# Bucknell University

**Construction & Design Group**

# DESIGN GUIDELINES & INSTRUCTIONS

**Updated January 2017**

# INTRODUCTION

This manual has been developed as a guide for Design Professionals commissioned to design new construction or alterations to buildings and related facilities for Bucknell University. It has been prepared in order to set forth those standards and procedures that the University has found to be most appropriate, and to indicate the University's preferences regarding materials used in the construction of its facilities and improvements to its campus grounds. This manual shall also apply to the University's in-house construction, maintenance, and repair projects.

Since this manual is a guide, nothing in it is intended to be so final that variation there from will not be considered and approved if it is in the best interest of the University to do so. A listing of certain manufacturers does not mean that all other manufacturers are to be excluded, unless otherwise indicated. It is the responsibility of the Design Professional to design a building with the best life cycle cost possible, within constraints of budget, and the University does not wish to handicap the Design Professional's efforts by insistence on rigid adherence to inflexible requirements. However, intended variations from the Design Guidelines in this Manual must be brought to the attention of the University's project manager for specific written approvals, and shall be supported by data indicating cost savings, increased life expectancy, better technology, or aesthetic value.

Unless otherwise stated in the Guidelines or otherwise directed by the University, where manufacturers are listed in the specifications, at least two manufacturers shall be named. Where a preferred manufacturer is listed in these Design Guidelines, that manufacturer shall be included as the first choice in the list given in the specifications and identified as the Basis of Design. Do not add to the list of acceptable manufacturers given in these guidelines unless approved by the University Construction & Design Group. In cases where only one manufacturer is given, additional manufacturer(s) may be added after approval by the Construction & Design Group.

Technical requirements for materials and methods of construction are arranged according to the 16-Division Specification Format of the Construction Specifications Institute (CSI), and include the areas in which the University requires certain minimal standards in the selection of materials and the quality of workmanship. When the manual does not address a particular material or assembly, no standards have been developed by the University. In all cases, the Design Professional shall use his or her professional judgment, and, when such

judgment indicates materials or methods contrary to information found in this Manual, the Design Professional shall discuss these items with the University's Project Manager for the project.

In general the University is encouraging sustainable design concepts in all projects. The designer shall consider LEED requirements wherever possible in the design of the project, and these items shall be discussed with the University's project manager.

# GENERAL DESIGN CRITERIA

1. Ensure that all Mechanical Rooms are adequately sized to provide for maintenance & the ability to service equipment. Rooms shall be sized to allow for increased equipment space requirements in the future. Access via ladders is not acceptable.

2. On each floor there should be at least one custodial closet with enough space to store enough supplies to service the floor. The room should contain a floor mounted mop receptor with hot and cold water supplies as well as space for cleaning solution dispenser(s).

3. Data Closets shall have the following design features:
    a. Air-conditioning or sufficient exhaust (air-changes) to dispense heat build-up from the electronic devices contained therein.
    b. Two duplex, 120v electrical outlets, 20 ampere dedicated circuit.
    c. At a minimum 2-3070 doors (or a height that matches adjacent doors).
    d. Through the Bucknell project manager obtain the latest closet configuration from the ISR organization.
    e. ¾" plywood back-up board.

4. Provide exterior access with double doors for Mechanical and Electrical Rooms.

5. Study anticipated trash flow patterns to disposal areas to ensure best placement of trash and recycling rooms and/or dumpsters. Include recycling centers. Consider aesthetics of the location of disposal areas, and provide enclosures, bollards, concrete pads, or screening where appropriate. Provide adequate ventilation at these areas.

6. Provide an adequate number of outside GFCI receptacles with weatherproof covers and hose bibbs, carefully located and freeze-protected, for proper watering and future maintenance of all grass and landscaped areas.

7. Provide receptacles in stair towers at every landing.

8. Provide power-activated doors at all exterior door locations for both sets of vestibule doors in compliance with ADA requirements.

9. Provide loading docks in locations that do not detract from the building's appearance, yet where they will be readily accessible.

10. Ensure adequate access to each roof level. The Roof shall be readily and safely accessible. Access shall also be lockable.

11. Ensure strict compliance with ADA, Local, and State Buildings Codes.

12. Coordinate finish packages with Facilities and Users. Present at least 3 options for colors and palette of finishes for final selection and approval.

13. Provide As-Built drawings in electronic format complying with Bucknell University's CAD standards.

14. Bucknell University encourages the use of Energy Star products, including equipment, building envelope materials, lighting, and office equipment, in the design of its buildings.

# DIVISION 2 - SITEWORK

## SITE PREPARATION

1. Topsoil shall be stripped to the depth determined by the Soils Engineer, usually not less than 4". Topsoil shall be stockpiled where directed on University property. Topsoil shall remain the property of the University unless otherwise directed by the University. Topsoils shall not be mixed with subsoils or other site debris.

2. The Contractor, while working the site, is responsible for protecting all existing trees to remain so that they will be free from any damage. All trees affected by construction activities shall be protected with snow fencing at least 4 foot away from the tree dripline. If damage is done, the Contractor shall be responsible for replacement of damaged trees.

3. Do not stockpile soil within the dripline of existing trees.

4. Protect stockpiled soils from rain, wind, etc.

5. Dispose of all debris or unsatisfactory material off site.

## BUILDING DEMOLITION

1. When a building is to be demolished, without new construction in its place, all foundation walls shall be removed to a point 3’-0" below grade. All basement slabs below the 3’-0" level need not be demolished, but must be broken into approximately 4’ square areas or less to allow drainage of water. Require the Contractor to hire the services of a Pennsylvania licensed surveyor to document the location of all foundations left in place below the 3’-0" location, as well as abandoned utilities, and utilities relocated as required by the

demolition work. Survey shall become part of the as-built drawings required of the Contractor at completion of the work.

2. All demolition debris shall be removed from the University property and disposed of by lawful means. Backfill of buildings shall be with clean fill, compacted to at least 95% minimum density for cohesive material and 95% relative density for cohesionless material. Area shall be topsoiled and seeded or planted with sod unless otherwise directed. Topsoiling, seeding and sodding shall be in accordance with Section “Lawns and Grasses” in this Design Guideline.

3. Through the Project Manager, the University must be contacted for a Hazmat determination. Contractor will be responsible for removal and disposal of all hazardous materials in accordance with governing regulations. If in the course of a renovation additional HAZMAT material is uncovered, the Contractor will immediately notify the University’s project manager.

4. At least 14 days prior to disruption of any existing utilities, Contractor shall notify the University project manager, and obtain written approval at least 48 hours prior to disruption. Contractor shall comply with regulations regarding notifying the Pennsylvania "One-Call" system before beginning excavation.

5. Existing utilities that will no longer be in service shall be completely removed where possible. Where complete removal is not possible, utilities shall be cut and capped with written permission from the University’s project manager. The location of the cuts/caps shall be indicated on the as-built survey provided by the Contractor.

6. Before demolition begins existing conditions of adjacent features shall be documented photographically.

7. Contractor shall be responsible for DEP notifications and submissions. Bucknell University shall be copied on all submissions.

# EARTHWORK

1. All excavation for Bucknell University projects shall be unclassified excavation, meaning that whatever material is encountered during excavation must be removed. If the soils reports indicate large

quantities of rock at the elevations of the building footings, this procedure may be modified, with the permission of the Project Manager. Blasting is not permitted during excavation. The Contractor shall be instructed to stop excavation if anything of archaeological value is encountered.

2. The prime consultant or architect shall retain the services of a geotechnical engineering firm, approved by the University, to prepare a soil investigation report prior to designing the foundation system. The cost for this work is to be included in the prime consultant's or architect's fee.

3. The Contractor shall be required to hire a soils & geotechnical testing agency qualified according to ASTM E 329 for testing of all earthwork (hired by Owner and coordinated by Contractor). Soils Engineer shall be a Professional Engineer licensed in the Commonwealth of Pennsylvania and possess professional liability insurance in the minimum amount of $500,000. Soils Engineer shall provide all field and laboratory services required to:

    a. Test and evaluate all samples of proposed fill materials to determine optimum moisture density relationship in accordance with ASTM D 1557.

    b. Test all samples to assure compliance with gradation requirements of this Specification. Grain size analysis shall be performed in accordance with ASTM D 422.

    c. Determine depth of topsoil stripping.

    d. Inspect all proof rolling and determine the presence of any local soft pockets.

    e. Inspect excavation in natural soil to determine if bearing stratum meets design criteria.

    f. Inspect and test compacted fill to determine compliance with Specifications. Field densities shall be determined by ASTM D 1556M, ASTM D 2167 or ASTM D 2922.

    g. Keep written records of all tests and field instructions, and summaries of these reports shall be mailed weekly to the Professional, University project manager, and Contractor.

Final written summaries shall be provided upon completion of work.

4. Foundation elevations shall be shown at elevation of suitable bearing.

5. All underground utilities shall be marked and identified with a 6 inch wide by 4 mils thick polyethylene warning tape inscribed with the utility description.

6. Hand excavation shall be required to verify locations of all utility tie-in points.

7. All backfill materials shall be reasonably free of clay and sand and completely free of rock greater than 2 inches, frozen material, debris, waste, vegetation, and other deleterious materials.

8. All backfill materials shall be compacted to 95% of maximum density as determined by ASTM 1557.

9. If the excavation requires sheeting and shoring, the Contractor shall hire a Professional Engineer to design the shoring system.

# UNDERGROUND STRUCTURES

All manhole openings in underground structures shall be no less than 30” diameter. This is true for structures for all utilities.

# WATER DISTRIBUTION/FIRE PROTECTION

Fire hydrants shall be dry barrel-type with two (2) – two and one-half inch (2-1/2") hose nozzles and a single four and one-half inch (4-1/2") pumper nozzle. All threads on hose and pumper connections shall be National Standard Fire Hose Thread. The operating nut shall be one-inch square. Coordinate with the University Construction & Design Group for fire hydrant location and position. The University prefers a yellow FDC Storz type fitting.

# ELECTRICAL AND COMMUNICATION STRUCTURES

1. Coordinate, through the University project manager, all tel/data structures with ISR. The group should "sign-off" on all proposed designs prior to the preliminary design submission.

2. Electrical manholes should be 8’ x 8’ x 8’ minimum size and be flush with surrounding environmental surfaces.

3. Designer should provide an effective means of draining manholes.

4. Provide accurate and complete as-builts at completion of construction.

5. Refer to University standards for data closets and rooms in the “Data Communications” section in this Design Guideline.

6. Manholes meeting the “permit required” confined space criteria shall be called-out on design drawings and be signed as such at entry to the manhole.

# STORM DRAINAGE

1. Provide an adequate number of exterior storm drains that resist clogging and provide clean-outs as required.

2. Provide slot drains at the end of long sidewalk runs with grade toward building.

3. Road grates shall be bicycle safe.

4. The top of lawn grates shall be set 1/2" below finished grade level to facilitate drainage. Lawn grates shall be round.

5. All storm drainage plans and designs must be submitted to the Township for approval. It is recommended that this occur prior to the preliminary design submission.

# CEMENT CONCRETE PAVEMENT

1. Graffiti Protection: Wet concrete pavements shall be protected from graffiti. If graffiti is present, concrete shall be removed by Contractor and replaced at Contractor’s expense.

2. Concrete pavements shall be given a medium-to-fine textured finish, and two coats of a curing and sealing compound. The contractor shall provide a sample of exterior concrete, prior to beginning any installation, for the university's project manager's approval.

3. Driveways and sidewalks that will have a dual function as service access ways shall be minimum 6" thick concrete on minimum 4" crushed gravel or crushed stone sub-base. Concrete and sub-base thicknesses shall be designed according to anticipated vehicle weight.

4. Pedestrian only sidewalks shall be minimum 4" thick concrete on 4" crushed gravel or crushed stone sub-base. Sidewalks that may double as service access shall comply with Paragraph No. 3 of this Section.

5. Provide curing and sealing compound for concrete surfaces.

6. Locate sidewalks to suit locations where pedestrians would normally walk, rather than strictly in accordance with symmetry of design. Coordinate with the University's Construction & Design Group.

7. Blankets or other methods shall be employed to protect concrete being installed during cold weather. Comply with ACI 306.1 for cold-weather protection.

8. For asphalt pavement applications place a 2 ½" thick compacted binder coarse on an aggregate subbase. Within 24 hours the wearing course shall be place with a 1 ½" compacted thickness.

# SITE IMPROVEMENTS

1. Wood Benches – Historic and Formal Areas (Coordinate with the University Construction & Design Group for Locations):

2. Bollards
   a. Fixed Bollards: Standard bollards shall be used at loading docks, service areas, and other areas of low visibility to the general public. Refer to the Products and Manufacturers List for Architectural bollards for high visibility areas.
      1) Materials:

a) Bollard post shall be 6 inch i.d. Schedule 40 mild steel seamless pipe with a minimum wall thickness of 7/32 inch. Thin wall tube is not acceptable. Top of bollard post shall be fitted with a cast aluminum hemi-dome end cap, permanently double monobolted in place. Easily vandalized friction fit end caps are not permitted. Bollard shall include 2 each 9/16 inch diameter thru holes for No. 4 rebar.
b) Foundation: Minimum 3,000 psi concrete.

2) Finish:
a) Bollard shall be coated with a tough, opaque, UV resistant exterior grade polyester powder coating applied to a minimum thickness of 6 mils. Liquid, epoxy or lead-containing powder coatings are not acceptable.
b) Color shall be black semi-gloss as selected by the University.

b. Removable Bollards: Standard bollards shall be used at loading docks, service areas, and other areas of low visibility to the general public. Refer to the Products and Manufacturers List for Architectural bollards for high visibility areas.

1) Materials:

a) Bollard post shall be 6 inch i.d. schedule 40 mild steel seamless pipe with a minimum wall thickness of 7/32 inch. Thin wall tube is not acceptable. Top of bollard post shall be fitted with a cast aluminum hemi-dome end cap, permanently double monobolted in place. Easily vandalized friction fit end caps are not permitted.
b) Footing and associated hardware to allow bollard removal.

2) Finish:
a) Bollard shall be coated with a tough, opaque, UV resistant exterior grade polyester powder coating applied to a minimum thickness of 6 mils. Liquid, epoxy or lead-containing powder coatings are not acceptable.

b) Color shall be black semi-gloss as selected by the University.

3) Lock to be furnished by Owner.

3. Handicap Access Post for Mounting Door Push Plate (if post includes a card reader, then refer to post specification in the Security Management System Specifications).

a. General

1) Post shall be 4" x 6" tubular seamless steel, 1/4" minimum wall thickness.

2) Top of post shall be fitted with a steel cap overlapping 2" on all sides. Overhanging edges shall be at a 20° down angle. Cap shall have smooth, rounded edges. Weld cap to post providing watertight seal.

3) Openings shall be provided for conduit entrance below grade and mounting hardware for handicap push plate installation. See handicap push plate manufacturer for size of opening and mounting hardware required.

4) Access post and cap shall be primed and painted to match curtain wall system framing at entrances. Color to be approved by Architect.

5) Foundation: Minimum 3,000 psi concrete.

b. Handicap Activation Device

1) Shall be stainless steel, 6" round push plate switch. Engraved with international handicap insignia and the words, "Press to Open". Pad-mounted opening devices shall not be used.

c. Painting

1) Materials for painting tubular steel post and cap.

a) Surface preparation shall be SSPC-SP-10.

b) Paint shall be epoxy acrylic urethane.

c) Manufacturers

(1) Prime Coat

(a) Themec, Model 161-1211, DFT 3-5.

(b) Sherwin-Williams, Recoatable epoxy primer, DFT 3-5.

(2) Intermediate Coat

(a) Themec, Series 73, DFT 2-3.

(b) Sherwin-Williams, Corothane 11 B65W200, Series/B6002, DFT 2-3.

(3) Finish Coat

(a) Themec, Series 73, DFT 2-3.

(b) Sherwin-Williams, Corothane 11 B65W200, Series/B6002, DFT 2-3.

4. The University uses standard exterior light poles and bicycle racks. The information on these standards will be provided by the Project Manager.

# LAWNS AND GRASSES

1. General: Strict compliance with the requirements of this section is very important to the University. The University will reject any work not complying with these requirements.

2. Installer Qualifications: A qualified installer with a minimum of 5 years experience, whose work has resulted in successful lawn establishment.

    a. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

3. Topsoil stripped from the building site and stockpiled may be used if the following requirements are met.

    a. Topsoil shall have a pH of between 6.0 and 7.0, and shall contain not less than 2% nor more than 10% organic matter as determined by AASHTO T194.

    b. Topsoil shall be fertile friable loam, sand loam, or clay loam which will hold a ball when squeezed with the hand, but which will crumble shortly after being released.

    c. Topsoil shall be free of clods, grass, roots, or other debris harmful to plant growth, and free of pests, pest larvae, and matter toxic to plants.

    d. Topsoil shall comply with the requirements of Section 801 of the Pennsylvania Department of Transportation Publication 408 Specifications.

4. When topsoil stripped from the building site does not meet the above requirements, Contractor shall provide topsoil from off-site sources. Topsoil shall comply with requirements of the "Exterior Plants" section of the Design Guidelines.

5. Give attention to proper swale design.

6. Grass seed and seeding restoration shall comply with the University standard formula which is 4-Star perennial rye mix (available from Seedway) applied at a rate of 9-12 lbs. per 1000 square feet.

8. Fertilizer: Liquid or dry formulations.
Lime: Raw ground limestone conforming to Section 804.2 (a) Publication 408 Specifications. The application rate for lime shall be based on the PH test results of the soil.

9. Basic dry formulation fertilizer shall be analysis 0-20-20 and as defined by the Pennsylvania Fertilizer Law.

10. Starter fertilizer shall be analysis 10-5-5 or 12-6-6 and as defined by the Pennsylvania Fertilizer Law. Application rate shall be 50 lbs per 10000 square feet.

11. Mulch: Wheat or oat straw, thoroughly threshed, or wood cellulose containing no growth or germinating – inhibiting substances.

12. Mulch Binder: Asphaltic, vegetable gum, or polyvinyl acetate emulsion.

13. The University will accept hydroseeding with cellulose in lieu of straw mulch as long as overspray does not occur in unwanted areas.

14. Maintenance of Lawn Areas: Contractor shall provide watering, hand weeding, and mowing once per week for a six week period, and cleanup, edging, and repair. Reseed areas that do not produce a prompt catch of grass within 24 days of seeding. Continue maintenance until all areas are grassed and free from bare spots or off-color areas and weeds, and turf areas are accepted.

15. Contractor shall maintain E&S controls until lawn is established.

16. Lawn and landscape edging shall be metal with integral stakes and green in color supplied in ten foot lengths.

17. The University prefers biodegradable or rapid breakdown polypropylene netting for seed mats.

18. A physical separation shall be provided between sidewalks and parking lots so that parked cars do not overhang onto sidewalks. The material used and size of the separation shall be proposed by the designer based on site conditions, but it could be lawn, mulch, or other landscaping. The University prefers to not use bumper blocks in parking spaces of new parking lots.

# EXTERIOR PLANTS

1. General: Landscaping should be kept simple to allow mechanized equipment to be used whenever possible. Soil berms and landscaping are desired for aesthetic value in parking areas, but plants and trees with little to no maintenance must be specified. Plowing patterns, and snow "dumping" areas must be considered in developing this landscaping. Confer with University Construction & Design Group. Avoid extensive planting of flower beds. Provide an adequate number of receptacles and hose bibbs, carefully located and freeze-protected. Perennial flower beds will be considered providing that they are low maintenance year round. Coordinate size of plantings with the University.

2. Planting Season:

    a. Deciduous Trees and Shrubs: October 15 to May 15.

    b. Evergreen Trees: March 1 to May 15; August 1 to September 15.

    c. Seedlings and Seedling Transplants: March 1 to May 15.

    The planting periods may be extended or reduced according to prevailing weather and soil conditions at the discretion of the Professional.

3. Warranty: Extend warranty requirements of the General Conditions to cover the entire planting operation, including the one-year guaranty period.

4. All plants shall have a well-branched, vigorous and balanced root and top growth and, unless otherwise specified, shall be No. 1 Grade conforming to "American Standard for Nursery Stock" of the American Association of Nurserymen (AAN). They shall be free from disease, injurious insects, mechanical wounds, broken branches, decay or any other defect. Trees shall have reasonably straight trunks with well-balanced tops and a single leader. Deciduous plants, other than those specified as container grown, shall be dormant.

    a. Sizes:

1) Deciduous non-flowering trees: 3-4” diameter.

2) Deciduous flowering trees: 2” diameter, 8-10’ height.

3) Evergreen trees: 8-10’ height.

4) Shrubs: 5 gal bucket.

5) For shrubs and bushes specify minimum sizes in terms of gallons for containers or ball sizes, crown, etc., to provide for the appearance of fairly mature landscaping immediately after planting.

6. Topsoil:

a. Weathered surface soils (A Horizon), or amended unweathered topsoil (B Horizon), or blend of both, free from hard fragments and stones larger than 1 inch across in the greatest dimension, objectionable salts, noxious woods and plants, partially disintegrated debris, or other materials inferior to the surface soils or that would be toxic or harmful to plant growth.

b. Grading Analysis:

| Sieve | Minimum Percent Passing |
|---|---|
| 2” | 100 |
| 1/2” | 90 |
| 1/4” | 80 |
| #10 | 70 |

7. Peat: Natural product containing a negligible amount of woody matter.

8. Manure: Mushroom manure free from clumps and foreign material larger than 1 inch and substances toxic to plant growth and noxious weed seed.

9. Fertilizer; 16-8-16 fertilizer in 4-ounce, 8-year release, heat-sealed polyethylene packets.

10. Planting Mixtures:

    a. For backfilling plant pits of deciduous trees, shrubs and vines: Four parts by volume of topsoil and one part of decomposed stable manure, all mixed by hand or rotary mixer.

    b. For backfilling plant pits of evergreen and broadleaf plants: Four parts by volume of topsoil and one part of peat humus, all mixed by hand or rotary mixer.

11. Mulch: Processed hardwood bark, ground or shredded, aged a minimum of 2 years. Apply 4" minimum mulch over weed barrier. Provide gravel or decorative stone in traffic areas and at building drip lines.

12. Stakes and Guys:

    a. Wood Stakes: Rough sawn red or white cedar, southern yellow pine, or approved hardwoods; free from knots, rot or other defects.

    b. Ground Anchors: 4" universal iron type, 4" auger type, or wooden "deadmen"

    c. Turnbuckles: Galvanized steel, nominal 1/8" x 6".

    d. Wire: #12 gauge galvanized steel.

    e. Chafing Guards: New or used 2-ply reinforced rubber or plastic hose; use all the same color on the project.

13. Maintenance and Replacement:

a. Contractor shall be responsible for keeping all plants in healthy, growing condition until acceptance.

    b. During planting and until final acceptance, Contractor shall maintain plants and work incidental thereto by replanting, plant replacement, watering, pruning, shearing, spraying, weeding, reguying, and by performing other operations of care for promotion of root growth and plant life so that work is in satisfactory condition at the completion of the Contract.

c. During the guaranty period, Contractor shall promptly replace plants that are dead or are in unhealthy, unsightly or badly impaired condition; replace with healthy plants as soon as it is reasonably possible; do not make replacements in any season unfavorable for planting.

d. When any plant is replaced during the guarantee period, the guarantee period for the replaced plant shall be one (1) year from the date the plant was accepted by the Professional.

e. Any damage done to the lawn and seeded areas shall be repaired to a condition generally recognized as acceptable and to the satisfaction of the Professional; additional cost repaired for restoration work shall be at Contractor's expense.

14. Care shall be exercised in planting material along walkways, driveways and adjacent to lighting fixtures. This plant material shall not block sight-lines, walkways or lighting fixtures when fully matured.

15. Minimum Planting bed depth for all shrubs shall be 12".

16. Plant Locations: No plants shall be placed within river stone or gravel beds. Plants must only be placed in mulched beds.

# PLANTING ACCESSORIES

1. When landscape edging is used, only steel edging is permitted. Aluminum edging is not acceptable.

2. Landscape edging shall only be used to separate mulch beds from river stone or gravel beds. Landscape edging shall not be used to separate mulch beds from lawns.

3. River stone or gravel beds around the building perimeter should only be used if the stone beds are required for a drainage system. Otherwise mulch beds shall be against the building façade.

4. If a yard drain for an underground drainage system is located within a mulch bed, a steel ring is required around the drain separating the mulch from the drain. River stone shall be placed inside the steel ring.

# DIVISION 3 - CONCRETE

## CAST-IN-PLACE CONCRETE

1. The latest edition of American Concrete Institute (ACI) standards shall be followed.

2. Testing: The Contractor shall be responsible for all coordination with the Owner's testing agency to perform all concrete testing and inspections in accordance with applicable ASTM standards.

    a. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
        1) Slump: ASTM C143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
        2) Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
        3) Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
        4) Compression Test Specimen: ASTM C31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
        5) Compressive-Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at

28 days, and one specimen retained in reserve for later testing if required.

b. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

c. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.

d. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

e. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

f. Test results shall be reported in writing directly from testing laboratory to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

g. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

h. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed.

i. Testing In-Place Concrete Floors for Flatness: For floors, use ASTM E1155, "Test Method for Determining $F_F$ Floor Flatness and $F_L$ Floor Levelness Numbers."

3. Air-entrained concrete shall be used where concrete is exposed to the weather. With the exception of air-entrained agents, no antifreeze or other admixtures are permitted.

4. All concrete floors which will be exposed within the finished building shall be sealed.

5. No chloride ion additives shall be permitted.

6. Provide sleeves with collar and link seals at all penetrations below grade. Core drilling is not acceptable.

7. Concrete slabs shall contain steel reinforcing bars or welded wire fabric. The Architect must also consider the possibility of adding engineered polypropylene fibers in addition to the required reinforcing bars or welded wire fabric. A discussion with the University is required to determine the need for fibers in the concrete on a case by case basis.

# DIVISION 4 - MASONRY

## UNIT MASONRY ASSEMBLIES

1. No chloride additives in mortar shall be permitted.

2. Provide cavity walls for exterior masonry walls. The exterior back-up walls shall be CMU in lieu of metal studs.

3. Face brick shall be red; color and texture to be approved by the University. University standard face brick is one of three choices: Glen-Gery 53DD, Glen-Gery Bucknell Custom Blend, or Watsontown Bucknell Custom Blend, unless otherwise approved. The brick selection will be project specific. The bricks shall be placed in the University's flemmish bond pattern.

4. Provide mortar color to match existing adjacent construction. Coordinate with the University Facilities Department. If there is no adjacent construction, the standard Bucknell University mortar mix shall be used.

5. Provide adequate through-wall flashing, with Mortar Maze weep holes in masonry at 16" o.c.

6. Give attention to parapet design. Ensure proper waterproofing at back sides of parapets. Metal copings are preferred, rather than cast stone, brick, or concrete copings when design permits.

7. Indicate masonry expansion joints at proper spacing and locations.

8. Provide a datestone.

9. Masonry Accessories:

    1.) Concealed flashings shall be copper laminated fabric flashings, weight of 7 oz.

2.) Weep hole/ventilators shall be one piece flexible, honeycomb shaped, ultraviolet resistant polypropylene co-polymer cell vent to fit in a vertical mortar joint.

3.) Cavity drainage material shall be continuous, reticulated, nonabsorbent mesh, made from polyethylene strands or shaped to maintain drainage at weep holes without being clogged by mortar droppings. It shall be the thickness of the entire cavity.

4.) Anchors and ties shall be hot dipped galvanized or stainless steel.

5.) Flashing at bottom of veneer system at weeps to be brushed stainless steel (matte finish)

6.) At jack arches above windows use tubular weeps with insect guard. Do not use cellular weeps.

7.) Do not use metal flashing at window heads.

# MASONRY RESTORATION AND CLEANING

1. Clean existing exterior masonry surfaces by means of pressure washing. Specify only those pressures and cleaning solutions that can do no damage to existing masonry.

2. Repair existing mortar joints by raking out loose mortar, cleaning joints, and repointing with mortar of type and color to match existing mortar.

3. Rake and caulk horizontal bed joints at precast copings.

4. Shell pointing and acid cleaners are not permitted.

# DIVISION 5 – METALS

## STRUCTURAL STEEL

1. Design structural steel framing in accordance with the latest AISC specifications.

2. Designer shall confirm compatibility of fireproofing with primer or unpainted steel.

3. Steel connection design is the responsibility of the steel fabricator. All connections must be designed under the supervision of a licensed professional engineer in the Commonwealth of Pennsylvania. Shop drawings and calculations must be signed and sealed.

## COLD FORMED METAL FRAMING

1. All non-loadbearing 3-5/8" interior metal studs less than twelve feet in height shall be a minimum of 25 gauge. All non-loadbearing 6" interior metal studs less than fifteen feet in height shall be a minimum of 25 gauge.

2. All non-loadbearing 3-5/8" interior metal studs greater than or equal to twelve feet in height shall be a minimum of 22 gauge. All non-loadbearing 6" interior metal studs greater than or equal to fifteen feet in height shall be minimum of 22 gauge.

3. Provide double 20 gauge studs around door openings.

4. Exterior metal studs, load bearing metal studs, and all structural elements shall be designed under the direct supervision of a Professional Engineer experienced in this work and licensed in the Commonwealth of Pennsylvania.

## METAL FABRICATIONS & STAIRS

1. All exterior miscellaneous steel shall be galvanized and prime painted, ready for field finishing.

2. All metal stairs shall be designed under the direct supervision of a Professional Engineer experienced with the work and licensed in the Commonwealth of Pennsylvania.

# HANDRAILS AND RAILINGS

1. In general the designer will avoid using painted surfaces on all rail surfaces that are gripped by the hand.

2. Interior Handrails and Railings:

   a. Material: Steel pipe, ASTM A53, standard weight (Schedule 40), unless otherwise required by structural loads.

   b. Finish: Wear-resistant paint, gloss finish, when the university project manager in writing, has granted permission beforehand.

3. Exterior Handrails and Railings:

   a. Material: Type 304 stainless steel or aluminum tube or pipe, ASTM B429, alloy 6063-T6.

   b. Finish:

      1) Stainless Steel: Bright, directional polish; No. 4 finish.

      2) Aluminum: Factory-applied baked enamel finish. Field-applied finishes are not acceptable.

   c. All fasteners shall be stainless steel. Fasteners shall be concealed as much as design will allow.

   d. If posts are embedded in concrete, provide proper concrete coverage to prevent spalling and cracking. Consider using a surface mounted base plate connection if aesthetics are acceptable.

4. All Interior and Exterior Handrails shall be designed under the direct supervision of a Professional Engineer experienced with the work and licensed in the Commonwealth of Pennsylvania.

# DIVISION 6 - WOOD AND PLASTICS

## ROUGH CARPENTRY

1. Where fire-retardant-treated wood or preservative-treated wood are used, the treatment shall be accomplished by means of pressurization. Preservative treatment is required for all wood in damp areas or in contact with earth, concrete, masonry, plaster or roofing.

2. All lumber shall be inspected, marked according to grade and certified by the appropriate bureau governing that product.

## FINISH CARPENTRY

1. Materials and Fabrication: Conform to Architectural Woodwork Institute specifications for Custom quality work as a minimum.

2. Renovation Work: Finish carpentry shall match adjacent construction unless otherwise approved by the University.

3. Wood trim shall be hardwood such as maple, oak, or cherry. Avoid use of softwoods.

## ARCHITECTURAL WOODWORK

1. Cabinet Work: Materials and fabrication shall conform to Architectural Woodwork Institute specifications for Custom quality work as a minimum.

2. Cabinet hardware shall be furnished and installed by the installer of cabinetry. Hardware shall include self closing hinges and ball bearing drawer guides.

3. Plastic laminates: Before specifying, give due consideration to the particular condition of usage that will be encountered. Of special concern are flame spread, chemical & water resistance, fuel contribution, smoke generation and toxicity for plastic laminates and for the adhesives used to install them. Avoid use of plastic laminates in residence halls.

4. Solid Surfacing Material: Desirable where budget permits.

5. Prior to delivery of materials on site for installation, the Contractor shall provide the proper environmental controls for material storage (i.e. weatherproofing, climate control). These controls shall be maintained for the duration of the project.

# DIVISION 7 - THERMAL AND MOISTURE PROTECTION

## WATERPROOFING

1. Waterproofing of below grade spaces is required.

2. Material shall be protected against damage during backfill by a protection board.

## EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

1. It is preferred that such systems be avoided. When required, only the "hardcoat" systems defined as Class PM, Type A, polymer modified protective finish coating, externally reinforced as developed by the Exterior Insulation Manufacturers Association (EIMA) may be used. Such systems require mechanical fastening of extruded polystyrene insulation and reinforcing mesh, and rigid acrylic modified cement plaster finish.

2. Pay special attention to locations of crack control joints and details of flashing and sealing at penetrations to insure a properly designed and watertight installation.

## MEMBRANE ROOFING

1. Avoid flat roofs with no slope. Minimum slope on roofs must be 1/4" per foot via sloped steel or tapered insulation.

2. For low-slope roofs, provide a modified bituminous membrane roofing system containing a two ply membrane with insulation and aggregate surface finish.

3. Slate roofs shall contain 3/16” nominal thickness grade S1 slate shingles conforming to ASTM C406. No broken or cracked shingles shall be used,

and no shingles with broken corners shall be used. Provide extra full size slate units equal to 2 percent of the amount installed.

3. Roofs shall have a minimum 10-year warranty signed by the General Construction Contractor, roofing subcontractor and the manufacturer of the roofing system. Ten-year guarantee shall cover both material and labor for defects which occur. The roof warranty shall cover the entire system including flashing, adhesives, etc. 15-20 year warranties are preferred.

4. Walkway pads shall be provided to all roof equipment and appurtenances requiring maintenance.

## SHEET METAL FLASHING AND TRIM

1. Ensure adequate flashing at all penetrations at walls and roofs.

2. Sheet metal flashing and trim shall be either 24 gauge min. galvanized steel, 0.0187” thick min. stainless steel, ASTM B 370 cold rolled copper (16 oz. per square foot), or aluminum.

## ROOF SPECIALTIES AND ACCESSORIES

1. Provide access to the roof from interior of building. Interior roof hatches must be lockable with a padlock, and shall be located in areas restricted to the general public and accessible only by authorized personnel.

2. Roof access by stairs is preferable to vertical ladders.

3. Provide snow guards where required.

## JOINT SEALERS

1. Do not use and misuse the word "caulk". Such materials generally consist of oil-based materials and are no longer used for glazing or as a sealant in masonry joints or other exterior wall joints.

2. The use of 2-part polyurethane or silicone-synthetic rubber type sealant is preferable. Determine which particular sealant type is best suited to each individual application. Specify pourable urethane-based sealants for construction joints in traffic bearing locations such as concrete walks, patios, steps and similar locations. Specify mildew-resistant silicone sealant for sanitary applications such as in food preparation areas and toilet rooms.

# DIVISION 8 - DOORS AND WINDOWS

## STEEL DOORS AND FRAMES

1. Exterior hollow metal doors shall be not less than 16 gauge steel. The top channel of each metal door shall be solid without pockets which collect dirt and water. All exterior doors and frames shall be galvanized.

2. Interior hollow metal doors shall be not less than 16 gauge steel.

3. Exterior door frames shall be 14 gauge, all-welded construction. Interior door frames shall be 16 gauge.

4. At fire-rated construction provide fire-rated door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

5. Hollow metal doors and frames shall be reinforced for hardware.

6. Double wood or metal studs shall be provided at all door frames for rigidity.

7. The University's preferred manufacturer is Steelcraft.

## WOOD AND PLASTIC DOORS

1. Avoid the use of wood doors for exterior applications.

4. Interior wood doors shall be 5 ply construction solid core, either mineral core where a fire rating is required, high density particle board core, or wood stave core. Most doors shall be 1-3/4" thick.

3. Wood doors which are to receive clear or stained finish shall be factory finished and pre-machined for hardware. Specify that the door edges shall be fabricated of wood matching the face.

4. Provide glazed openings in all corridor & stair tower doors.

5. Glazed openings in fire-rated doors shall comply with requirements for fire-rated doors.

# ACCESS DOORS AND PANELS

1. Provide an adequate number and size of access doors and panels for access to mechanical and electrical work or any device that can expect to require maintenance. Provide key locks on all access doors accessible to the public or students. Coordinate location and quantity of access panels with University facilities personnel.

2. Specify access door materials for the environment and conditions under which they will be used.

# ENTRANCES AND STOREFRONTS

1. Aluminum doors shall have minimum 5" stiles, 5" top rail and 10" bottom rail. These minimum requirements are needed for coordination with Bucknell's standard hardware and for durability.

2. All hardware, with the exception of cylinders, shall be provided and installed by the aluminum door manufacturer. Cylinders shall be provided under finish hardware section of the Specifications.

3. Hinges: Provide continuous rod or pin type hinges. Do not use geared hinges. Standard hinge size shall be 4 ½" x 4 ½". Standards finish shall be US26D.

4. For entry doors, provide card readers, or as a minimum, conduit and box for future card readers. Confirm with the Construction & Design Group.

5. Coordinate with ADA requirements at entrance doors and provide automatic door operators when applicable. Push plates shall be provided at the interior of vestibules as well.

# WINDOWS

1. Operable windows are preferred unless the windows are very large.

2. Aluminum window and storefront frames shall be thermally broken.

3. Maintain historic character of buildings being renovated. Wood windows shall be aluminum- or vinyl-clad.

4. All first floor and fire escape windows on residence halls shall be equipped with security screens**.** Example Product: "Crime Shield" as manufactured by Exeter Co., in Wyoming, PA.

5. Use Energy Star compliant windows where possible.

6. A safety and security film manufactured by 3M (Scotchshield Ultra600) shall be applied to all first floor windows on residence halls.

# HARDWARE

1. Cylinders for locks shall be manufactured by Best Lock Company. Provide Best 7-pin removable cores. Standard finish shall be US26D.

2. Specify heavy duty door closers with cast iron bodies and a minimum 10-year warranty. Avoid in-floor closers. Closures shall be ISO 9000 certified.

3. Exit devices and panic hardware shall be heavy duty and durable and conform to applicable requirements of NFPA 80 and NFPA 101. Finish shall be US26D.

4. In paths of egress, provide magnetic hold-open devices connected to fire alarm system.

5. Locks for dormitories, classrooms, and offices shall be a “T” function meaning the door can only be locked with a key.

# KNOX BOX

1. A 3200 Series Hinged Door Knox Box shall be installed in all Residence Hall Projects.

2. Coordinate location of Knox Box with Bucknell Public Safety and Facilities.

3. A Simplex fire alarm connection is required for the Knox Box.

4. University prefers the Knox Box to be installed in brick veneer.

# AUTOMATED DOOR OPERATORS FOR HANDICAPPED

1. Provide ADA wall or bollard mounted push plates.

2. Do not specify pad-mounted openers of any kind.

# GLAZING

1. For exterior windows provide double-pane insulating glass with Low E coating.

2. Insulating glass shall have U value of 0.4 or less.

# DIVISION 9 – FINISHES

## GYPSUM BOARD ASSEMBLIES

1. Minimum single-layer thickness of gypsum board shall be 5/8 inch.

2. Utilize moisture resistant GWB in toilet rooms and other applicable areas. Use cement board in showers.

3. Consider corner guards in areas of high traffic where damage to corners may occur.

4. Use impact resistant GWB in high use corridors, etc.

5. Specify 0.0329-inch thick (20 Ga.) studs in the following areas:

    a. For head runner, sill runner, jamb, and cripple studs at door and other openings.

    b. In locations requiring support for casework, fixtures, handrails, shelving, chalkboards, tackboards, and other wall-mounted items.

    c. In location to receive ceramic tile.

6. Require coordination with other Sections and provide backing plates or blocking for support of all wall-mounted items.

7. Provide Type X gypsum board for fire-rated construction.

8. Refer to Cold Formed Metal Framing in Division 5 for additional information.

## CERAMIC TILE

1. Ceramic floor tile shall meet the standards of the Americans with Disabilities Act (ADA) “Accessibility Guidelines for Buildings and Facilities” (ADAAG). Static coefficient of friction shall be minimum 0.6 for level floors

and 0.8 for ramped surfaces as determined by testing identical products per ASTM C1028.

2. Preferred ceramic tile sizes are 4” by 4” or larger for floors and 4-1/4” by 4-1/4” for walls.

3. If specifying ceramic tile for shower stall floors, provide impervious waterproofing under floor and on walls over the cement board.

4. Contractor shall provide the University with extra stock equal to 4 percent of each type of tile installed or a minimum of 15 sf. Trim shapes shall also be included.

5. When budget permits full ceramic tile walls are preferred in all rest room and shower areas. Wainscot height can be used to save. Epoxy painted walls are a distant third preference.

# TERRAZZO

1. Sand-cushion cementitious terrazzo is preferred over epoxy terrazzo, where project conditions permit.

2. Terrazzo bases shall be used for shower stalls.

# ACOUSTICAL PANEL CEILINGS

1. All ceiling tile shall be class 1 fire rated.

2. Contractor shall provide the University with extra stock of full-size acoustical panels equal to 4 percent of each type of acoustical panel installed or a minimum of 15 panels of each type.

3. Coordinate with the University project manager to specify a type of ceiling panel already in use at the institution. Introduce a new material only with written permission from the project manager.

# RESILIENT FLOORING

1. Resilient tile flooring shall be 12” by 12” by 1/8” thick vinyl composition tile, of homogeneous through-pattern construction.

2. Resilient base shall be 1/8” thick vinyl or rubber base, minimum 4” high provided in rolls.

3. Stair treads shall be rubber, slip-resistant, radial disc type and of a pattern that can be easily cleaned. Do not specify deeply scored patterns.

4. Contractor shall provide the University with extra stock equal to one box of resilient tile flooring for each 30 boxes or fraction thereof, of each type and color of resilient flooring installed.

5. Resilient flooring shall be cleaned and waxed at time of acceptance by the University.

# CARPET

1. Lees “Faculty Remix” is the preferred material for carpet. Other acceptable manufacturers are Milliken and Interface, and the University project manager must approve in writing any deviations from this specification.

2. Face pile shall be 100% nylon with built-in static control and stain-resistant hollow filament fiber.

3. Provide carpet with the following fire-test-response characteristics:

   a. Methenamine Pill Test (DOC FF-1-70): Passes.

   b. Flooring Radiant Panel (ASTM E648): Class I.

   c. Smoke Developed: 450 or less per ASTM E84.

4. Use only direct glue down installation.

5. In general, the University prefers broadloom over carpet tile. However, expenses associated with maintenance and replacement cycles should be incorporated in the decision to use broadloom or carpet tile. Carpet tiles may be preferred in certain high traffic areas.

6. The Designer **MUST** verify with the manufacturer that the carpet and pattern is available during the appropriate timeframe of the construction schedule. Submitting samples of carpet for University approval that are not available is completely unacceptable because it can delay the project.

7. Pattern is preferred over solid colors.

8. Carpet shall be thoroughly clean at time of acceptance by the University.

9. Contractor shall provide the University with extra stock of full-size carpet rolls (full width rolls) or carpet tiles equal to 5 percent of each type and color installed.

# WALL COVERINGS

1. In general vinyl wall coverings are to be avoided. Where vinyl wall coverings are specifically requested by the University, the following minimum weights should be specified:

    a. Light weight (12 to 16 oz. per sq. yd.) for areas with light traffic or out-of-reach areas.

    b. Medium weight (14 to 20 oz. per sq. yd.) for areas with average traffic such as offices and reception areas.

    c. Heavy weight (20 to 26 oz. per sq. yd.) for areas with heavy traffic such as classrooms and corridors.

# PAINTING

1. In order to coordinate color schemes throughout University facilities, and to ensure economy in future repainting, paint colors shall be limited to the palette of standardized colors provided by the University. The University standard color is “Bucknell White.”

2. The Design Professional shall submit color samples for all painted surfaces. All colors must be approved by the University before incorporation in the construction documents.

3. Specify low-sheen or semi-gloss paint for walls, and gloss paint for metals. Avoid flat paint except for ceilings.

4. Specify heavy-textured coatings where wall surface defects are significant and must be covered.

5. No lead-containing paints shall be used, unless authorized in writing by the University.

6. Only paints with low or no VOC’s shall be used.

7. Contractor shall provide to the University with 5% of each color and type paint used, along with manufacturer's name and color formula number.

# DIVISION 10 - SPECIALTIES

## TOILET COMPARTMENTS

1. Floor mounted compartments and wall hung screens shall be used. For both, ensure adequate connections.

2. Compartments and screens shall be solid plastic. Doors shall have continuous hinges.

3. Provide tamper proof fasteners.

## EXTERIOR SIGNAGE

1. Exterior building signage shall utilize the Times New Roman font. Size, color, and placement shall be discussed with the university on a project basis.

## INTERIOR SIGNAGE

1. Signs shall match type, colors, lettering, and mounting techniques of existing signs.

2. Room Signs:

   a. Sign Type: One piece polymer sign face, .030 inch thick, with raised ADA compliant lettering; perforated in-house updateable message inserts; clear removable window for updateable message protection; acrylic frame, radius corners; wall mount.

   b. Type Style: Sans Serif.

   c. Provide Microsoft Windows compliant updating template software for the System.

3. Stairwell safety signs, meeting the requirements of Section 5-2.2.6.6 in the Life Safety Code handbook, shall be provided. Signage content shall be consistent with the University labeling and number schemes.

4. Stairwell and exterior egress doors, in Residence Buildings, shall be provided with white reflective (Scotchlite®) adhesive lettering – indicating EXIT – in proximity to the floor (6-8" above finished floor surface), on occupied side of door.

# FIRE PROTECTION SPECIALTIES

1. In many cases the University will provide fire extinguishers for the project to be installed by the Contractor. Verify with the University project manager for each project.

2. Units may be surface mounted utilizing standard "J-type" hook or similar type of hook. Mobile-style clamp brackets are prohibited. Units shall be installed in accordance with the latest version of NFPA 10.

3. Provide semi-recessed cabinets with vandal-resistant lens. Cabinets shall be unlocked, with window made of polycarbonate or other plastic glazing to verify the presence of fire extinguisher. Break-glass faced cabinets are prohibited.

4. Provide appropriate signage and/or lighting where necessary or specified by the University.

# TOILET ACCESSORIES

1. The University shall furnish to the Contractor the following toilet accessories for their installation:

    a) Towel Dispensers
    b) Soap Dispensers
    c) Toilet Paper Dispensers
    d) Waste Receptacles
    e) Sanitary Napkin Dispenser

2. DO NOT USE electric hand dryers except in areas specifically discussed with the Bucknell Project Manager.

3. The designer shall coordinate and draw the locations of all accessories on the construction documents.

4. Provide baby changing stations in both male and female restrooms in areas where the general public is likely to gather.

5. The sanitary napkin dispensers should be located in all non-residential womens restrooms and all gender neutral restrooms. The dispensers are provided to the University by Susquehanna Paper and Supply. It includes a coin mechanism that can be set to $0 to dispense.

# ARTWORK HANGERS

1. Artwork display systems shall be stainless steel cable system type with push button security hooks by http://gallerysystem.com. "The Original Gallery System".

# DIVISION 11 - EQUIPMENT

## FOOD SERVICE EQUIPMENT

1. The Design Professional shall use the services of a food service equipment specialist approved by the University in preparation of the design of kitchen areas and other food preparation areas. Such areas shall be designed in close coordination with the University food service personnel. Exceptions must be granted by the University project manager.

2. Care shall be taken in addressing proprietary vs. non-proprietary.

## LABORATORY EQUIPMENT

1. Fume Hoods: All new hoods shall meet testing criteria established by the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) in ANSI/ASHRAE 110, "Method of Testing Performance of Laboratory Fume Hoods". All hoods, bench, distillation, or walk-in types, shall have proper aerodynamic design to minimize eddy currents and assure against air movement from the hood into the laboratory. This shall be accomplished by airfoil sides and an aerodynamically designed sill with a one-inch air gap between it and the hood floor. All hoods shall be variable volume, designed to maintain constant face velocity at varying sash heights. Hood systems shall be designed for a face velocity of 100 feet per minute when in use. Motion sensors on the face of the hood shall set back the face velocity to 60 feet per minute when no one is present at the hood. Fans and/or hoods shall be final tested and certified as to face velocity at completion of the installation.

a. Provide ADA Fume Hoods complying with requirements of the Americans with Disabilities Act where required by governing regulations.

2. Eyewash Units: Units shall be installed at or near sinks within the hazardous operations space. Such spaces include wet laboratories, areas where dust is generated, darkrooms and other areas where liquid chemicals are used or handled. Handheld hose type units, wall mounted units, pedestal-mounted units, eye/face wash units, and combination

safety shower/eyewash units shall provide a soft spray of 3-7 gpm at 30 pounds per square inch of pressure.

All eyewash units must flush both eyes simultaneously, the flow must remain on without the use of the operator's hands, the unit must remain activated until intentionally cut off, and the nozzles must be protected from airborne contaminants.

A sign must be posted to identify the location of the eyewash unit and the area behind or around the eyewash unit must be painted with a bright color. Eyewash-units for non-ADA compliant units should be installed between 2’-9" and 3’-9" from the floor. For ADA compliant stations, for dimension references, CABO ANSI A117.1 standards for drinking fountains shall be followed, as applicable to eyewash units. Provide four spare nozzles for future replacement. Appropriate plumbing shall be provided for wash water.

3. Safety Showers: Safety showers shall be installed in a conspicuous location, such as a well-traveled aisle, doorway or corridor. They must be within the room or space they serve or within 25 feet of the main room door. Safety showers must be installed in locations that are accessible at all times. Provide a floor drain at each safety shower. Floor drains shall be provided where potential environmental contamination is not a factor. Requirements for drains designed in locations where contamination of the effluent is possible shall be reviewed against local, state and federal environmental regulations.

   Safety showers shall be installed so that the center of the shower head is at least 25" from the nearest wall, bench or furnishing and at a safe distance away from electrical equipment or outlets. The base of the shower must be between 6’-10" and 8’ above the floor. The shower head should be a deluge-type head, and should be made of plated brass or plastic. The safety shower unit shall be capable of providing a flow of 30-50 gallons of non-tempered water per minute at 30 pounds per square inch of pressure.

   Safety shower activating valves are to be operated by pulling either a chain, a cord attached to die valve lever, an 8 inch minimum diameter ring or a triangle connected by a chain or cord to the lever. The lowest point of the ring, triangle or cord should be located no more than 48" from the floor for frontal approach and no more than 54" from the floor for a side approach, and should run within 1 to 2 inches of a wall or bench. Safety

shower activating valves are to be quick-opening, self closing globe valves. A shut off valve accessible via a 6 foot ladder is to be installed for each shower head.

A sign must be posted to identify the location of the safety shower, and the area behind or around the safety shower must be painted with a bright color.

Installation and operation of safety showers and eyewash units shall comply with ANSI Z358.1-1990.

# DIVISION 12 - FURNISHINGS

## LABORATORY CASEWORK

1. Casework shall be manufactured and approved for laboratory use, and shall be chemical resistant, impervious and easily cleaned.

2. Casework doors and drawers shall have locks keyed to the University master key system.

3. Drawers shall be full suspension type.

4. Metal Casework:

   a. Metal laboratory casework shall be cold-rolled, carbon-steel sheet complying with ASTM A366 or stainless steel complying with ASTM A 666 Type 304.

   b. Gauges: Drawer bodies, shelves, interior door panels, security panes, and sloping tops shall be 20 gauge. Ends, backs, case tops and bottoms, bases, exterior door panels, and vertical posts shall be 18 gauge. Top front and intermediate rails, gussets, table legs, frames, leg rails, and stretchers shall be 16 gauge. Drawer suspensions, door and case hinge reinforcements, and L-shaped front corner gussets shall be 14 gauge. Table leg corner brackets and leveler gussets shall be 11 gauge.

   c. Construction: All exposed welds shall be polished smooth.

6. Wood Casework: All wood shall be clear of defects and discoloration. Casework surfaces exposed to view after installation including those behind glass doors shall be Oak. All casework not exposed to view after installation shall be hardwood plywood. Ends shall be oak hardwood plywood, 3/4" thick.

## ENTRANCE MATS

1. The University will provide entrance mats. Mats shall **not** be recessed.

# WINDOW TREATMENTS

1. Horizontal blinds are preferred over vertical blinds. Window shades shall be manually operated string roller shades mounted inside of window opening. Shade mechanism shall allow shade to be in full open position, full down position, and stop at any position in between.

2. Consider blackout blinds in areas where slides or computer graphics are to be shown.

3. Vinyl roller blinds shall be used in residence halls. Aluminum horizontal mini blinds shall be used in offices.

# DIVISION 13 – SPECIAL CONSTRUCTION

## LIGHTNING PROTECTION

1. Lightning protection systems shall be provided where recommended by the Risk Assessment Guide contained in NFPA 780 - Lightning Protection Code, and Bucknell University's request.

## HAZARDOUS MATERIAL REMEDIATION

1. Removal or encapsulation of asbestos, polychlorinated biphenyl (PCB), lead paint, and other hazardous material shall not be part of the General Contract for Construction. It shall be done by separate Contract, and the University shall hire an experienced firm specializing in removal and encapsulation of hazardous materials for performance of the work.

2. If the Contractor unexpectedly encounters hazardous material, he must immediately notify the University.

## FIRE ALARM

1. Standard fire alarm system for the University is a Simplex fully addressable system using a 4100ES panel (no substitutions). System shall be equipped or designed to interface with a network system, with appropriate communications card for data transmission via copper and fiber optic cable. Coordinate with the Simplex representative and the University Facilities staff.

2. Comply with ADA requirements for sound and light accessories of fire alarm system. Notification (audio-visual) devices shall comply with ADA requirements.

3. Magnetic door holders shall be provided on doors where applicable. Typically these locations include busy egress paths and stair towers.

4. Fire Alarm Panels shall be located where accessible to firefighters. Do not locate in mechanical rooms.

5. Duct smoke detector remote test stations shall be located where readily accessible for testing.

6. All smoke detectors shall be photoelectric type.

7. Heat Detectors shall be utilized where required by conditions.

8. Spare devices shall be provided as follows:

    a. Addressable bases

    b. Addressable pull stations

    c. Notification appliances to include audio-visual and visual-only devices

    d. Smoke sensors

    e. Heat sensors

# FIRE SUPPRESSION SPRINKLERS

1. Dry-type sprinklers are preferred over Glycol wet-type in areas subject to freezing.

2. Dry type sprinkler system air compressors shall be connected to the emergency power system.

3. All sprinkler system zones shall be monitored by the fire alarm system.

4. Sprinkler/Fire Protection Control Valves

    a. Valves shall be capable and wired for tamper monitoring.

b. PIVs shall be of type complete with valve handle, capable of being secured to body of PIV.

c. Valves shall be provided with metal or plastic signage, which adequately identifies area(s) served or protected by the valve. Appropriate materials shall be provided to hang sign at valve location.

d. A control valve chart, complete with valve location (s) and area(s) protected shall be provided to the University.

5. Coordinate sprinkler heads with mechanical equipment. Do not locate sprinkler heads close to heat source that may cause inadvertent discharge.

6. The use of flexible fire sprinkler connections is preferred.

# FIRE DEPARTMENT CONNECTIONS, STANDPIPES AND HOSES

1. Fire Department Connections: Provide sump type rather that Siamese type. Connections shall be a single-inlet equipped with a five-inch Storz® (or equivalent) fitting. The University Project Manager will provide product specifications upon request by the Design Professional.

2. Where applicable provide standpipe. No hose racks. Standpipe outlets shall be 2-1/2 inch with National Standard Fire Hose threads, reduced to 1-1/2 inch NST reducer, complete with blind caps and retention chain.

3. Provide exterior grade, fade resistant, high performance plastic sign above fire department connections on exterior of building. Signage to be mounted a minimum of six (6) feet above fire department inlet. Sign shall measure a minimum of 20" x 14", red letters on white background and display the following: “Fire Department Connection”.

# DIVISION 14 – CONVEYING SYSTEMS

## ELEVATORS

1. Regulatory Requirements: In addition to local governing regulations, comply with provisions of the following for manufacture and installation of elevator systems.

    a. ASME A17.1, “Safety Code for Elevators and Escalators”.

    b. Pennsylvania Vertical Transportation code.

    c. Americans with Disabilities Act (ADA), “Accessibility Guidelines for Buildings and Facilities”.

    d. Elevator recall protocol shall be as required in NFPA 72.

2. Pennsylvania L&I variances must be secured for all elevators having a sprinklered shaft. Variance is to allow for shunt tripping of power to elevator prior to sprinkler system activation (as required by IBC Code). The architect shall work with the contractor to secure this variance.

3. Require double wall hydraulic piston casings on hydraulic elevators with waterproof seals at pit floor, and with waterproof, high pressure seal at bottom of casings

4. Hands free emergency telephones shall be provided in all elevator cabs.

5. Preferred interior wall finish for cabs is stainless steel.

6. Provide card-reader operation for access to restricted landings.

7. Require the Contractor to provide, at completion of installation, as-built installation information on reproducible mylar drawings indicating the control wiring, motor data, and all pertinent elevator information necessary for maintenance purposes. Contractor shall also provide a manual describing all adjustment procedures, maintenance requirements, and a list of components including manufacturers and catalogue numbers.

8. Key switches used in hallways or inside elevators shall be on the University master key system.

9. Control System:

   a. The elevator manufacturer/vendor shall provide a new control system with all required functions including, but not necessarily limited to, call allocation, logic functions, door control, speed sensing/position, all with microprocessor operation. The control system shall not require the use of any proprietary or specialized manufacturer diagnostic tools for purposes of trouble shooting and/or repair. No hand held tools (data entry devices) will be acceptable for diagnostic or adjusting use. The manufacturer shall turn over to the University all tools/devices required for the maintenance of the elevator including equipment to reprogram software source codes at no extra cost to the University at the completion of the project.

   b. All software, diagnostic, adjustment/tune-up manuals and documentation and any other documentation required for the maintenance of the elevator including tools or devices necessary to reprogram the software source codes shall be provided to the University for approval prior to commencement of the installation of the elevator equipment. Once provided, no substitution of the equipment described in the manuals and documentation will be acceptable.

   c. All printed circuit boards shall be available to the University for purchase as spare parts in any quantity deemed reasonable by the University. Overnight delivery of printed circuit boards must be available for emergency repairs. Printed circuit boards shall be accompanied by all pertinent documentation for installation and use. All components of the elevator must be commercially available from standard parts suppliers.

10. Elevator manufacturer shall provide a one-year warranty for all service and maintenance during a one-year period after acceptance. Require the Contractor to submit monthly service reports to the University during warranty period.

11. Install a ladder, stop switch, a light and a sump pit in the elevator pit. Sump pump (provided under Division 15) may be required where there is a problem with water.

12. Provide a malfunction signal to the controller which will indicate when the elevator is out of order.

13. The design of hydraulic elevator machine rooms should be such as to provide for proper environmental conditions to prevent overheating or congealing of the oil. Consider providing air conditioning for elevator electronic controllers.

14. Provide security mirrors in all passenger elevator cabs.

15. Provide cab protective pads.

16. Provide lighting that meets the PA L&I requirements for lighting levels in pits (10 footcandles) and elevator machine rooms (19 footcandles).

17. Elevators shall be integrated with the fire detection system and contain an ADA compliant visual alarm device. Elevators shall include an automatic return to lobby and shutdown feature in the event of fire detection.

18. Provide training, related to elevator fire service operation and reset and emergency procedures to Facilities staff, and Public Safety personnel when project is completed. Follow the Construction and Design Group generated start-up checklist.

# DIVISION 15 – MECHANICAL

## BASIC MECHANICAL MATERIALS & METHODS

Consultants shall state the following design parameters on the Contract Documents:

1. Winter Dry Bulb Air Temperature, indoor & outdoor
2. Summer Dry Bulb Air Temperature, indoor & outdoor, non-air conditioned spaces.
3. Summer Wet Bulb Air Temperature, indoor & outdoor, air conditioned spaces.

Consultants shall state on the Contract Drawings the applicable building, zoning, fire, sanitary, and energy codes used for design.

Consultants shall provide a narrative that describes the intent and design parameters of each mechanical system in the project. Energy savings schemes shall also be included. The narrative shall be provided during schematic design for review by the University. The final version of the narrative shall also be included in the project specifications.

Consultants shall provide the following information on the Contract Drawings during the schematic design phase. The information shall remain on the drawings for the 100% Construction Drawings submission.

- Peak, Average Peak, & Design Peak outdoor dry and wet bulb temperatures for the heating and cooling seasons.
- Estimated loads of utilities.
- Fuel & Electrical use.
- The following Environmental Conditions for each space:
    - Wet & Dry Bulb, occupied and unoccupied.
    - Ventilation Requirements
    - Indoor Air Quality Requirements
    - Special Conditions such as humidity levels, noise/vibration sensitive areas, redundant life safety areas, etc.

Consultants shall provide the following the calculations during the schematic design phase. Final calculations shall also be submitted with the final project specifications.

- Heat Loss/Gain Calculations.

- Payback calculations for energy savings schemes.

The exterior design temperature shall be 0 degrees F.

Ensure that accessibility is maintained when designing equipment, piping, and ductwork.

Provide walk-around space and coil/filter pull space in all mechanical rooms. Show all coil/filter pulls on drawings.

Provide 100% outside air and exhaust for hazardous fumes and smelly fumes.

Do not locate rooftop equipment closer than 10 feet from roof edge where there is no parapet.

Provide concrete pads for all equipment.

All designs shall consider energy saving measures. Use Energy Star equipment where possible.

# MECHANICAL SOUND AND VIBRATION CONTROL

1. Design shall provide for a Noise Criteria rating in classrooms and laboratories of NC 35 or less.

# MECHANICAL IDENTIFICATION

1. Ductwork and piping shall have adhesively applied labels or plastic labels identifying service.

2. Aluminum nameplates or brass tags shall be used to identify all equipment.

3. All means of mechanical identification shall be coordinated with Bucknell's existing labeling system.

# MECHANICAL INSULATION

1. Insulation on exposed ductwork shall be rigid board type.

2. Insulation on exterior ductwork shall have several coats of mastic or PVC jacket.

3. Insulation on exterior piping shall have an aluminum jacket.

# BUILDING SERVICES PIPING

1. Victaulic piping is permitted in exposed areas, but not in concealed spaces. Seek owner approval before specifying any Victaulic piping.

2. Low pressure steam piping (15 psig) shall be ASTM A53 or A106, Schedule 40, Grade B, carbon steel. Pumped condensate and condensate from low pressure steam piping shall be ASTM A53 or A106 Schedule 80, Grade B, carbon steel. Inaccessible locations shall be welded to ASME/ANSI B31.1. For accessible locations, screwed pipe can be used for 2" and under but shall be welded to ASME/ANSI B 31.1 for piping greater than 2".

3. Underground steam piping shall be Schedule 40, ASTM A-53, Grade B, seamless or ERW carbon steel with mineral wool insulation, 10 gauge steel outer conduit, 1" minimum high temperature foam insulation, and high density polyethelene (HDPE) outer jacket. Underground condensate piping shall be Schedule 40 ASTM 312 Type 316L seamless stainless steel with mineral wool insulation, 10 gauge steel outer conduit, 1" minimum high temperature foam insulation, and high density polyethelene (HDPE) outer jacket. Underground chilled water piping shall be Schedule 40, ASTM A-53, Grade B ERW carbon steel with closed cell polyurethane insulation, 1.5" minimum thickness, and HDPE outer jacket.

4. Manhole piping shall be the same materials as underground piping. Piping shall be field insulated with Aerogel insulation or equal.

5. Wall sleeves shall be provided at all building and manhole entries to provide an effective moisture barrier. The space between the conduit and wall sleeve shall be made watertight by use of Link-Seal® pipe penetration seals or equal assemblies.

1. Steam piping gaskets shall be spiral wound with 316L winding filled with flexible graphite surrounded by carbon steel guide ring (e.g. Flexitallic).

2. Ball valves are preferred over gate valves at all sizes, for balancing.

3. No wafer type sandwich valves, butterfly or other, should be used. Lug type sandwich valves shall be used for ease of maintenance.

4. Valves 2” and larger shall be flanged, Class 150. Valves under 2” shall be screwed.

5. PVC piping is acceptable for sanitary sewer & storm drains.

6. PVC piping is not acceptable for heating pipe or tempered water pipe or any pressurized system.

7. Avoid ball joints on steam systems.

8. Flexible connections for pipe to equipment shall be stainless steel braids less than six feet in length.

9. Backflow preventers shall be provided on all new water and fire mains to buildings per PAWC requirements.

10. Provide isolation valves on all pieces of equipment and on branch piping. Isolation valves must also be able to be readily vented of any pressure, and to the extent possible, shall be lockable into either the open or closed position.

11. Combination isolation valves and other hydronic specialties are not acceptable.

12. Grooved end valves and hydronic specialties are not acceptable.

13. Provide bypass piping on critical service piping.

14. Provide water treatment as needed for specialized process or utility systems. Provide emergency eyewash and shower at all chemical treatment feed stations.

15. Provide protection of piping and duct work at job site. Temporarily seal ends.

16. Provide large elbow sweeps for piping from roof drains. Provide for overflow. Provide accessible cleanouts.

17. Domestic water, chilled water, steam, and gas meters shall be installed in all new construction or renovation work.

18. Install unions between ferrous and non-ferrous piping to prevent galvanic corrosion.

19. Steam traps shall have union or flanged connections at both ends and a strainer upstream with atleast a ¾" blow-off valve.

20. All systems shall be hydrostatically pressure tested to 1-1/2 times maximum design pressure or 100 psig, whichever is greater, and held at that pressure for 15 minutes.

# PLUMBING FIXTURES AND EQUIPMENT

1. Toilets shall be wall mounted where possible, and auto flush toilets are preferred in residence halls. Do not use automatic hands free faucets in residence halls.

2. Ensure adequate access chases.

3. Do not use automatic slow shutoff type faucets.

4. Do not use self-closing valves.

5. Provide sump pumps in occupied basement areas.

6. Tempering valves for domestic hot water heaters shall be at the hot water heater.

7. Do not use trap primers. Elephant trunk type trap primer alternatives such as Trap Guard are preferred.

8. Valves shall be lead free in order to comply with the 2014 Lead Free Act.

# HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

1. Provide split ductless system where advisable from an engineering standpoint, such as for spaces requiring extended cooling seasons or spaces remote from central AC. Provide for monitoring of space temperature.

2. Provide air conditioning with mini-split dx system for Electrical Wiring Closets.

3. The central chilled water system does not typically operate below 35$^{o}$ F outside air temperature.. Consider using direct expansion cooling for interior zones without windows that will have year-round load.

4. Provide economizer cycles, where feasible, to take advantage of free cooling.

5. Strainers shall be Y type except for heat pump systems, which shall be centrifugal type.

6. All heating systems shall be hydronic, not steam.

7. Provide automatic air vents at high points of systems.

8. Provide redundant operating and standby heat exchangers to assure system reliability.

9. Provide soft starts for large air handling units that have a large start-up power draw. Provide soft starts for all cooling towers.

10. Provide access to ceiling mounted fan coil units to permit filter changes and other maintenance. Filter return grilles shall be provided for units that are not readily accessible. Size drain lines appropriately to prevent clogging.

11. Cooling equipment shall have insulated drain pans with access doors.

12. Acoustic louvers shall be used on mechanical rooms.

13. Provide housekeeping pads and suitable vibration isolation.

14. HVAC for computer and server rooms or the like shall be designed to be a standalone system, not relying on chilled water and should be on emergency power.

15. Utilize variable speed drives where possible to control hydronic distribution and supply or return air fan speed to maximize control and energy efficiency. All hot water and chilled water control valves shall be 2-way.

16. Energy recovery units shall be evaluated on all exhaust systems to maximize energy efficiency.

17. Provide protection against freezing of cooling coils in air handling units. Consider providing freeze pumps or freeze prevention coils by Cooney Coil & Energy, Inc.

# AIR DISTRIBUTION

1. Provide galvanized steel ductwork for low pressure air supply, outside air, return air, and exhaust systems.

2. Provide aluminum ductwork for toilet/restroom exhaust, shower exhaust, and locker room exhaust. Flexible aluminum may be used for runouts to diffusers.

3. Insulated flexible duct may be used to connect to diffusers but shall be kept to a minimum, preferably not greater than 5 feet in length.

4. Direct drives are preferred on fans instead of V-belts.

5. When V-belts are used, provide cogged belts or a banded belt.

6. For laboratory exhaust, a manifold exhaust system is preferred instead of individual exhaust.

7. Exhaust fans for laboratories should be on emergency power.

8. Provide standoffs and locking quadrants on balancing dampers.

9. Provide protection of ductwork at job site. Temporarily seal ends.

10. Rapid entrainment type of diffusers are preferred. Avoid slot diffusers.

11. Duct access doors shall be provided at all coils, humidifiers, automatic dampers, fire dampers, balancing dampers, and other apparatus requiring service and inspection.

# HVAC INSTRUMENTATION AND CONTROLS

1. The University has standardized on Automated Logic Corporation (ALC) WebCtrl for all building automation systems on campus.

2. Color code wiring as per Bucknell specifications for all DDC wiring. ALL wiring shall be in conduit.

3. CO2 monitoring and control shall be provided in all public spaces with an occupancy of 50 or more. Demand controlled ventilation shall be implemented where applicable.

4. Building-wide humidity monitoring and control shall be provided on all projects. Zone humidity control shall be provided in spaces containing musical instruments, sensitive laboratory equipment, or other materials or equipment sensitive to humidity changes.

5. Occupancy sensors shall be provided in all classrooms, meeting rooms, and private offices and shall be considered in other public spaces as appropriate. Sensors shall set back zone temperature and air flow setpoints when spaces are unoccupied. When lighting systems are provided with occupancy controls, the design shall be coordinated to use one sensor for both HVAC and lighting control.

6. Monitoring and control points, as well as control sequences, shall conform to ASHRAE Design Guideline 36.

7. Provide surge suppression on DDC panels.

8. Provide discharge air temperature sensors on all terminal box units; i.e. VMAs, VAVs, CAVs, chilled beams, and reheat coils.

9. All new controls installations shall be integrated with the existing WebCtrl front-end.

10. Provide training for the University's personnel for proper operation of HVAC instrumentation and controls specific to each project.

11. Provide metering at the building level for each of the following as applicable:

    a. Steam, steam condensate, or hot water usage.
    b. Chilled water usage.
    c. Natural gas use (unless solely for emergency generator).
    d. Domestic water consumption.
    e. Electricity use. (Meter may be supplied by the electrical contractor.)

12. The BAS shall monitor both real-time demand and totalized consumption for each of the meters provided.

13. Chilled water meters shall be installed in the primary supply line to the building. Chilled water BTUs shall be calculated using the flow and primary supply and return temperatures. Temperature sensors shall also be installed in the secondary supply and return.

14. Chilled water flow control valve should be installed in the primary supply line. Flow will be controlled based on secondary supply water temperature.

15. Electromagnetic flow meters shall be used for steam condensate, hot water, and chilled water.

16. DP orifice meters shall be used to measure steam flow.

17. Turbine meters shall be used to measure natural gas and domestic water flow.

18. Electric meters shall be integrated with the BAS via BACnet or Modbus interface.

19. Electric sub-meters shall be provided for major mechanical equipment as appropriate. Sub-meter data may be provided from VFDs if applicable.

20. Consumption data shall reset to zero at midnight on the last day of each month.

21. All meter data shall be compiled and archived in an energy reporting software system.

22. All meter data shall be provided in the existing EcoScreen monitoring system.

# TESTING, ADJUSTING, AND BALANCING

1. Provide testing, adjusting, and balancing of air and water distributions, measuring electrical performance of HVAC equipment, setting quantitative performance of HVAC equipment, verifying automatic-control device functions, measuring sound and vibration, and providing written reports of testing, adjusting, and balancing.

# CAMPUS UTILITY SYSTEMS

1. The central utility plant supplies steam, chilled water, and electricity to the majority of campus buildings.

2. Steam leaves the central plant at a minimum pressure of 12.5 psig. Designers can assume a minimum pressure of 8 psig at any building entrance.

3. All steam condensate shall be recovered and pumped to the condensate return system. Manhole steam traps shall discharge to the nearest building's condensate recovery system. Traps shall not discharge directly to the condensate return system unless approved by Bucknell.

4. The chilled water system operates as a variable flow primary system. Secondary pumps are provided at each building interface with a decoupling bridge. Chilled water supply to the secondary pumps is regulated with a temperature control valve based on secondary supply temperature. Supply temperature setpoints are typically reset from 45 to 50F based on outdoor air temperature, outdoor air enthalpy, or cooling requests from the building systems.

5. Secondary chilled water flow should be varied based on system differential pressure.

6. Equipment shall be designed for a 12 degree minimum delta-T (45/57) at design conditions.

# DIVISION 16 – ELECTRICAL

## BASIC ELECTRICAL MATERIALS & METHODS

1. The Design Professional shall assure that NEC code required clearances are provided around all electrical equipment.

2. Provide ground conductor in all feeders and branch circuits.

3. Select equipment with minimal sound and vibration. The sound and vibration shall not be noticeable outside the room containing the equipment.

4. Electric rooms and closets shall not share space with storage, custodial, or telecommunications.

## HANGERS AND SUPPORTS

1. All electrical equipment shall have seismic supports in accordance with the latest IBC requirements.

## ELECTRICAL IDENTIFICATION

1. Provide nameplates, labels, and wire markers containing white letters on black backgrounds for all equipment, loads, and control enclosures.

2. Bucknell University has standard letter sizes for various labeling applications, and the information will be provided.

3. All electrical equipment shall be labeled in accordance with NFPA 70E.

## CONDUCTORS AND CABLES

1. All 15 kV feeders shall be installed in 5” PVC ducts encased in concrete.

2. Bucknell University has a standard on 15 kV cable and will provide catalog information as needed.

3. All high voltage 15 kV terminations shall be as manufactured by Elastimold or Copper/RTE.

4. The use of metal-clad MC type cable shall be limited and must be less than six feet in length.

5. Bucknell University has specific wire color requirements based on wire size, conductor application, and phase identification. The color requirements will be provided.

# RACEWAY AND BOXES

1. Conduit shall be ¾" size minimum.

2. Provide rigid conduit in supported slabs with the maximum conduit diameter not exceeding 1/3 of the slab thickness. Provide schedule 40 PVC under slabs on grade with rigid metal elbows at stubs.

3. No surfaced mounted conduit shall be provided in finished areas.

4. Flexible Conduit is permitted for the connection to equipment only, and the maximum length shall not exceed six feet. Liquid tight type conduit is required at all exterior, wet, or corrosive areas.

5. Sleeves shall be rigid metal and capped if not used.

# WIRING DEVICES

1. Convenience nylon receptacles shall be ivory color 20 ampere 120/277 VAC.

2. All wiring devices (switches and receptacles) shall have nylon or lexan coverplates.

3. Switches should be ivory colored toggle type 120/277 VAC.

4. Receptacles shall be placed at all landings in stair towers.

# MOTORS AND GENERATORS

1. Bucknell University prefers that all generators be installed outdoors.

2. Care should be taken to assure that exhaust fumes are vented properly.

3. Generators shall be designated primarily for life safety loads only. As a minimum, this includes exit and egress lighting and fire alarm systems. As a secondary consideration, generators shall also serve stand-by loads such as minimal heating system equipment, sewage pumps, fume hoods and controls, elevators, large walk-in type coolers, and critical computer systems and data closets.

4. The reliability of fuel sources shall be evaluated per the requirements of NFPA 70 (NEC). Preferred fuel is natural gas.

5. Transfer switches shall be installed within generator rooms.

6. Bucknell University wants to evaluate connection for portable generators for future buildings.

7. All generators shall be air cooled.

8. Adequate burn protection must be provided on generator exhaust piping.

9. When silencers are chosen, surrounding buildings and environment must be taken into consideration.

10. Acoustic louvers should be used on generator rooms.

11. Suitable vibration isolation should be provided for generators.

12. Provide housekeeping pads and vibration isolation under generators.

13. Ensure that generator exhaust does not short-circuit back into air intakes.

# TRANSFORMERS

1. All transformers shall be placed outdoors. The transformers shall be liquid filled pad mounted on a precast concrete vault.

# LOW-VOLTAGE DISTRIBUTION

1. The Design Professional should evaluate installation of surge suppression on all buildings. Suppression should be a cascaded arrangement for all buildings having a heavy usage of electronic equipment. Surge suppression shall be provided on all lighting panels with electronic ballasts.

2. Panelboards shall utilize bolt-on circuit breakers (Square D only). 25KA min.

3. All panelboards shall receive typed circuit directories.

4. Panelboards shall be sized to provide 30% spare capacity after installation of all new and re-fed circuits.

5. Branch circuit shall NOT share common neutrals.

6. All wiring shall be contained in a raceway.

# ENCLOSED CONTROLLERS

1. All motor controls shall include hand-off-automatic selector switches and pilot lights.

2. Motor circuit protectors shall provide short circuit protection for motor circuits.

3. Provide VFD motor starters for cooling tower fans and larger sized motors.

4. Design Professional shall evaluate the use of variable frequency drives (VFD's) on motors based on type of loads, frequency of starts, controls, etc.

5. Power Factor correction is not required on motors since it exists on the main substation.

# LIGHTING

1. Assure that all fixtures are accessible for relamping. Prime consideration should be given to accessibility in atriums, high ceiling areas, and outdoors.

2. Voltage for lighting systems is not standardized, and should be determined by building voltage.

3. LED lighting shall be standard for all locations.

4. Fluorescent lighting fixtures should utilize electronic ballasts with <10% THD and 4100K type T-8 lamps.

5. Conference rooms should be designed with dimmable LED downlights.

6. Lighting design levels should be in accordance with the recommendations of the Illuminating Engineering Society of North America.

7. Avoid use of emergency battery pack units for emergency lighting.

8. Exit signs should be provided with LED's.

9. Dimmer switches should be linear slide type.

10. Low mercury lamps shall be used for lighting fixtures.

11. Contractor shall be responsible for disposing of old lamps and ballasts removed as part of Contractor's work. Disposal shall be in accordance with regulations of the Environmental Protection Agency. Contractor shall provide Bucknell University with written documentation giving evidence of proper disposal.

# DIVISION 17 – INFORMATION SERVICE RESOURCES

## DATA COMMUNICATIONS

The design criteria for Data Communications will be provided by Information Service Resources and Learning Spaces at Bucknell University. The requirements and standards change frequently as new technology is developed. The latest information will be made available to the designer via the Construction and Design Group Project Manager. The work related to this section includes (but not limited to) the furnishing and installation of cabling, jacks, terminal blocks, and terminations. The work also includes the layout, wiring, and equipment in the Intermediate Distribution Frame Closet and the Main Distribution Frame Closet.

Please reference the technical specification section 17100 for all telecommunications criteria.

General guidelines are listed below:

1. Each wireplan shall consist of four light blue jacket, category 6, 4 pair, 24 gauge, 100 ohm wire.

2. The four wires in the wireplan will be terminated with approved jacks on 110 blocks in the communications closet. The top jack will be used for voice/CATV and the bottom for data.

3. Bucknell University must give approval for the reuse of any existing cables, conduit, and raceway.

4. All communications cabling used shall comply with the requirements of the National Electric Code Articles 725, 760, 770, and 800 as well as the appropriate local codes.

5. All cables shall be run in conduit. Wire trays are acceptable in corridors above A.C.T.

6. All cables, pull boxes, and conduits must be labeled at both ends with Bradymarker Labels.

7. Bucknell University requires that the cable lengths do not exceed the requirements listed below for each component:

| | | |
|---|---|---|
| A. | Ethernet Cable | 3 meters |
| B. | Station Cable | 80 meters |
| C. | Cross Connect/Equipment Cable | 7 meters |

# FIBER OPTIC CABLE

1. A tracer wire shall be installed with all underground fiber optic cable. Provide single conductor #10 AWG solid copper tracer wire with an orange jacket over PVC insulation. The tracer wire shall be pulled in the same conduit as the fiber.