakman, Moen, or Delta as faucet preferred basis of design. Provide mop-basins, floor mounted, in lieu of sinks.
- China and flush valves shall be from the same manufacturer.
- Utilize water conservation low-flow fixtures.

Expansion tanks – Bladder type.

VAV Systems

- Variable frequency drives preferred on air handling units. Drive capable of auto reset upon alarm clearance.
- Variable air volume units shall have a 1-volt to 10-volt damper motor and a flow ring mounted on the inlet side. Hot water heating coil mounted in the duct on the outlet side of box. No fiberglass insulation inside boxes.
- Parallel boxes are the preferred basis of design.

Mechanical Insulation – All piping insulation on domestic cold water, chilled water, and dual temperature shall be continuous.

Dielectric Fitting – Required when transitioning between incompatible materials.

Plumbing Specialties

- Vacuum breakers should be provided on outside faucets and janitor sinks. Air-gap or anti-siphon device where water line could be suspect to chemicals.
- Provide bottle filling station at drinking fountains. Use Oasis or Elkay as design standards.
- Water hammer arresters are to be provided.
- Where showers and commodes are on the same system the line should be sized large enough to prevent shower scalding when commode is flushed.
- Install RPZ on water make-up for heating, chilled water, and cooling tower water.
- Provide frost-proof wall hydrants on all roofs.

Natural Gas Piping – Equipment, regulators, and piping should be specified dependent on service and pressure available from local gas company's (ATMOS) equipment. Gas Company is to install line to building and furnish meter. Contractor is to run line from meter to all equipment. Provide shunt trip at meter tied to fire alarm, to turn off gas when alarm signals.

Hydronic Piping – Provide chemical feeders and appropriate valves on hot water and chilled water systems.

Chillers

- Consult RU concerning the use of regional chilled water plants by connecting buildings with chilled water piping.
- Chiller type depends on the loads. Provide five (5) year compressor warranty. Acoustics are important. Provide high-grade vibration isolation specifications.
 - Magnetic bearing chillers are preferred.
 - Water cooled machines for typical applications. Centrifugal, screw or scroll.
 - Air cooled scroll for smaller loads.
 - Energy recovery chillers for small winter cooling / summer reheat applications.
 - For DX applications consider using a heat pump.
- Prefer configuration of chiller to be such that the compressors and chilled water barrel are located in the mechanical room and condenser or cooling tower located outside. Manage the acoustics of the chiller in the mechanical room. Design appropriate mass and insulation to attenuate noise.
- Hot-gas-bypass is not acceptable.
- Chiller shall include the manufacturers' standard diagnostic package. The chiller controls shall be capable of resetting in 10-15 percent of full load. Provide capability of providing the following:
 - Resetting the chiller water supply temperature from an external 1-volt to 10-volt signal.
 - Chiller alarm contacts to external source.
 - Start – Stop function from external source.
 - Status of operation of chiller.
- The Building Automation System (BAS) shall control the start and stopping of the chilled water pumps. A water flow switch shall be provided in the line for chiller to sense flow before starting.
- If air type condensing unit is used, its control is directly from the chiller, not BAS.
- If cooling tower is required, building automation will control the operation. Install plate and frame heat exchanger with water tower to allow for water side economizing.
- Prefer variable frequency drives on cooling tower pumps and fans.
- Anti-freeze shall be propylene glycol, not ethylene.
- Ice storage controls shall be controlled by the BAS.
- Separate ice making control package with chiller is not required.
- Provide heat exchanger in ice storage system to keep glycol in mechanical room only and not circulating throughout the building.

Circulator Pumps

- Provide complete skid-mounted packaged unit. Shall have mechanical seals and replaceable rubber couplings. Seals, bearings, and impellers should be changeable without removing pump housing from building piping.
- Mount on concrete base.

- Provide two pumps with each pump having 100 percent pumping capability. Pumps shall be operated in a lead-lag mode.

Water-tube Boilers

- Shall be capable of being controlled from energy management system. Control of hot water supply shall be accomplished by energy management system.
- Check with local gas company (ATMOS) for pressure requirements.

Air Handling Units

- Double wall construction with solid galvanized steel interior panels. Fan/motor assembly to be mounted on internal isolators.
- Install UV lights and GPS around coils of AHU's.
- Consider heat pipe around large AHU coils. Use in conjunction with UV lights to eliminate coil cleaning.
- Energy recovery ventilators - wheels are acceptable. Plate and frame heat exchangers are not acceptable.
- Do not use steam or electric re-heat, unless specifically approved. Use energy recovery chiller/heat pipe or other strategies.
- Variable frequency drives, as opposed to vortex dampers, controlled by BAS.
- Motors shall be energy efficient, minimum 90% efficiency rating.
- Investigate routing condensate water to the cooling tower on water-cooled systems.
- Dampers shall be low-leakage.
- Damper operators shall be digital. Filters shall be standard size and readily available two-inch pleated pre-filter, 12 inch frame or bag filters to obtain maximum efficiency. Coordinate with LEED requirements.
- Provide minimum outside air duct to supply exhaust needs. Minimum duct shall have an air flow station connected to the BAS.
- Prefer outside air intake grills to be mounted above ground level and away from loading docks and other vehicle areas.

Fan Coil Units

- Shall be 4-pipe with control valves on each coil and controlled by BAS. Fan shall be energy efficient and controlled by the BAS. Fan speed shall be set on one speed, as determined by balancing contractor, and BAS shall cycle on and off. Design for medium speed to avoid noise issues associated with high speed fans.
- Where units have outside dampers, a freeze protection control shall be used as well as low limit control.
- Drain pan switches shall be used and wired to the BAS.
- Drains shall be gravity. Avoid condensate pumps if possible.

Plate Type Heat Exchangers – The exchanger shall be used in ice storage systems for “free cooling” when a cooling tower is used. In ice storage systems, the exchanger is used to separate the glycol from the water in the building system. When a cooling tower is used, the exchanger is used to transfer water temperature from the tower to the building system.

Metal Ductwork

- Shall be insulated on exterior. Vapor barrier on the insulation shall be continuous with no areas open to the air.
- If perforated duct is used for reduction of noise, there shall be a layer of Mylar between perforation and insulation, or use UV lights to prevent microbial growth in ducts.
- Provide manual balancing damper at main duct take-off, **not** at registers, and at regular intervals on long runs.
- Size duct work such that air and distribution noise does not exceed 45 db sound pressure level.

ELECTRICAL/FIRE ALARM/SECURITY

Lamps and Ballasts – Consider LED wherever practicable. Otherwise, use energy saving type, electronic ballast, T-8 fluorescent tubes, typical. Tubes shall be Low-Mercury Lamps: complying with EPA’s toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

Lighting Controls – Consult with RU for lighting controls. Many spaces may require specific controls and schemes (e.g. Offices, Classrooms, Conference Rooms, Laboratories, Hallways and Stairwells, Bathrooms, Support Spaces, Night Lighting, and Emergency Egress). Controls shall account for safety, energy conservation, and convenience. Large lighting projects control by BAS.

Conduit – Minimum size ¾” inch. EMT for all main runs and branches. May transition to MC after last junction box to light fixture. Run concealed in walls. Use flexible metallic conduit or liquid-tight flexible metallic conduit for final connection to machinery or vibrating equipment.

Penetrations – Utilize UL-rated penetration assemblies.

Lighting Fixtures

- Interior - two foot by four foot or two foot by two foot LED typical. Avoid two foot by two foot fluorescents. No U tubes. Temperature color 4100 K.
- Stairwells - Do not switch stairway lights off - may dim with occupancy sensors. Fixtures shall be reachable from the landings with an 8 foot ladder; otherwise, use LED.
- Notify RU of any lamps that will be difficult to access for changing lamps. Utilize LED lights in these applications.
- Exit - Lights shall be LED.
- For fixtures containing unit-mounted inverters for LED lamps, the inverters shall be easily accessible.
- Office and Classroom - Select low glare lens for offices and classrooms.
- RU standard is 4100k for color temperature; discuss space uses with RU.
- Incandescent lamps shall not be used unless approved by RU.
- Exterior - Discuss design and fixture selections with RU. Walkway lighting to match existing. Fixtures shall be traditional, outdoor light fixture, 120V-277V, 100W or 45W depending on spacing, LED. Poles/posts as manufactured by Mainstreet; Harrisonburg series fiberglass lamp post. Finish is to be black in color, painted with polyurethane paint to match core color. Poles are to be 10 feet 9 inches in height and furnished with embedded base. Provide 120V receptacle at top of pole. Parking lot fixtures are to be LED on 30 foot poles. Above is to describe standard of acceptance, other manufacturers may be acceptable.
- Occupancy sensors - Use ceiling-mounted occupancy sensors (wall sensors get blocked by furnishings too easily). Control common areas with occupancy sensors. Consult with RU for the durations. Offices and dorm rooms shall be occupancy sensor controlled when the light switch is on. Wall sensors may be permitted in spaces that are not regularly occupied (e.g. janitor’s closets, storage rooms) that are 100 square feet or less.

Outside Lighting – Use LED wherever practicable. All exterior lights shall be controlled by the Building Automation System (BAS). Calculates sunrise and sunset and turns the lights on and off at the appropriate times. Utilize exterior-rated ballast. Install manual override.

Devices – All devices shall be rated 20 amp minimum. Provide receptacle in stairs for housekeeping. Provide receptacle on building exterior by entrances or every 100 feet. Provide receptacles at rooftop equipment. Label all receptacles with circuit number and panel designation.

Panels – Provide 25% spare spaces minimum in the panel for future needs. Provide emergency panel that connects to all life safety devices. Calculate arc-flash rating for each panel, and note on drawings. Require arc-flash warning labels on panels.

Emergency Power – Provide generator, not battery back-up. If providing a generator, consult with RU about other than life safety back-up power needs.

Wiring – Copper.

Boxes – Shall be installed such that they are **not** back to back, and a minimum of one stud space apart.

Equipment grounding – A green ground conductor shall be installed in raceway serving electrical distribution equipment, in branch circuits serving receptacles, and to equipment served by flexible conduit, except lighting fixtures. Ground conductors shall be continuous from the equipment to the ground bus of the switchboard, panel board, or control center serving the equipment.

Motors - shall be energy efficient on all equipment, minimum 90% efficiency rating.

Starters - Five horsepower and above shall be soft-start or variable frequency drive.

Arc Flash Labels - Provide power study to calculate the arc flash incident energy at each piece of electrical equipment likely to require examination, adjustment, servicing, or maintenance while energized. Source impedance at service connection of each existing building may be obtained from RU. Obtain approval of proposed list of equipment to be included from RU. Provide arc flash labels on each piece of equipment.

Lightning Protection System - shall be provided for all new construction and major renovations.

Standard Building Utilization Voltage- shall be 120/208 or 277/480 3-phase.

Distribution System to Building

- Coordinate with RU to select connection point to 4.16kV distribution as well as the approved connection method.

- Provide minimum 3000-psi concrete encased duct bank system from the identified connection point at the University's 4.16kV system (typically a manhole) to the load to be served. Duct banks are to be steel reinforced under roadways, within 10 feet of foundation or wall penetrations, and anywhere that heavy loading, shear, or potential settling of soil is anticipated. Add red dye to concrete mix such that concrete is a uniform red color when cured. Use Schedule 40 PVC conduit in duct banks separated with manufactured plastic or fiberglass conduit spacers. Install a continuous 4/0 bare copper grounding conductor either under or within the concrete encasement and extend it into all pull and termination structures and equipment to create a continuous system ground. Provide at least one spare duct in runs between underground structures. Do not exceed 450 feet between pull/splice structures to facilitate cable installation. Perform cable-pulling calculations to verify design, and add pull structures as required. Terminate feeder duct bank run either in an underground vault with a sub-surface load-interrupter switchgear, or at a pad-mounted load-interrupter switchgear. Extend duct bank from load ways of switchgear to transformer(s).
- Provide manholes as required per design. Equip each manhole with cable stanchions and racks on each wall as required, pulling-in irons, a continuous 4/0 bare copper ground ring, and a 10' x 3/4" copper clad steel ground rod driven into the soil through the manhole floor. Procure manholes and accessories per RU guide specification.
- Provide 4/0 CU, 15kV, 133% Insulation Level, Type MV-105 cable for extension of the medium voltage system. Procure cable per RU guide specification. Connections to new switchgear are to be looped, in that, the existing feeder is broken, extended to the new switch, then returned to the tap location and then reconnected to continue feeder loop. All proposed designs for connections to the 4.16kV system must be submitted and approved by the University.
- All connections in the medium voltage system are to be made using modular elbow connections: 600A class dead-break on the main feeder systems and 200A load-break on the transformer feeders. No straight splices are to be used either for initial tap or as intermediate splices.
- No new medium voltage equipment is to be installed inside buildings.
- Load-interrupter switchgear are to be loop-type with incoming and outgoing 600A class loop ways, two (2) for the main feeders and up to three (3) 200A class load ways for the taps to the transformers. All connections shall be via IEEE 386 dead-front elbow interfaces, 600A dead-break for loop ways and 200A load-break for tap ways. Loop ways shall be equipped with load break switches having "OPEN, CLOSE, and GROUND" positions. Load ways shall be equipped with relayed vacuum fault interrupters in series with load break switches, also equipped with "OPEN, CLOSE, and GROUND" positions. Switches shall be pad-type or underground vault style, and shall be SF6 dielectric gas insulated. Procure switches per RU guide specification.
- The City of Radford Electric Department provides transformers. All transformers are to be dead-front design. Coordinate with the electric utility to size and coordinate delivery of transformers for projects.

Communication Raceways - Shall be provided. Specifications are to be coordinated with RU.

Data/AV

- 1" data conduit penetrations and double gang boxes with 1" conduit provided to above-ceiling access.
- 1½ inch AV conduit penetrations.
- 4-inch risers.
- Category 6 cable is required for ethernet, and RG6 cable is required for cable television.

Fire Alarm System

- Initiating devices shall be addressable.
- Remote signaling to the Police Department in the Allen Building is accomplished with a control module connected to contacts for trouble and alarm. The module will be provided by the owner and the owner will make connection to the Police Department. Contractor to make connection from module to fire alarm panel.
- Provide secondary connection to RUPD.
- Consult with RU whenever magnetic hold open devices are proposed to be provided at any doors.
- Very Early Smoke Detection Apparatus (VESDA) systems are acceptable. Use where detectors will be difficult to access.
- Devices shall be "changeable" and shall not require special programming to make changes. Provide necessary hardware and software to RU.
- Main fire alarm panel shall be located in an Electrical Room (preferred) or a Mechanical Room. Panel shall not be located in IT/Data Rooms.
- Fire alarm annunciator panels are required; coordinate locations with RU.
- RU's intention is to utilize JCI/Simplex systems and components. Sole source waivers for each project are required to be submitted to BCOM for review and approval.

Security Requirements

- Access Controls – Consult with RU prior to specifying the use of any electronic access control systems or devices.
- Cameras – Consult with RU prior to specifying the use of any camera systems or devices.
- Access control shall be low-voltage plenum-rated multi-conductor control cable. Systems to be compatible with C-BORD, RU preferred vendor.

Floor Markings

- Show required free floor area for all electrical devices and components.

BUILDING AUTOMATION

Building Automation System (BAS)

- Extend existing BAS to provide direct digital control, and monitoring (typical unless otherwise approved). RU has a dual source BAS provider. Johnson Controls and Automated Logic are the basis of design. The projects shall be designed around both of these control vendors. The Contractor will select from one of these two vendors to provide the BAS system.
- Items such as pneumatic dampers, valves, etc. which can be provided by other vendors and remain functional with the BAS shall be specified in the controls section of Division 15.
- Provide power source as required for all BAS equipment and controls.
- Control sequences shall follow the BAS vendor's pre-programmed sequences when possible.

Network - The BAS connects to the existing university system by means of the campus Ethernet system. This connection will be provided by the owner. Provide temporary cabling and connections during construction to maintain connectivity to University system.

Control Devices - The correct control device for a specific application will be selected by the BAS vendor and approved by the owner.

Radford Standard Control Sequences

Hot Water Converters – Converters shall have two steam control valves, one-third and two-thirds capacity. BAS shall monitor hot water supply and control steam valves using hot water reset from outdoor air. Reset schedule shall be 10-70 outdoor temperature, 80-100 hot water supply. The BAS shall monitor outside air and close the converter valves when the temperature rises above 60 degrees.

Hot Water Pumps – The BAS shall start one of the pumps when an occupied command is sent and the outside air temperature is below 60 degrees. The BAS will sense the differential pressure in the hot water lines at the highest point and send a 0-10 volt signal to the variable frequency drive to control the speed of the pump. Two-way valves shall be used on all the units except for a few three-way valves (1 or 2, on larger units) needed to provide a water supply to the pumps when all valves are closed.

Fan Coil Units – BAS shall control the heating and cooling valves as well as the fan on and off. A thermostat shall be mounted on the wall to control the units. Adjustable thermostats are used in offices and private rooms and non-adjustable thermostats in public areas. If the units have multi-speed fans, the balancing contractor shall set the correct speed to obtain the designed CFM and the BAS shall turn the fans on and off. If outside air dampers are required, low limit control shall be employed.

Variable Air Volume Boxes – BAS shall sense the pressure from the flow ring and convert to CFM using the information provided from the balancing contractor. BAS shall control the damper

motor, parallel or series motor, and the heating valve during occupied periods to maintain space temperature. During unoccupied periods, the fan and heating coil shall maintain unoccupied temperatures.

Air Handling Units

Constant volume units shall incorporate economizer dampers with up to 100 percent outside air and a separate minimum outside air duct with a damper for exhaust make-up. Also a return (exhaust) fan shall be ducted to the outside and to the return of the AHU with dampers at each location. The BAS shall open the minimum damper to its set position to provide make-up air for building exhaust when the unit is running and close it when the unit shuts down. The economizer damper shall remain closed, return damper open and the exhaust damper closed when the unit is not in economizer mode. A CO₂ sensor located in the return duct shall control the economizer dampers to maintain a maximum of 1,000 ppm level of CO₂ in the space. When the system is in the economizer mode, (set below 65 degrees outdoor air) the dampers shall be controlled by a calculated discharge setpoint, with a mixed air flow limit, and mechanical cooling disabled. The BAS shall control the heating valves, cooling valves and pre-heat valves when required.

VAV Air Handling Units shall operate as above with the addition of the following: The CFM shall be controlled by a Variable Frequency Drive on the supply fan and return fan. The supply fan is controlled by measuring the static pressure in the ductwork at two-thirds the total length of the duct. The static pressure setpoint is established by the balancing contractor to supply the required CFM. The return fan speed shall be controlled by sensing the differential pressure in the return duct before the fan and the mixing box on the air handling unit. The differential setpoint is set so as to achieve a slight positive pressure in the building. The minimum outside air duct shall have an air flow measuring station in the ductwork. The BAS senses the flow and controls the minimum outside air damper to maintain the correct CFM required for building exhaust even when the supply fan slows down.

Chillers

Chillers shall have the manufacturers' standard diagnostic package which has the capability to receive a 0-10 volt signal to reset discharge water temperature, start-stop point, alarm contacts and status contacts. These points are wired to the BAS. The BAS shall start the chilled water pumps and a flow switch mounted in the chilled water line shall signal the chiller of a positive water flow. The BAS shall signal the chiller to start and send a voltage to set the water temperature. The chillers leaving water temperature shall be reset using outdoor air. Reset schedule shall be 65-85 outside air, 45-54 water temperature. The BAS shall monitor the outside air and stop the chiller when the temperature falls below 60 degrees.

Chillers in an ice storage system shall operate as above with the following additional controls:

- Unoccupied mode – The chiller has an ice making mode point which the BAS tells to energize. The BAS starts the pumps, switches the building valve and the chilled water valve into the ice making position. These valves will direct the water into

the ice tanks and by-pass the building. The chiller will run in the ice making mode until the BAS senses that the tanks are full (from a tank level sensor) and tells the chiller to shut down. The pumps and chiller will stop and wait for an occupied signal from the BAS.

- Occupied mode – The BAS will start the pumps, switch the building valve, and modulate the chilled water valve to by-pass tanks. The BAS will have a 10 minute delay before switching the chiller out of ice making mode and starting the chiller. This delay allows for the water in the loop to warm above the freezestat set point in the chiller before starting. The BAS shall calculate the chilled water setpoint by using outside air reset. This set point shall control the chilled water valve to supply the correct temperature to the building. The BAS will add two or three degrees to this setpoint and send the signal to the chiller to produce water that is two or three degrees warmer than the setpoint. This allows the ice to bleed in and use ice while the chiller is uploded, thus saving energy. The BAS will shut the chiller down on a request for demand limit. This allows the pump and ice to cool the building during this time. NOTE: this happens usually twice a day and lasts for approximately 1 hour.

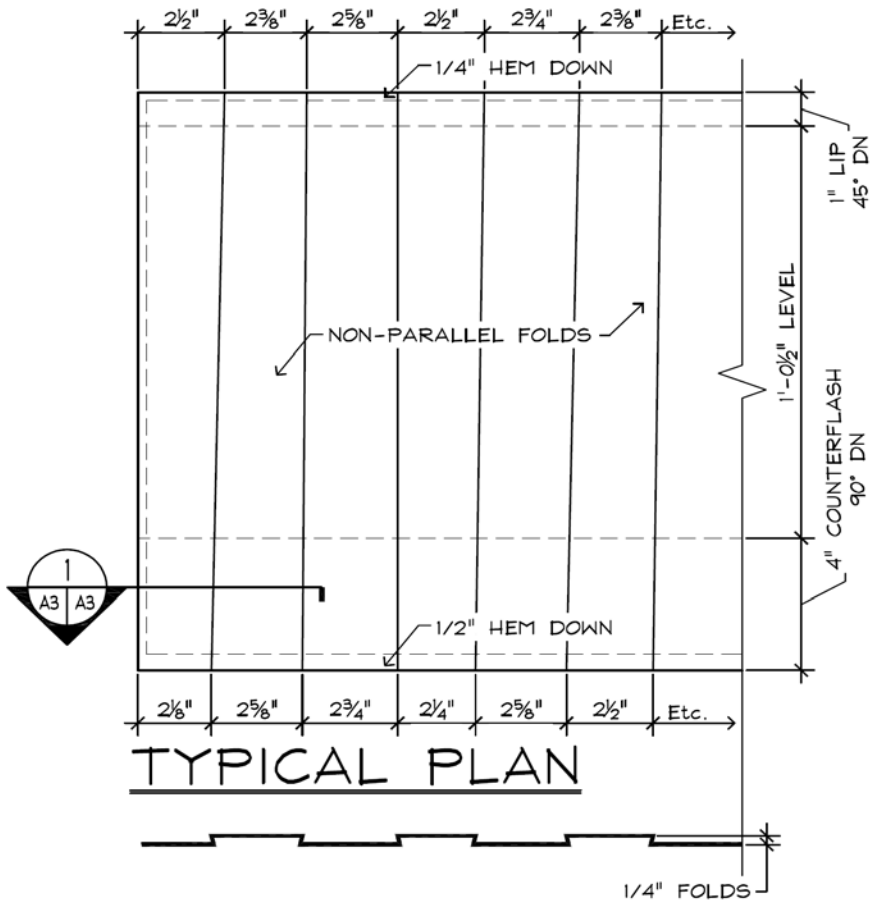
Chilled Water Pumps – The BAS shall start one of the pumps when an occupied command is set and the outside air temperature is above 60 degrees. The BAS will sense the differential pressure in the chilled water lines at the highest point and send a 0-10 volt signal to the variable frequency drive to control the speed of the pump. Two-way valves shall be used on all the units except for a few three-way valves (1 or 2, on larger units) needed to provide a water supply to the pumps when all valves are closed.

Steam Flow Meter – Owner will provide steam flow meter in the main steam line after entering the building. The meter shall be connected to the BAS to record steam usage. Provide power source as required for steam meter.

KW/KWH Meter – Owner will provide KW meter with the CTs mounted in the transformer vault or the main electrical service room, as directed. The meter shall be connected to the BAS to record electrical usage.

HVAC – Economizer cycle shall be used when room/space requirements would not be jeopardized.

APPENDIX A – STANDARD DETAILS

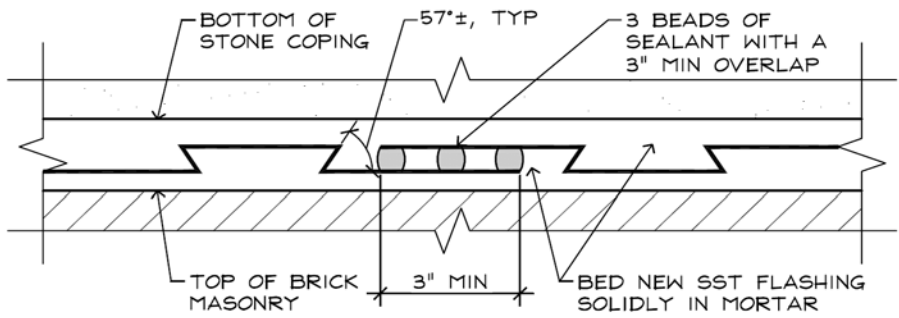


TYPICAL PLAN

TYPICAL SECTION

TYPICAL FLASHING DETAIL

SCALE: 3" = 1'-0"



SST FLASHING HEAD FLASHING JOINT DETAIL

SCALE: 3" = 1'-0"

NOTE: TRIM COUNTERFLASHING TO ALLOW FOR 3-INCH MIN OVERLAP

