NORTHERN ARIZONA UNIVERSITY

DESIGN GUIDELINES

VOLUME FY17, VERSION 1
MAY 1, 2017

CREATED AND MANAGED BY NAU FACILITY SERVICES

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INTRODUCTION

The Purpose of This Manual

Refer to the Introduction and User Guide for the Design Guidelines and Technical Standards for more information.

Advice to the Design Professionals

1. Ask Questions

Although the Design Professional (DP) team was chosen as best suited to the project, this may be the first project of this particular building type the DP team has undertaken at Northern Arizona University (NAU, Owner). Time spent in researching the goals NAU has in mind with the project, familiarity with campus infrastructures, how and why design was handled in a particular way on a similar project, and familiarity with the campus and user group structure prior to the beginning of architectural programming, will be invaluable to the design team. The Facility Services Project Manager assigned the responsibility to lead this project on behalf of NAU is your single point of contact for the project.

2. Communication Ground Rules & Documentation

- Under no circumstance should verbal approval be accepted or given. Any inquiry or direction that potentially affects project scope, budget, schedule or the Design Professional's compensation shall be made in writing and responded to in kind.
- Assume nothing. Assumptions made by DP team without written clarification in the form of letters, meeting minutes, sketches or written telephone conference logs will promote misdirection, miscommunications, design errors and subsequently lost time. It is the DP's responsibility to ask for and receive clarification, and have this information memorialized by way of a Project Authorization, before any work is to commence.
- Direction, approvals, clarifications, etc. that do not originate or go through the Project Manager, no matter what the lever or area, are not acceptable and are not binding, and will be at the expense of the DP.

All questions and communications regarding this project, the user group or the University must be coordinated through the Owner's Project Manager. This is the established project protocol, and will be further detailed to you by the Project Manager. It is the project manager's responsibility to answer, or direct the DP to those that can answer specific questions regarding any topic connected with the project in a timely and professional manner.

3. Contingencies

Some Design Professionals may be under the impression that project contingencies (design, construction and inflation) are for the use of design "extras". This is an erroneous and dangerous impression. Owner's contingencies are to be used at Owner's discretion.

4. Expectations

The Design Professional is required to be within the particular design phase budget, and if the project estimate at the completion of a particular phase indicates the design is over budget, the team will not gain the approval necessary to enter into the next phase. The team will then be required to expend the necessary time and effort to be within that budget, at the Design Professional's expense.

The further over budget the design is, the more time and effort will be required to bring the project within the budget. This is time that will not be compensated. It is therefore in the best interest of the Design Professional to obtain the highest degree of detail appropriate to all phases of design, to recognize all cost ramifications to particular design intent, and avoid promotion and pursuit of design elements that can neither be justified by the program nor afforded by the particular phase budget.

It is the Owner's expectation that by following the guidelines, procedures and advice as presented in this manual, the Design Professional will produce a design that not only meets program, budget and schedule, but also achieves a quality of design excellence.

There are principles of design that are thematic through the Design Guidelines and Technical Standards. It is advised and expected that Design Professionals consider these, as well as other industry standard design principles when working on NAU projects:

a. Design Aligns with the Campus Context
   Does the design of the space align with the campus master plan, academic master plan, landscape master plan, enterprise goals, and university mission? Does the design look like it belongs on the NAU campus, or does it stand out as different?

b. Planning and Design Process
   Ensure participation in the design process and build consensus and support with Owner's staff, which includes Facility Services personnel, as well as the user groups and other key stakeholders.

c. Support and Operations
   Consider not just the initial design and construction of a space, but also the follow-on support and maintenance required. The Technical Standards are an invaluable resource for design consideration of facility operations.

d. Environmental Quality
   Owner's spaces are heavily occupied, with some users spending long periods of time in the spaces. As such, they shall address human needs that go beyond the obvious components like technology and furniture. For example, consider the distractions of a

room that is too cold, has flickering lights, or provides uncomfortable furniture that doesn't encourage collaborative work.

e. Layout and Furnishings
A successful space design anticipates not just what the occupants will be using but also how they will be using it. This includes considerations such as movement paths through the space, seating density, reconfigurability of the room, visibility of learning activities (if a classroom environment), and comfort of the furnishings.

f. Tools and Technology
Some technologies are foundational to a design, such as adequate electrical power or sufficient network capacity. It is critical to consider not simply how advanced technology is, but rather whether it is truly capable of supporting the anticipated activities for the space.

g. Innovation
NAU has specific design guidelines and technical standards, but innovation is still necessary. Think outside the box to solve design challenges and enhance a space's functionality.

h. Safety
Safety is paramount on a campus. Crime Prevention Through Environmental Design (CPTED) is a methodology that directly addresses the relationship between the physical environment and the incidence of crime. The following guide is a resource for understanding and using crime prevention through environmental design as a problem-solving tool: http://www.popcenter.org/tools/pdfs/cpted.pdf. Design Professionals must create a building design that inhibits people from self-harm (suicide prevention).

These principles are adapted from a 2015 Educause article by Malcolm Brown, located: http://www.educause.edu/ero/article/seven-principles-classroom-design-learning-space-rating-system.

PROJECT TEAM / STAKEHOLDERS

The NAU Facility Services Planning, Design and Construction (PDC) department manages Owner's projects. The Director of Planning, Design and Construction will assign a Project Manager responsible to manage each project. Several NAU Departments may also be involved in a project, with different roles and responsibilities. The Design Professional and the Contractor, along with Owner's Project Manager, shall ensure that all applicable Owner departments are consulted throughout the project.

Below are the different Owner departments that shall be involved in every project's design and construction, with a brief description of their responsibilities. These groups will participate in the Plan Review process prior to issuance of a Building Permit.

1. NAU FACILITY SERVICE PLANNING, DESIGN AND CONSTRUCTION GROUP

Owner Project Manager

The Project Manager, referred to as "NAU PM", "Owner PM", or simply "PM", guides each project from planning through project close out and warranty. The Owner PM works with the user groups, Facility Services Operations department (Trades), and Contractor to review the DP's work for compliance with program requirements, schedule, budget, and for conformance to required codes and NAU standards and procedures.

The Owner PM is the direct contact for the DP, Contractor, and other project consultants once the project has completed programming. After project programming is complete, all project work, information, and correspondence is directed to the Owner PM. The Owner PM is the liaison for the user group as well as other NAU departments. The Owner PM is also responsible for monitoring project activities during design and construction through occupancy.

The responsibilities of the PM include, but are not limited to, the following:

a) Ensures the appropriate development and conformance of the project to the program, budget, schedule, and Design Guidelines and Technical Standards.
b) Manages all meetings between NAU user groups, DP, and Contractor after project programming.
c) Recommends approval of all payment to DP and Contractor.
d) In conjunction with Owner's Contract Administrator, develops the contract for construction.
e) Manages the negotiation for a Guaranteed Maximum Price (GMP) with Contractor, if applicable.
f) Manages the construction contract.
g) Evaluates the DP and Contractor performance for construction phase.
h) Manages the entire project budget, including Contractor's fees, Design Professional's fees, additional vendors' fees, and Owner's contingencies.

i) Manages warranty issues.

Administrative Staff

The PM is supported by administrative staff, including the contract administration staff, project assistant, and interns.

2. **NAU FACILITY SERVICES UTILITY SERVICES**

The Director of Utilities shall be consulted for:

a. Location of existing utilities
b. Location of point of connection for any new utility
c. Coordination of any new utility layout
d. Optimization of building orientation on proposed site based on energy modeling
e. Review of proposed mechanical systems
f. Review of all energy modeling
g. Submittal to ACC (Arizona Corporation Commission) for Natural Gas scope of work

3. NAU FACILITY SERVICES OPERATIONS AND MAINTENANCE

Facility Services Operations and Maintenance is responsible for all NAU physical facility maintenance and operational activity, and therefore has a vested interest in the maintainability and long term of operational cost of every physical addition to the NAU campus. The Operations and Maintenance department is comprised of several subdepartments, known as "Trades", which include: Electrical, Paint, HVAC, Building Access Services, Plumbing, Landscaping and Outdoor Services, Custodial, Carpentry, and others. These Trades are responsible for the inspection of construction work.

During the plan review process, Trades will assist in the plan review effort by asking questions and providing comments regarding longevity, maintenance requirements, accessibility of construction materials and building systems.

4. NAU FACILITY SERVICES ENGINEERING

NAU Plan Record/Vault

Facility Services has the responsibility to keep all documentation related to the University's past projects, regardless of size and importance. All Construction Drawings, Specifications, RFI, ASI, Submittals, Shop Drawings, As-Built Drawings, Owner's Manuals, etc… are kept on record at Facility Services. The documentation kept by NAU Facility Services is only as good as the documents provided to Owner at completion of a project. NAU encourages all DP and Contractors to be vigilant when it comes to the closeout process and ensure that complete and accurate documentation is provided for record keeping. Payment from Owner may be withheld until all documentation is received.

Building Officials

Facility Services includes in its organization the NAU Fire Marshal and the NAU Building Official, which is the Authority Having Jurisdiction, both in charge of verifying that all projects meet all applicable codes as adopted by Owner. Combined together, they have authority to perform plan review, issue construction permits, perform field inspections and issue the Certificate of Occupancy prior to the Substantial Completion Certificate is issued by NAU PM in conjunction with the DP.

The Owner issues construction permits and Certificates of Occupancy, depending on the scope and size of the project. Coordinate with Owner (Project Manager and Building Official) to confirm if this project will be subject to issuance of a construction permit and a Certificate of Occupancy.

5. NAU USER GROUPS

The NAU User Groups are those colleges, organizations or departments that will be the actual occupants or the direct beneficiaries of the project. User groups can be compromised of several colleges, organizations or departments, students, or a single uniform group. The User Group acts in an advisory and informational capacity to the Design Professional regarding programming/design function and space parameters.

6. NAU POLICE DEPARTMENT

This group must be consulted when a project affects any campus pedestrian or vehicular circulation and use patterns.

The responsibility of this department is to review the project for:

a. Photometric levels at parking lots, parking structures and access paths to buildings.
b. Security systems and reporting to NAU PD.
c. Site design for safety, including camera locations, blue phone locations.
d. Pedestrian and vehicular access, flow, density, direction on campus.
e. Traffic study as applicable.
f. Any proposed traffic changes, scope changes that might impact circulation on campus.
g. Any proposed new or altered pedestrian crossways.
h. Any proposed new street lights or street signs.
i. Approval of the site logistic plan prior to start of construction.
j. Traffic control plans during construction.

NAU PD shall review and sign-off on the site plan (from the DP) prior to design completion and site logistics plan (from the Contractor) prior to start of construction thru Owner's formal plan review process. The DP is responsible for submittals and incorporation of any comments received regarding the site plan. The Contractor is responsible submittals and incorporation of any comments received regarding the site logistics plan.

Owner (Project Manager) may schedule a meeting with NAU PD and Fire Marshal to ensure that all emergency response parties are familiar with access to the construction site.

7. NAU PARKING & SHUTTLE SERVICES

This group must be consulted when a project affects any parking or bus routes on campus, either on a permanent or interim/temporary basis.

This group shall review and sign-off on the site plan prior to design completion and site logistics plan prior to start of construction thru NAU Facility Services formal plan review process.

The DP is responsible for submittals and incorporation of any comments received regarding the site plan. The Contractor is responsible submittals and incorporation of any comments received regarding the site logistics plan.

8. NAU EQUITY AND ACCESS OFFICE

Facility Services has signed a memo of understanding with the Commission for Disability Access and Design (CDAD). A CDAD representative will review the project for ADA Compliance. The DP is responsible for submittals and incorporation of any comments received during the design review.

9. NAU ITS AND TELECOMMUNICATIONS

Information Technology Services (ITS) and Telecommunication encompasses all voice and data communication and transmission design for NAU. ITS and Telecom reviews and assists all project design engineering regarding telecommunications and data for conformance with NAU standards. The DP is responsible for submittals and incorporation of any comments received. If required, this group will advise the DP in the design phases regarding NAU telecommunications and data interfacing, serviceability and maintenance. In regards to server rooms, for new construction or major renovations, DP shall not design new server rooms.

10. ARCHITECTURAL REVIEW

Content under development. Consult Owner (PM) for requirements on a per-project basis.

11. OTHERS

Every project is unique. Occasionally, there may be the need to involve other groups into the project team/stakeholders. This may include the City of Flagstaff, Coconino County, other ABOR institutions, etc.

DESIGN GUIDELINES

1. CAMPUS MASTER PLAN AND ARCHITECTURAL DESIGN

1.1. Overview

In 2010, NAU contracted with Ayers Saint Gross as the Design Professional to update the Campus Master Plan. The development of this Plan involved Owner's stakeholders, as well as the City of Flagstaff's community. It is expected that any Design Professional working for Owner will be familiar with the 2010 Campus Master Plan.

Northern Arizona University Campus Master Plan is available online:
http://nau.edu/uploadedFiles/Administrative/Finance_and_Administration/Facility_Services/Folder_Templates/2010_MasterPlan.pdf

In 2015, NAU contracted with WLB Group as the Design Professional to prepare a Landscape Master Plan. It is expected that any Design professional working for Owner will be familiar with the 2015 Landscape Master Plan. It is available online at:
https://nau.edu/uploadedFiles/Administrative/Finance_and_Administration/Facility_Services/Documents/DP_Contract/2015%20Landscape%20Masterplan%20Final.pdf

1.2. Basis of Design

All structures are to be designed with a useful lifetime of 100 years. A low cost design approach in areas that cannot be "seen" undermines the philosophy of building at NAU, and in the end, is usually much more costly in maintenance and in remedial corrective action. Every effort should be taken by the DP to properly specify and detail masonry veneers, applications, joints and fastening systems to protect against moisture infiltration, efflorescence, cracking and the resulting excessive maintenance caused by improperly designed masonry wall systems.

1.3. Materials Palette

Brick masonry construction is the preferred method for a majority of buildings on campus. Brick will be selected during project design.

Masonry is a prominent part of the built environment at NAU. A materials palette was established for use for all new construction as part of the campus master planning. Materials included in the palette are the only materials allowed for use in the exterior of all new buildings and renovations. Brick, sandstone and stone veneer are the masonry elements described and shown in the master plan.

Glass block is specified for day lighting and insulated light transmission for open public space lighting and private or semi-private applications. In all cases, maximum translucency is desired but applications where modesty is required (such as restrooms) or in applications that benefit

from natural light without visual or physical noise (such as administrative offices), special glass block finishes are necessary.

Smooth faced block to transmit the most light and allow visibility is suggested for public spaces where privacy is not required. Design Professional should specify smooth clear faces that maximize solar collection and visual clarity or designs that do not compromise light transmission are preferred. Block that has a non-directional pattern or creates a distortion will provide the best privacy. Select a block that maximizes transmission and still provides privacy.

Reliance on "after-the-fact" material selections to compensate for a problematic design decision is unacceptable.

1.4. Thermal and Moisture Protection

1.4.1. General

The success or failure of the moisture protection concept is determined at the very outset of the design process.

The DP is expressly responsible for incorporating overall requirements into the project, and for ensuring that its sub-consultants are aware of the requirements and incorporate them into their designs as well. See Division 7 for more detail.

Building renovation design shall remove / relocate conduit, piping and equipment off the roof to limit roof penetration and obstructions.

The DP shall review the proposed roofing system early on (design development) with a considered manufacturer or installer of the system(s) for insights and suggestions that could alter the approach in mind.

1.4.2. Below Grade Spaces

Below grade spaces are high-risk, expensive designs. Wherever possible, avoid:

- The use of finished below grade spaces requiring drainage systems and wall waterproofing.
- Planters above or adjacent to basement areas

Owner actively discourages below grade elements in its projects. Designs incorporating below grade finished spaces will receive the strongest scrutiny during the programming and conceptual design phases. Be prepared to thoroughly document the unavoidable need for such elements.

Depending on the nature of the soil (refer to Soil Report), moisture contained under the slab, concrete mix design specified for slab-on-grade and type of flooring specified above slab, the DP shall analyze the need for an impermeable moisture barrier under slab-on-

grade and provide a written report presenting all findings and recommending which moisture prevention system should be used for the project.

1.4.3. Traffic Decks

Owner actively discourage use of traffic bearing decks in its projects. Designs incorporating horizontal traffic decks will receive the strongest scrutiny during the programming and conceptual design phases. Be prepared to thoroughly document the unavoidable need for such elements. Failing such documentation, the Design Professional will be directed to revise or even start completely anew the design.

Special attention should be given to ensure that all horizontal traffic surfaces provide appropriate slip resistance, and provide adequate moisture protection and drainage from its surface.

1.4.4. Roof Design

1.4.4.1. General

The DP shall coordinate with Owner's Project Manager and Trades to determine the appropriate roofing system based upon project budget and goals.

The following are the preferred roof systems:

- Sloped roof with standing seam metal roof
- Sloped roof with asphalt shingles
- Flat roof with thermoplastic membrane roofing

Any other roof systems will be subject to high scrutinizing scrutiny to ensure that the interest of the Owner in terms of Life Cycle Cost analysis, maintenance and longevity are achieved.

Any of the above roof systems should alsoshall incorporate sufficient insulation layers to provide an R-value to meet ASHRAE 189.1 standards, either below or above deck.

Do not design roofs which are intended to serve as walking surfaces for user functions. Activities which must be conducted on the roof top (e.g. astronomical or weather observations, greenhouses, etc.) will require a design which incorporates platforms, penthouses or similar special enclosures.

Similarly, do not design roofs which are required to be used as working platforms for maintenance of mechanical and electrical equipment. Enclose such elements in a penthouse.

Any mechanical or electrical equipment which must be installed on the roof must be installed on either a prefabricated curb or a field fabricated platform. Where the top surface of such curbs and platforms is not completely covered and waterproofed by the actual equipment, the top surface must be a solid sheet metal cap. Design must meet OSHA workspace and fall precaution criteria.

Avoid use of conduit and piping installed on top of the roof.

No Electrical or Mechanical Equipment on the roof.

Combine roof penetrations (exhaust ducts) wherever possible to minimize roof penetrations.

Installation of any type of roof top mechanical or electrical equipment on sleepers is not acceptable.

Wherever possible, make the basic roof slope, and the slope of the crickets to the drains, part of the structural system (slope the structure). Avoid as much as possible thicknesses of roof insulation greater than 2" to create a roof slope.

By sloping the structure, it will be possible to eliminate use of lightweight concrete fill altogether.

Dead flat roofs are not acceptable.

Design for a slope of 1/4" per foot, throughout the field of the roof and for all crickets, at the time of construction. Ensure that anticipated deflections and proposed cambers will result in a minimum slope of 1/4" per foot throughout the life of the facility to guarantee positive drainage.

Space drains so that slopes in cricket valleys are at least 1/8" per foot.

Provide metal or 2x4 wood framing and sub-framing for large crickets. Cricket surfaces must be able to accept live loads similar to those of the basic roof deck.

Small cricket up-slope of equipment curbs must maintain 1/8" per foot slope in their valleys, and may be fabricated of tapered insulation, not to exceed 4" thick.
Do not assume that base flashings and counter flashing can be successfully nailed into concrete or masonry. Provide a 3/4" plywood nailer at all parapets.

When possible, provide positive overflow drainage, preferably with a scupper through the parapet wall to daylight, or with a complete separate parallel overflow drain system daylighting.

Design all roof drains and overflow drains in a depressed sump.

1.4.4.2. Roofs and Snow

Roof design shall accommodate a snow load of minimum 40 lbs/sf.

Provide snow drifting analysis from a structural engineer to accommodate increased snow loads at areas where snow accumulation due to drifting might exceed the 40 lbs/sf of minimum required snow load.

Design roof and overhang to prevent formation of icicles. Provide protection for areas susceptible to icicle damage.

Roof drains should be design for the anticipated roof rain load. Design/calculations shall be done by the Design Professional to determine the size, location and quantities of roof drains.

Roof drains shall be provided with leaf screen at the top.

Design all roof drains and overflow in a depressed sump. Use #4 lead for roof drain sump pans.

Do not use exterior roof drains without the specific permission of Owner (both the Project Manager and Roofing department). Exterior roof drains should be at least 4 inches in diameter and shall have heat tape all the way down.

Interior roof drains are preferred, with heat tape down into the roof drain leader at least 3’-0” below roof. Installation of heat tapes at roof exposed to sun shall be evaluated on a case-by-case basis, with final determination in concurrence with Owner.

Gutter system should be seamless type 24 gauge minimum. Only non-corrosive fasteners, same material as metal being fastened. If straps are used, use #8 screws (min.).

Ensure that the design makes adequate allowance for proper flashing of perimeters and penetrations. Sufficient vertical dimension to install the cant strip, base flashing, counter flashing, and coping, will result in a parapet at

least 18" above the finished roof at the highest point of the roof slope. Include a specific detail in the construction documents. This includes:

- Parapet walls
- Partial roof structures
- Equipment curbs and platforms
- Door and window sills

1.4.4.3. Re-roofing

Design the project to allow for one complete re-roofing without removal of the existing roof system, should the Owner decide to do so. This includes:

- Structural load capacity
- Camber and deflection
- Parapet heights
- Joints, drains, and flashings

Re-roofing must comply with the requirements for new installations as much as possible. The DP is responsible for preparing complete details and specifications for the required reroofing work.

Roofing repairs (e.g. installation of a new exhaust fan), must comply with the requirements for new installations as much as possible. The DP is responsible for preparing complete details and specifications for the required repair work. Generic notes such as "flashing as required" are not acceptable.

On existing re-roofing project, verify if the existing flat area is asbestos containing and if so, it shall be removed from roof deck by Owner-appointed abatement contractor. The roofing contractor will be responsible for coordinating with Owner and abatement contractor to dry in all exposed area the same day.

1.4.5. Envelope Design (ASHRAE 189.1 Climate Zone 5 Recommendations)

All new Buildings shall be designed for LEED in accordance with the design contract, with an emphasis on building envelope efficiency to promote energy reduction.

In climate zones 2 through 8, as defined by the US Department of Agriculture, the recommended construction is standing-seam roofs with two layers of blanket insulation. The first layer is draped perpendicularly over the purlins with enough looseness to allow the second insulation layer to be laid above it, parallel to the purlins.

Through-fastened metal roofs are screwed directly to the purlins and have fasteners that are exposed to the elements. The fasteners have integrated neoprene washers under the heads to provide a weathertight seal. Thermal spacer blocks are not used with through-

fastened roofs because they may diminish the structural load carrying capacity by "softening" the connection and restraint provided to the purlin by the metal roof panels. To meet the performance recommendations of this standard, through-fastened roofs will generally require insulation over the purlins in the conventional manner, with a second lay of insulation added to the system. The second layer of insulation can be placed either parallel to the purlins (on top of the first layer) or suspended below the purlins.

ASHRAE 189.1 Envelope Energy Efficiency / Thermal Performance Factors, see below:

Item	R-Value	U-Value
Roof Insulation	R-25 Continuous R-49 Attic	
Wall	R-13 Cavity + R-10 Cont.	
Fenestration Assembly		U-0.4 wood vinyl, Fiberglass frame U-0.4 Curtainwall U-0.45 Other Metal SHGC-0.35 (Solar Heat Gain Coefficient)
Overhang: Projection Factor = A/B	A=overhang B=opening height under overhang	

1.4.6. Dampproofing and waterproofing

Proper architectural design and detailing of areas exposed to moisture should not rely solely on such treatments as the only barrier to moisture, but rather as a "guarantee" or "second line of defense", in other words, the design and specification of appropriate materials should in itself greatly mitigate a majority of moisture infiltration problems.

The DP should review foreseeable methods and procedures relating to waterproofing materials early on (design development) with a considered manufacturer of the product(s) for insights and suggestions that could alter the approach in mind.

1.4.7. Thermal Insulation

This section applies to all constructed building vertical and horizontal surfaces that are thermal barriers to the environment and also inclusive of demising partitioning acting as acoustical barriers. Owner's goal for all new and renovation projects is a substantial reduction in energy usage, both campus wide and building specific. All effort should be focused to mitigate thermal and acoustical factors through proper architectural design, detailing, orientation and adjacencies, and utilize applied insulating materials as a further enhancement to the composite performance of the design rather than the sole means of obtaining the desired performance.

Attics and other roofs include roofs with insulation that is entirely below (inside) the roof structure (attics and cathedral ceilings) and roofs with insulation both above and below the roof structure. If attic space is ventilated, provide tempered air and exhausting. Ventilated attic spaces need to have the insulation installed at the ceiling line. Unventilated attic spaces may have the insulation installed at the roof line. When suspended ceilings with removable ceiling tiles are used, the insulation needs to be installed at the roof line. For buildings with attic spaces, ventilation should be provided equal to 1 sq. ft. of open area per 100 sq. ft. of attic space. This will provide adequate ventilation as long as the openings are split between the bottom and top of the attic space. Additional ventilation can further improve the performance of the building. In accordance with ASHRAE Standards, Flagstaff is located in Climate Zone #5. In climate zones 2 through 8, the recommended construction is standing-seam roofs with two layers of blanket insulation. Where R-38 rigid insulation is provided, it shall be provided as 2 layers of blanket insulation held in place with steel banding spaced 30” o.c.

1.4.8. Exterior Insulation and Finish Systems

This section applies primarily to exterior insulation and finish systems that would be considered as the "secondary" skin treatment to a building, soffits, mechanical screen walls, infills, etc. The term "secondary" is used to refer to as Owner's desire for brick masonry to be used as the "primary" skin material.

Exterior insulation and finish system (EIFS) is a barrier exterior finish system that combines insulation qualities with a durable and aesthetically adaptable finish, but the main concern that has developed with EIFS is that water might get behind the barrier system and remain trapped.

When designing an EIFS, DP shall ensure that the materials selected and the wall section details will:

- Eliminate the possibility of water entry into the system;
- Provide an exit for water or moisture.

In Northern Arizona, where freeze/thaw cycles are very frequent, with high temperature differential between low and high, it is imperative to use materials with high flexibility that will not crack when submitted to the many temperature changes characteristic of the climate. Such system would be referred to as “modified” or “drainable” Exterior Insulated Stucco System. Specify primary products as produced and supplied from a single manufacturer, which has produced that product successfully for not less than 5 years.

Concrete masonry units are preferred as the backing material, however if budget and/or design considerations deem this inappropriate, fiberglass reinforced gypsum/Portland

cement ("Dens Glass" panels, 3/4" thick, over structural steel studs, and with a waterproof membrane is an acceptable substrate).

Composite panels of expanded polystyrene with a minimum composite R value of 20 mechanically attached to the back-up system.

The composite finish system shall consist of heavy duty glass fiber reinforcing (adjacent to any area of pedestrian traffic, to a height of 8'-0" above finish floor), synthetic elastomeric primus layer, minimum 3/8" thick and a elastomeric synthetic finish layer, minimum 1/16" thick. Type PM System is highly preferred (Polymer Modified System, in which the mesh is mechanically attached to the foam and substrate). Use Type PB system (Polymer Base System, in which the mesh is adhesive, applied to the foam) only with specific permission of the Owner.

Consider alternative exterior cladding systems in areas where the finish may be subject to physical abuse. Indicate all required expansion, control, and design joints on the drawings. DP shall provide all flashing details and installation details on final construction documents.

NOTE: DP shall present a detailed system evaluation to Owner, including the Project Manager, Paint department, and Carpentry department.

1.4.9. Vapor Retarders

The building envelope is a key element of an energy-efficient design. Compromises in assembly performance are common and are caused by a variety of factors that can be easily avoided. Improper placement of insulation, improper sealing or lack of sealing around air barriers, incorrect or poorly performing glazing and fenestration systems, incorrect placement of shading devices, and misinterpretation of assembly details can compromise the energy performance of the building.

The building envelope should be designed and constructed with a continuous air barrier system to control air leakage into or out of the conditioned space. An air barrier system should also be provided for interior separations between conditioned space and space designed to maintain temperature or humidity levels that differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions.

If possible, a blower door should be used to depressurize the building to find leaks in the infiltration barrier.

1.4.10. Fire and Smoke Protection

The use of spray applied fireproofing is prohibited unless all other methods of fire protection (above ceiling sprinkler systems, plaster enclosure, troweled application, etc.)

are found to be unfeasible. DP must receive approval prior to the Design Development Phase Submittal.

Fireproofing systems which are part of a renovation project (e.g. repair of damaged or missing systems, or removal and replacement of existing systems) should follow these standards. Existing fire resistance ratings must not be compromised. The consultant DP must prepare a complete specification and details for the required repair work. Generic "repair fireproofing as required" notes are not acceptable.

1.4.11. Smoke Containment Barriers

Smoke containment barriers such as automated fire curtains are highly discouraged due to lack of reliability, frequent operating issues and higher maintenance requirements encountered on previous projects.

DP shall incorporate smoke containment barriers in the design in such ways that minimize the use of any moveable barriers.

The preferred smoke containment barriers is a solid wall (gypsum board on metal studs or masonry) with doors kept open using magnetic door holders tied to the fire alarm system.

1.4.12. Sealants and Caulking

Due to the Freeze/Thaw cycles in Northern Arizona, DP shall minimize the use of caulk joints in design.

Pay particular attention in sealant system design to expected joint movement, joint dimensions, sealant position (horizontal, vertical, or overhanging), and potential for physical abuse of the sealed joint.

1.5. Finishes

1.5.1. Tiling

Tile color and patterning should be clearly indicated by a sample and a colored sketch or plan and elevation at the final schematic design presentation.

1.5.2. Acoustical Ceilings

Careful design consideration should be given in the location of all lighting fixtures, diffusers or any other ceiling projection. Generally, office areas should be designed to accommodate an 8' ceiling height.

1.5.3. Flooring

Terrazzo is an extremely durable product and is recommended for design consideration in corridors, lobbies, and restrooms in heavily used facilities, budget permitting.

1.5.4. Wall Coverings

Application of Wall Coverings are discouraged because of difficulties in maintainability and repair when damaged. Wallpaper may be specified for some installations with Owner approval.

The DP shall submit a sample of color and texture of the proposed product at the final schematic design submittal.

1.6. Furnishings

1.6.1. Window Treatments

Window treatment is dictated by user preference and shall be determined, if applicable, during Design Development review meetings.

2. PRE-CONSTRUCTION DESIGN DELIVERABLES

Design Professionals are required to provide complete drawings and specifications sets to allow for minimum Requests for Information (RFI) during construction.

Contractors are expected to do a thorough review of these documents prior to construction for coordination purposes and to report any conflicts, incomplete information, etc., as well as to prevent last minute changes in the field during construction.

At a minimum, the Design Professional and the Contractor shall provide, during the Pre-Construction Phase, all documents listed in their contract agreement. Refer to Design Professional contract and its associated exhibits, for the specific deliverables applicable to the project. **The DP is to submit a Basis of Design (BOD) along with the program development submittal and an updated BOD at each subsequent design phase submittal.** An energy model and associated report and a total cost of ownership report is to be submitted when evaluating options for building orientation, architectural components and MEP systems. These reports will be used by Owner to select the building materials and systems. The energy model and reports shall be updated and submitted for each subsequent design phase submittal.

3. DRAWING LABELING AND FORMAT

The intent of these drawing numbering standards is to provide a set of documents that are consistent with the Owner's current needs and future construction, and are consistent from one project to another.

ELECTRONIC FILE FORMAT

- Facility documentation drawings and construction project drawings must be submitted to Owner in full compliance with AutoCAD software (file extension = .DWG)
- Owner will not accept any drawings in the Drawing Interchange Format (DXF) or any other format that .DWG. If any drawing translators are used prior to submittal, the results of such translation shall be 100% complete. It is the responsibility of the Design Professional to cross-check translated drawings for errors and omissions.

TEXT

- Text size must be legible and appropriate to the graphic information presented and the intended plotted scale of the drawing. Text must be in all upper case letters throughout the drawing.
- Text usually should not touch other graphic objects, and must be placed with enough space around it to be legible when the drawing is plotted and reproduced.

TITLE BLOCKS

The title block should be placed in paper scale, with its insertion point inserted at a coordinate location of (0, 0, 0), and at a scale of 1:1. Depending on the purpose of the drawing, whether it is for facility documentation or construction, the drawing's title block should contain certain essential information that Owner needs, to store and retrieve each drawing in its library.

Project Information

- Project Number - assigned by the Facility Services Planning, Design and Construction
- Project Name - assigned by the Facility Services Planning, Design and Construction
- Firm Name - representing the drawing author
- Building Name and Building Number - specify only if the project name does not include this information already, and the project is building specific.

Drawing Information

- Drawing Title - indicating the drawing content, e.g. floor plan, section, detail, etc.
- Facility Services Project Number – shall be referenced on all sheets
- Drawing Number
- Date of Drawing – original drawing date including significant revision dates

- Drawing Scale – representing the intended plot of the drawing with title block
- North Arrow
- Electronic File Name and Effective Date

STANDARD SHEET SIZES AND FORMATS

All sheet sizes are to be limited to five standard formats. Required sheet size is specific to each project and is under the discretion of the University. They are as follows:

- A Sized Plot 8 /1/2" x 11"
- B Sized Plot 11" x 17"
- D Sized Plot 24" x 36" (preferred format)
- E 1 Sized Plot 30" x 42"
- E Sized Plot 36" x 48"

CAD FILE TRANSMITTAL

The content of electronic drawings must match the delivered original hard copy set. To ensure the integrity of the electronic drawing set upon delivery:

- Ensure the drawings adhere to the guidelines presented in this document.
- Include a transmittal sheet (electronic and hard copy) with all submittals indicating the Owner's project number, project name and complete listing of all materials submitted, including file names and sheet numbers for each item included in the submittal. File names shall contain the sheet number they represent. This ensures the completeness of the drawing set and assists in archival procedures.
- Electronic data deliverables (.DWG and .PDF format) are required at all submittal stages.

CD-ROM LABELING

All CDs are to be labeled as follows:

- DATE – The date when the submittal was delivered to the campus for final acceptance.
- PROJECT – Title of the project name and project number.
- SUBMITTAL – Project submittal phase (i.e. 50% schematic, etc.).
- BLDG NUMBERS – Building number identified by the campus specific to the project.
- COMPANY – Name of design professional firm for the project.

SUBMITTAL REQUIREMENTS

- All submittal documentation forwarded to Owner shall be submitted in a timely fashion, coinciding with the needs of the project and the Facility Services Planning, Design and Construction Staff. The delivery of submittal documentation during

various stages shall be timed appropriately to ensure Owner receives the most accurate information available.

- Ensure the Owner's project number is located on all drawing sheets (including the cover sheet) and all other submitted documentation, i.e. Specifications and Operations and Maintenance Manuals. The Owner's project number should be located in the title block of all drawings, and in the header or footer of Specifications and Operations and Maintenance Manuals, and any other submitted items.

VALIDATION OF DELIVERED MATERIALS

- Owner will validate the CAD data and other materials submitted by Design Professional. If submittals do not conform to the Owner's Drawing Numbering Standard Guidelines, Owner may return the materials to the Design Professional. The Design Professional is responsible for revising the materials to make them conform to the Owner's Drawing Numbering Standard Guidelines.

4. BUILDING, FLOOR, AND ROOM NUMBERING GUIDELINES

4.1. Overview

These guidelines will allow floor, room numbering, and way-finding procedures to be applied consistently to all of Owner's buildings.

For new buildings, these standards should be explicitly followed. In cases of renovation or additions to existing buildings, the building's existing numbering system may be extended, or abandoned in order to use the following standards to renumber the entire building including the renovated and/or added space.

The intention is for each facility's floor and room numbering scheme to be structured so that the numbers flow through the building in a consistent, comprehensible, and user-friendly pattern. The scheme should be clear to the users of the facility, not causing confusion for individuals attempting to locate spaces.

All drawings issued for construction shall contain accepted room numbers so that all affected equipment including but not limited to doors, electrical panels, telephone backboards, air distribution devices, as-built information, and air balance reports will not have to be cross-referenced or revised during construction or after occupancy of the space.

Room numbers affect several agencies including emergency responders, multiple campus databases, chemical inventories, maintenance, and telecommunication systems; because of this room numbers are not to be changed without a formal review process by Owner's Space Management department.

4.2. PROCESS

4.2.1. Building Numbering

The Owner's Office of Space Management will assign new building numbers with the approval of Facility Services.

4.2.2. Floor Numbering

4.2.2.1. Floors

Floors are numbered using a 1-digit standard starting with '1' for the first floor and continuing up for every floor above. The first character of a room number indicates the floor level of the building. The level with a "1" as the first character should be the uppermost floor entered at grade or one half flights above grade. Levels below this can use the character "B" (basement). Buildings located on steeply sloping sites may need to vary from this rule; where

necessary, the floor numbered "1" may not in fact be the uppermost floor entered at grade.

4.2.2.2. Mezzanines

Large mezzanines shall be numbered as a whole floor. Example: When a mezzanine exists between the first floor and the next whole floor, it will be numbered as the second floor.

A mezzanine is defined as a partial floor located between structural floors.

4.2.2.3. Attics and Roof Levels

Usable attic floors and penthouse levels should be numbered as if they are whole floors. For example, a two-story penthouse atop a three floor building will be numbered as the fourth and fifth floors. Do not use prefixes such as "R" for roof level.

4.2.3. Room Numbering

4.2.3.1. General

Use 3 or 4 digit numbers (plus optional alpha prefix or suffix) consistently throughout the building.

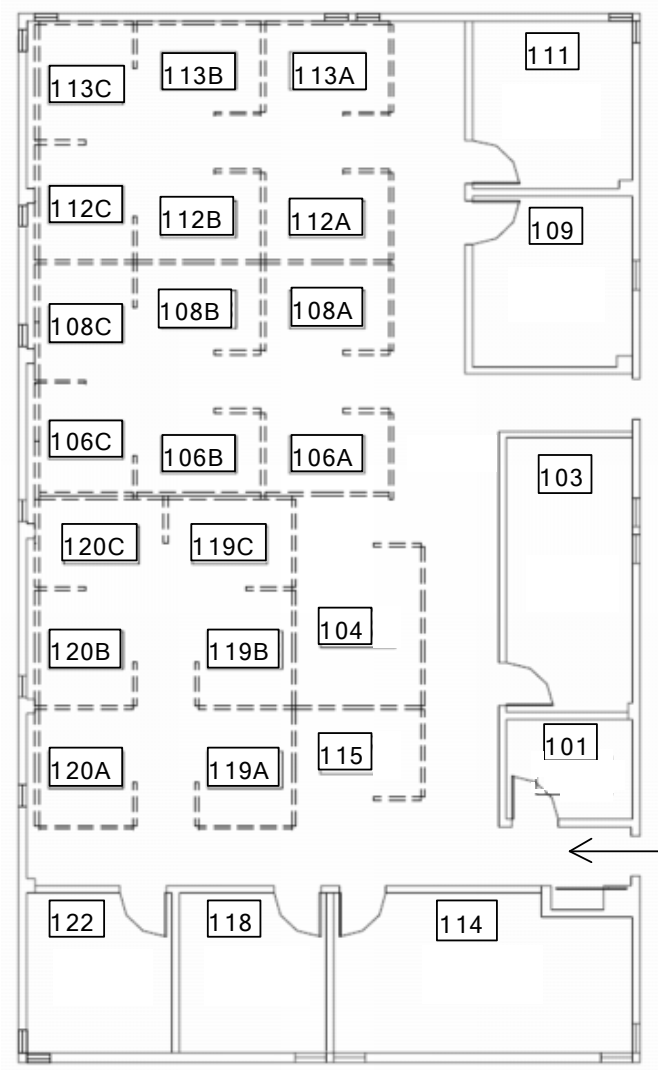
4.2.3.1.1 Three digit numbers shall be used for rooms with assignable or public space. The first digit shall indicate the floor number, for example: first floor will be numbered 100's; second floor will be 200's; third floor will be 300's etc. Ground floor or basement rooms will be numbered as B01, B02, etc. When rooms open off of another room and not from a corridor (such as in a suite of offices), use the number of the first room with a letter suffix (example: Reception 301, Office 301A, Office 301B, Office Storage 301C). Rooms in a designated wing shall have an alpha prefix specific to the wing (example: A112A, B112A)

4.2.3.1.2 Four digit numbers shall be used for non-public rooms. Number shall be as a suffix to the 100 level to describe restrooms, electrical and mechanical rooms, elevator control rooms, custodial closets or enclosed stairwells. (Example: 1001, 1002, 1003)

4.2.3.1.3 Rooms with specific uses and unique spaces may be designated by their room type followed by a number or an alpha numeral per the building user's request (i.e. "Studio A"). These designations shall be determined in schematic design if possible.

4.2.3.1.4 Cubicles should have their distinct room number. Each cubicle within the row is designated using a singular room number followed with a letter. Letters are in alpha order from the main corridor. See Figure 1

Figure 1



4.2.3.2. Number flow

Numbers should flow from one end of the building to the other. In a building with only one dividing corridor, room numbers should flow in ascending order from one end of the building to the other. In a building with a more complex corridor system, numbers should flow in ascending order in a counterclockwise fashion, from right to left, through the corridors from the main entrance, or similar location such as elevator lobby. Any doors that face the Lobby or entry point should be numbered in the beginning sequence.

4.2.3.3. Odd vs. Even

Use odd numbers on one side of a corridor and even numbers on the other side. Room numbers shall be coordinated so that even numbers are on one side of a corridor and odd numbers are on the other side. See Figure 2. In more complex designs, or where the availability of numbers is limited, the odd-even format can be abandoned if consecutive numbering results in a more logical scheme.

Figure 2

4.2.3.4. Skip numbers to maintain succession of room numbering

In some instances, room numbers on one side of a corridor shall be skipped in order to maintain succession with the room numbers on the opposite side of the corridor. This may occur, for example, when a suite of rooms or large space is accessed through a single door and there are no other doors on that same side until further down the corridor. This will allow for future renovations that may convert suites or large spaces into separate or small rooms with a corridor door. See Figure 2.

4.2.3.5. Skip numbers to allow for future renovations

When a corridor contains large rooms such as classrooms, meeting rooms, etc. on both sides of the corridor, room numbers shall be skipped to allow for future renovation of a large space into smaller spaces. Sufficient numbers shall be reserved to allow for the large spaces to be divided into standard size office spaces. See Figure 2.

4.2.3.6. Use similar numbering on each floor

An effort shall be made to maintain consistent room numbers for similar elements on each floor (i.e. for restrooms occurring in the same location on

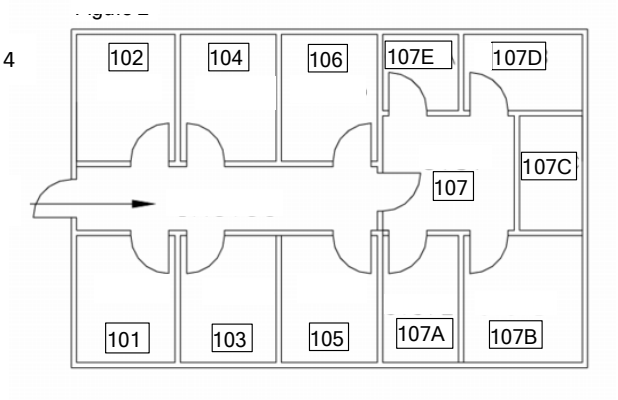
each floor use a common room number format and the same ending digits). See Figure 3

Figure 3

4.2.3.7. 4.2.3.7 Alphabetic Suffixes

Use alphabetic suffixes for rooms entered from other rooms (rather than a hallway). Rooms entered from a main corridor or lobby is numbered with no letter suffix. When rooms open off of another room and not from a corridor (such as in a suite of offices), use the number of the first room with a letter suffix (example: Reception 301, Office 301A, Office 301B, and Office Storage 301C). See figure 4. Assign suffix letters in the order rooms are encountered and, where possible, in the same direction as the overall numbering sequence. Only a single suffix is allowed; thus in the case where the first room already has a suffix, the next alphabetic designation shall be used. Avoid the letters “I” and “O” which may be interpreted as numbers. Large suites with many rooms can use non-suffixed numbers if it makes the numbering scheme more understandable.

Figure 4



4.2.3.8. Each room should have only one number

Each room should have only one number regardless of the number of doors opening into it. Exceptions can be made where a particularly large room is subdivided into different areas of use, such as by cubicles. In these cases, one-character letter suffixes are added to create unique numbers. Where the number of areas exceeds the suffixes available, additional sequential numbers should be used.

4.2.3.9. Number all accessible spaces

In addition to rooms, all interior spaces that can be directly accessed, such as corridors, vestibules, stairwells, elevator shafts, and accessible pipe spaces shall be numbered in a manner as consistent as possible with standard room spaces. Where doors or walls separate different areas of these spaces, each area shall receive its own unique number.

4.2.3.10. Public Circulation

In a building with only one dividing corridor, public circulation numbering should flow in ascending order from one end of the building to the other. In a building with a more complex corridor system, numbers should flow in ascending order in a counterclockwise fashion, from right to left, through the corridors from the main entrance, or similar location such as elevator lobby. Numbering should begin with the floor number followed by 00 and an alpha character. (Example: 100A, 100B, 200A, 200B)

4.2.3.11. Standards for Parking Decks

Standalone parking decks are considered buildings and will have a building number and room numbers to cover all usable space within the structure. This also includes the top uncovered level.

4.2.3.12. Conflicts and Special Cases

In the case of conflicts or questions, Owner's Space Management department should be consulted and will provide a room numbering scheme to be used.

Existing building as of December 31, 2013 have numbering systems established at the time of construction. All new construction starting January 1, 2014 must adhere to the new guidelines.

Appendix A: Room Numbering Guidelines

Room Number	Formula	Example	Brief Description
Typical Rooms	Room Number	101,112,224	Group of rooms that are entered from a corridor
Suites and Sub-Rooms	Room Number + Letter	101A, 134A, 134B	Group of rooms that can be entered from a main "lobby" like space
Rooms within Sub-Rooms	Room Number + Letter + Letter	104AA, 245AA, 245AB, 245AC	Typically small closets within a sub-room
Wings	Letter + Room Number	A101, B101	Unique leading letter assigned to all rooms within a wing
Cubicles	Room Number + Letter	101A, 112A	Assigned distinct number grouping and in alpha order from main corridor
Building Common Areas	4 digit room number	1001, 2001, 3002	Numbers assigned in areas such as; Mechanical, Electrical, Janitorial, and Restrooms
Circulation	Floor Number + 00 + Letter	100A, 100B, 100C	Assigned to public circulation areas that are not independent rooms

5. STORM WATER DRAINAGE DESIGN & SURFACE WATER PROCEDURES

5.1. DESIGN INTENT

The goal is to provide the structures necessary to make use of storm water through harvesting; and infiltrating water, keeping water onsite wherever possible.

Storm water drainage management also includes the LEED goals of water collection and onsite reuse. The entire project area needs to be considered for opportunities to collect and store storm water for irrigation. These features must also be designed to withstand the stress of freezing and thawing that are a reality on the Flagstaff mountain campus.

Within a project's design process, managing the storm water drainage is a key part of the integrated site design promoting proactive solutions that are consistent with or exceed regulatory standards. Given current limited storm drain and land capacities, some of the mitigation of past and future storm water drainage issues at Northern Arizona University should occur on a project by project basis.

Project designs shall include retention and infiltration facilities to contain the first inch of precipitation at a minimum. Additional retention may be added to address problems elsewhere on campus. The Design Professional is to consult with the Owner (Director of Utilities) for guidance on providing retention on a site by site basis.

Ways to store and reuse storm water may include such elements as mini-retention basins or large retention basin, designed as landscaped areas to promote students gathering and shall not include any concrete.

5.2. GENERAL STORM WATER GUIDELINES

5.2.1. General

Preliminary siting studies for the project shall consider information related to the existing drainage conditions of the site, using the most recent campus-wide drainage study as a reference. The preliminary siting studies shall consider, at a minimum:

- The existing site area and adjacent areas within 500 feet of the project, and include all areas which may contribute storm water (watershed) to the proposed site.
- The general area where the site is located, for example, the campus historical core, north campus, south campus, etc.
- Evaluation of existing landscapes, plant palette, formal, informal, historic, ornamental and introduced plants.
- Evaluation of the contextual setting of the site.
- Utility (below/at grade) corridors, emergency routes, pedestrian and automobile core circulation routes.

- Identified project building expansion and proposed expansion adjacent to the project site.
- Evaluation of adjacent facility parking, vehicular and service accesses.
- Whenever possible, site development should not diminish the quality or increase the quantity or rate of storm water drainage flow that leaves the site in its existing condition. Potential increased storm water drainage flows should be mitigated on-site if possible.
- Downstream conveyance impacts must be evaluated and mitigated to prevent the hazards associated with overflows, pounding and ice formation.
- Wherever possible, site development should include strategies such that the storm water flow does not diminish in quality or increase in quantity when compared to the level of the original natural condition of the site. This can be achieved through the use of landscape features and water harvesting.
- Opportunities for water harvesting should be specifically discussed in conceptual narratives in early design stages. **"The City of Flagstaff Low Impact Development: Guidance Manual for Site Design and Implementation, 2009"** should be used for the design basis.(http://www.flagstaffstormwater.com/index.aspx?NID=8).
- Site development should meet or exceed all applicable regulatory standards. The intent is to meet at a minimum the current City of Flagstaff storm water drainage standards and exceed them where possible, and to demonstrate innovative techniques for which the City of Flagstaff may not have applicable standards.
- Retention of storm water: the conveyance and retention capacity shall be sufficient to collect and store the first inch of precipitation that falls onsite for a typical rainstorm.
- Plans will incorporate: conservation of natural areas, minimizing disturbance of natural drainages, minimizing and disconnecting impervious surfaces, and minimizing soil compaction. Many of these points require consideration of construction methods, site access and control of the site areas that are not intended for development, during construction.
- All project sites shall include areas designed to collect and infiltrate water which may include swales, buffer strips, porous pavements, bio-retention, sedimentation and extended detention basin designs.
- Provide a Storm Water Drainage Report. This report, to be prepared for each project will be based on the format and technical standards of the City of Flagstaff Engineer's Design Report.
- Wherever possible, site development should occur such that all flows exiting the project site remain in the current watershed sub-basin so as to not impact drainage patterns in adjacent watershed sub-basins.
- Flood Prevention: Proposed building ground floor elevations and any apertures into the building should be 1' or more above the 100 year flood plain. Sunken access ways or patios leading to building levels below the natural grade of the site are not permitted when adjacent to a 100-year floodplain, and discouraged in other areas. Soil should be graded so that water drains away from the building at a minimum of

2%, subject to other site criteria, such as accessibility. Elevations of underground utilities shall be considered in the grading layout.

Site development must be done in a way to avoid the following conditions:

- Ponding of a duration that may allow mosquito breeding, in access ways which may create a nuisance for pedestrians, or within 10' of building foundations (to prevent infiltration that may cause indoor mold or structural problems).
- Any water catchment not draining within 24 hours
- Retention (groundwater infiltration) facilities not draining within 12 hours.
- Surface water that is wasted, e.g., by running down the street.
- Surface water that is routed in a way which inappropriately distributes sediment or chemicals.
- Channelized or concentrated water conveyed over sidewalks
- Water running off of irrigated turf areas.
- Water that puddles in areas where freezing may cause a pedestrian or vehicular hazard or damage to hardscape.

5.2.2. STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

- All projects will have a Storm Water Pollution Prevention Plan (SWPPP) no matter what their acreage. If a project is less than one acre of disturbed area, an Arizona Pollutant Discharge Elimination System (AZPDES) permitting will not be necessary. On all projects, best management practices shall be followed by the contractors to ensure that existing storm water drainage systems are not polluted during construction.
- If one acre or more is disturbed an Environmental Protection Agency AZPDES Storm Water Construction General Permit must be secured. The Northern Arizona University Office of Regulatory Compliance may be contacted (http://www.orc.nau.edu/) for guidance in securing this permit and filing the associated EPA Notice of Intent (NOI). A copy of the permit shall be provided to NAU Office of Regulatory Compliance and NAU Facility Services Project Manager prior to any construction work on site. A copy of the SWPPP Guidance Checklist can be found at: http://www.azdeq.gov/environ/water/permits/download/cswppp.pdf.
- All SWPPPs shall be prepared by the Civil Engineer of record.
- The Contractor shall secure permits with Arizona Department of Environmental Quality.

5.2.3. STORM DRAIN DISCHARGES

- Water discharged (e.g., storm water drainage, condensate) from sources that must be pumped to a location for conveyance/disposal should not be directed to roadways/hardscape. Such discharges should be directed to

planted areas except when the water quality would be detrimental to plants.

- Storm water drainage shall not be directed into the sewer collection system. Use of the sewer system in this way is considered a prohibited discharge by City of Flagstaff.
- Sewer manholes are not allowed in low lying areas and/or known watercourses to prevent waters from infiltrating through perforations in the manhole cover.

5.2.4. ROOF DRAINAGE

- Roof drainage outlets and landscape surface materials must be designed to prevent landscape erosion.
- Ponding within 10' of the building edge is prohibited.
- Roof leaders/scuppers should be of a small enough diameter so as to divide roof runoff into a series of outlets with a low enough volume/velocity that will allow water to be harvested equally throughout the site (i.e., broken into small volumes for smaller basins/swales). Large diameter outlet pipes convey too much water at too high velocity to capture in small-scale landscape swales. Proper clean outs should be provided to allow necessary maintenance of smaller diameter pipes.
- Roof Drain pipes are prone to freezing during the winter.
- Roof drainages should flow freely even under freezing conditions, new construction shall include interior or insulated and heated roof drains with temp sensor switches to prevent warm weather operation. Renovations of roofing where roof drains are a problem will include correction of the problem through similar design solutions.
- Depending on the project site, the Design Professional should review with Owner the strategies to drain the roof (day-lighting versus tie-in to storm water drainage underground).

5.2.5. ANCILLARY WATER SOURCES AVAILABLE ON OR NEAR SITE

- Water sources such as mechanical condensate, process water, gray water, drinking fountain water, and other sources identified shall be considered as part of passive and active water harvesting systems.
- Such water may be used, if deemed appropriate, for landscape irrigation, return to central plant for other uses, supplementing water for pools or water features, or other uses to be determined.

5.2.6. SOILS

- Site soils need special consideration during the design process for effective use of Low Impact Development (LID) technologies.

5.2.7. PLANNING

- Soils evaluation should begin with planning for site areas where soils are to be used for structural and vegetative support and for water collection and infiltration. Areas considered for infiltration should be evaluated for soil characteristics especially percolation rates, prior to designating these areas for natural infiltration. If soils are suitable, these areas need special planning and protection because construction activities will change the nature of the soils and potentially destroy their useful characteristics.
- Site planning for soil protection should be treated with the same level of attention as protection of existing vegetation and provision of structurally appropriate soils for building support. Soils that are to be used in the final LID structures or in landscaping must be protected from contamination and compaction by construction equipment. Evaluation of the trade-offs between removal and replacement of soils, gravels and non-structural earth and protection of this resource onsite shall be part of the design.
- Cost effectiveness of different solutions should be evaluated and presented as part of the design effort.

5.2.8. TESTING

- If possible, soils testing should be conducted at the time of or prior to preparation of the initial draft of the Storm Water Drainage Report that will be prepared for a project. Such reports should investigate not only structural characteristics but also percolation rates.
- A soil percolation test is required after rough grading of major/regulatory detention and retention facilities to verify that site development activities have not negatively impacted percolation rates. If reduction in percolation rate is identified, mitigation may be required.

5.2.9. SUBSURFACE PREPARATION

- Structural soils should be explored for use under large expanses of hardscape or other areas with limited percolation.
- Soils beneath/adjacent to French drains, and other sub-surface structures should be over-excavated and replaced with an engineered soil designed to absorb or accept water.

5.2.10. COMPACTION

- Soil beneath the bottom of all water harvesting areas should be loosened to a depth of at least 18” prior to trenching and installation of irrigation lines.
- Specified compaction required for buildings, streets, and other structures shall be maintained within specified distances around such structures.

Beyond these compaction zones, soil should be loosened to a depth of at least 12” prior to planting within all landscaped areas.

- All construction debris and waste material must be removed from the soil within landscape and basin areas.
- Once compaction is achieved and completed, soils should not be disturbed as to not affect soil compaction.
- Acceptable limits of compaction must be maintained through completion.

5.2.11. SOIL GRADING

- The finished grade of all landscaped areas that are designed for use as catchments should be recessed downward from adjacent paved surfaces. Maximum reveal at edge of pedestrian circulation paving shall be 1/2" to minimize the risk of injury. Shoulders are to be consistent with the landscaping portion of Division 32 00 00 Northern Arizona University Technical Standards.

5.2.12. GROUND COVER MATERIALS

- All materials shall be consistent with landscaping standards 32 90 00 and approved for use by Owner.
- Within areas conveying significant storm flows, ground surfacing should consist of a material that is able to withstand scouring. This includes hardscape paving, rock mulch, graded or sized rock, riprap, fractured rock, and turf in some situations. Bare soil, decomposed granite, or other loose forms of mulch are not suitable for this application. Filter fabric placed with 12" minimum toe downs at edges shall be used under all rock, mulch, and riprap within conveyance areas.
- Fine grades of decomposed granite should not be used within or adjacent to basins or water harvesting areas. Landscape areas which shed water rather than capture it should receive ½”+ crushed gravel with no fines, preferably with a mixture of sizes and some color variation to reflect the native desert surface.
- The bottoms of landscaped basins should receive ¼” pea gravel or ½”-1” sized/graded crushed rock that has been washed to remove all fines or organic mulch.
- Colors samples of all proposed rock types shall be submitted for approval.
- Organic mulch is encouraged in locations where the vegetation, water collection, erosion, and slope characteristics make it appropriate.
- Turf, as a surface material in large regulatory basins, is only permissible when combined with a low-flow landscaped area which allows a majority of the turf to drain within a short time. It is preferable to utilize turf predominantly on the bottom rather than sides of large basins for ease of irrigation and mowing and to allow the turf to be watered by sheet-flow

runoff. Based on project-specific considerations, turf panels may include a shallow retention catchment (6" or less) which shall include a prepared soil bed that will rapidly absorb retained rainfall. Extensive subsurface soil preparation will be required for turf in basins which collect greater volumes.

5.2.13. RIP-RAP

- Where required, utilize rough, non-angular, owner approved stone (samples should be provided by Contractor for size verification by Design Professional).
- Filter fabric should be included under riprap used for erosion protection in a conveyance channel, and any gaps in riprap shall be fully filled with pea gravel or sized/graded rock that is swept in the gaps to prevent erosion.
- Rip-rap to be sized per City of Flagstaff Storm Water Management Manual and Design Professional shall include calculation in report.

5.3. SNOW MANAGEMENT

In all designs and site planning, snow management must be considered and provided as follows:

- Parking areas need to allow for efficient snow removal operations and include appropriate turning radii for snow plows and heavy equipment.
- Snow storage areas adequate for a typical winter storm (2 feet of snow in 24 hours) shall be included in parking lot design.
- Snow melt drainage from the storage areas and for areas around the building will be designed with special consideration for access to snow melt drainage conveyances for maintenance activities as needed.
- Evaluation and design of areas that are prone to collect snow or ice with special attention to the areas on the north side I of buildings and structures where refreezing of melted snow or ice causes hazardous conditions to pedestrian and maintenance vehicle traffic.
- Evaluation of snow melt and melt storage shall include coordination with Owner to determine if deicing materials or chemicals are being used on snow and ice and if runoff will need special handling to prevent damage to landscaping through use of the water or clogging of infiltration systems by cinder fines or other materials.

5.4. STORMWATER EVALUATION PROCEDURES

Depending on the nature of the project and site, an independent Storm Water Drainage study (as a precursor to the Storm Water Drainage Report described below) may be required and completed prior to the start of the project for the purpose of understanding site issues, budgeting, or other needs. Facility Services will determine if an independent study is required and contract for this initial work if necessary. This independent study could be part of the programming and sustainability evaluation.

5.4.1. Project Design Process

The Design Professional's scope of work will require compliance with the storm water drainage standards found above. As a result of project-specific design guidelines identified in the independent storm water drainage study, storm water requirements may be developed which call for unique conveyance features or other special requirements.

The project design should be informed by project-specific site development guidelines, The Northern Arizona University Design Guidelines and Technical Standards, site soils tests, and other regulatory considerations. For projects located in south campus, review the *NAU Assessment of South Campus Storm Drainage.* These resources shall guide the preparation of a Storm Water Drainage Report and design solutions, as required in the project scope of work and described below.

The Northern Arizona University Director of Utilities is available to the Design Professional throughout the project to review these standards and guidelines and to discuss and provide guidance on detailed storm water drainage design solutions.

The Design Professional is responsible for ensuring that all applicable sub-consultants understand the studies, plan sets, details, and specifications each sub-consultant will need to prepare in order to meet these standards. Sub-consultant fees should appropriately reflect the work necessary to meet these standards.

During the first design stage where site development concepts are being investigated there should be a demonstration of how existing drainage impacts the site along with conceptual options for how storm water drainage may become an integral part of the project design. At each subsequent plan review phase the submittal set shall include designed storm water drainage elements which are responsive to the Concepts and Mitigation section of the Storm Water Drainage Report described below and are developed to a level of design commensurate with the rest of the project.

Appropriate soils tests will be completed as early in the design process as possible to inform the final storm water drainage design solutions. These tests shall include measures needed to understand the suitability of the soil for the infiltration needed for retention/detention, in addition to structural and other characteristics as described in Sections above.

5.4.2. Storm Water Drainage Report

During the first design stage where site development concepts are being investigated, a draft Storm Water drainage Report will be prepared by the Design Professional. The report will have two main components: an Existing Conditions Analysis section, and a Concepts and Mitigation section.

5.4.2.1 Existing Conditions Analysis: this report section analyzes and documents existing storm water drainage conditions on the project site. The form and methods used for this report should conform in general to City of Flagstaff standards, e.g., use the format of the City of Flagstaff Storm Water Management Design Manual to create a Drainage Report.

South Campus technical analyses shall be built on the *NAU Assessment of South Campus Storm Drainage.*

5.4.2.2 Concepts and Mitigation: each subsequent draft of this report section should include increasing specificity and technical documentation on proposed storm water drainage features and mitigation which emerge from the initial vision/concepts. This report section shall include, at a minimum, the following two elements:

- Storm water drainage vision and concepts for the project, presented in narrative and graphic form, conveying how storm water drainage may be incorporated in the project design. Include specifics concepts such as existing drainage patterns and proposed pathways, infiltration, detention, and storage. Evaluation of required, recommended, and anticipated storm water drainage features shall be included, along with topics such as defining finished floor elevations relative to flood levels and evaluating other storm water drainage sources in the vicinity for potential use within the project site. The final Report shall include a water budget for the proposed landscape, including an analysis of water sources available to meet the budget. Proposed concepts and features shall come from a collaborative process involving all applicable team members. At a minimum this should include the project's Landscape Architect, Civil Engineer, and the project Architect.

- Assessment of anticipated storm water drainage impacts of the project on the surrounding area including the watershed above the site, adjacent storm water drainage relationships and downstream areas potentially affected and likely mitigation needed. Maps should indicate how the site/project interfaces with its own and adjacent watersheds.

5.4.3. Storm Water Drainage Report Submittals

Each draft of the Storm Water Drainage Report will be reviewed by the Owner. Following is a summary of each report draft:

- First Draft: The first draft of the Storm Water Drainage Report shall be included with the projects programming design submittal. The storm water drainage conditions, concepts, features, and mitigation described within the report are to be included in the presentation. All subsequent project presentations and submittal sets shall include

these storm water drainage elements developed to a level of design commensurate with the rest of the project.

- Second Draft: A second draft of the Storm Water Drainage Report shall be due with the schematic and design document phase submittal set. This draft shall include updated/refined graphic and narrative descriptions of storm water drainage concepts, features, and mitigation.

- Final Report: The final version of the Storm Water Drainage Report shall be submitted with the construction document submittal and will include updated modeling and analysis of designed features and mitigation. It shall be sealed by a registered Civil Engineer and shall include calculations, model outputs, assumptions made, and any other relevant information to provide a comprehensive report. An executive summary is to be provided which includes, among other information, a statement from the project Civil Engineer noting in both technical and layman's terms ways in which the project design varies from and/or meets NAU Standards.

REFERENCES:

The City of Flagstaff Low Impact Development: Guidance Manual for Site Design and Implementation (latest revision).
http://flagstaff.az.gov/index.aspx?NID=1464

City of Flagstaff Stormwater Management Design Manual (latest revision).
http://www.flagstaffstormwater.com

6. CAMPUS SUSTAINABILITY

6.1. OVERVIEW

Northern Arizona University is committed to a leadership role in promoting sustainability on our campus and in our design and construction practices. The University is actively pursuing policies that provide for a sustainable future.

NAU's Sustainability Action Plan (http://nau.edu/Green-NAU/SAP-Home/) includes a description of the goals for advancing sustainable building including "providing incentives to use Leadership in Energy and Environmental Design (LEED) standards and other green building practices in the development of facilities".

Much of the reduction in emissions is proposed to come from energy conservation efforts and improved efficiency of new and renovated buildings. These Design Guidelines are part of the effort described in the Sustainability Plan to "phase in a high performance facilities program that makes energy and water conservation objectives and green building design services part of planning all new or renovated facilities."

Where applicable, a Total Cost of Ownership (TCO) analysis may be required, to include environmental, economic and social costs and benefits. Project teams are encouraged to submit a TCO analysis with their initial review package for any proposed design elements with an initial first cost greater than a conventional solution.

Design Professional teams are expected to incorporate sustainable systems within the context of construction and renovation to meet the goals of the Owner.

This is a suggested process for meeting the goals and requirements.

- Establish project-specific benchmarks:

  Discuss, record, and document the specific goals for the project during programming and during all phases of design. Most projects will adhere to the benchmarks provided herein but in some cases projects may have more stringent requirements or focus on a certain area. Include the benchmarks selected in the programming documentation.

- Model the building energy and site systems:

  During programming and schematic design, the project team will develop a baseline energy model to identify key areas for focus during alternative evaluation. The baseline energy model will be used for alternative evaluation. An update to the model will be provided with each design submittal along with a summary report indicating

assumptions, changes from the previous models, and a monthly consumption estimate for each utility along with peak flow rate.

- Develop and compare alternatives:

  During Design Development, the project team will test alternative systems using life cycle cost analysis. Proposed alternatives will be presented, recommended alternatives discussed, and selected alternatives documented in an energy model report included in the design development documents.

- Provide after-construction documentation:

  Simple, bulleted list of the sustainable design features (upon completion of construction documents).

  One-year post occupancy report (indicating how sustainable goals have or have not been met; what worked and what didn't work; hindsight evaluation - what would you do differently, etc.).

6.2. DESIGN CRITERIA

6.2.1. General:

Sustainable design precepts appropriate for the Northern Arizona mountain environment should be incorporated – water conservation, building orientation, sun exposure, and snow and ice accumulation are issues of special concern in mountain environments.

- Appropriate passive solar design techniques shall be incorporated where the project scope and budget support it, solar water heating and photovoltaic systems should be considered if determined to be economically viable.
- Landscape design shall be in compliance with the 2015 NAU Landscape Master Plan. Water harvesting techniques and use of the Owner's reclaimed water system is required. Protect significant natural and historic landscaping and incorporate those elements into the new landscape design aligned with the 2015 NAU Landscaping Master Plan.
- Appropriate day-lighting design should be considered to minimize the requirements for artificial lighting and to promote the interior/exterior connection of the building.

6.2.2. Building Size & Footprint:

Minimize the overall building size (square footage and footprint) while meeting the building program requirements. The goal is efficient use of space to reduce overall resource consumption; including embodied energy, operational energy, and building materials.

6.2.3. Design for Future Use:

Plan for a "100-year Building" through flexibility of use and future reuse; no "throw-away" buildings. Design interior spaces that are flexible and allow for changes in use. Use standard furniture wherever possible. Minimize use of custom millwork, custom building systems (door frames, doors, interior windows etc.) to maximize reuse in the future. For retrofits, analyze current space requirements for space efficiency, function, and use proximity.

6.2.4. Building Life Expectancy:

Appropriate use of construction materials, mechanical, electrical and plumbing systems should be selected that result in a building with an intended useful life of 100 years, and also respond to the attributes of the Northern Arizona mountain environment.

6.2.5. Programming & Space Planning:

Group spaces or activities with similar energy requirements and times of use to allow for zoning efficiency of passive and mechanical energy systems. The goal is to reduce demand and optimize operational efficiency.

6.2.6. Service Areas:

Service areas shall support efficient operations, program, and building management for NAU sustainability initiatives; such as recycling collection, trash compaction, water capture, service vehicle access, etc.

6.2.7. Transition spaces:

Provide sufficient exterior screening, transition courtyards, exterior atrium spaces, shade trellises, etc., to allow the building occupant the opportunity for eye adjustment from bright to low light and from low to bright light.

6.2.8. Landscape Maintenance:

Reduce maintenance and potential problems caused by landscape debris. Specify plants appropriately for their purpose and location. Avoid overplanting. Consider mature landscape growth potential to insure appropriate integration with lighting, underground utilities and other site systems.

6.2.9. Waste Management:

Owner is working to quantify waste and recycling rates for all ongoing and any future projects on campus. Contractors are asked to identify waste diversion opportunities and track waste and recycling figures for each of their respective projects. Waste and waste diversion totals should be tracked on a monthly basis and entered into the project-specific spreadsheet. Refer to Division 1 of the Technical Standards for Contractor requirements.

6.2.10. User Involvement:

Survey building occupants/users for sustainable design, maintenance and operations suggestions; utilize the recommendations in the design as practicable.

6.2.11. Carbon Neutrality:

A zero carbon emission campus is the NAU goal. Design Professional to evaluate strategies to achieve a carbon neutral project. Energy models are required at certain design subphases in the Design Professional contract. Develop a budget for carbon neutrality based on Schematic Design energy model.

6.2.12. Building Envelope:

Design the building envelope to minimize heat loss and gain. Exceed the current ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) building envelope performance baseline standard by 30% or more. Avoid thermal bridging by providing thermal breaks in the exterior building envelope.

6.2.13. Climate-Responsive and Passive Systems Design:

Design buildings in a climate-responsive manner to reduce energy demand, maximize passive heating and cooling, and minimize mechanical HVAC requirements (through building form, orientation, articulated shading, natural ventilation, glazing, interior thermal mass, blinds, controls, geothermal energy, earth tempering, etc.)

6.2.14. Window Glazing:

Select glazing size and materials appropriate for the orientation of the windows. Use double or triple glazing wherever possible. Thermal breaks shall be included in window frames at all exterior glazing.

6.2.15. Window Shading:

Every exterior window shall be shaded appropriately for the window orientation. Consider cleaning and maintenance of windows and shading devices in the design. Provide a shading analysis for review. Ensure that operable interior shading is accessible to the building occupants.

6.2.16. Mechanical Systems:

Specify HVAC and electrical systems that find a balance between energy efficiency and maintainability. Coordinate systems and controls with other building systems to optimize building operation and reduce energy consumption on a Total Cost of Ownership basis. Motion sensors and daylight-responsive dimming will be evaluated on a project needs basis. Provide electronic ventilation controls. Connection to the Central Plant heating and cooling systems is to be evaluated on every project. Consider extended life cycle maintenance and material costs in MEP systems design. Use heat recovery systems wherever possible to minimize energy usage.

The DP shall include a written description of how the mechanical systems are to operate and interface with other systems within the BOD. A detailed written sequence of operations is to be included within the plans at the Design Deliverable submittal.

6.2.17. Energy Commissioning & Monitoring:

In regards to projects that effect NAU's energy system, provide clear building energy commissioning requirements beginning in schematic design to establish energy goals, and ending with a post-occupancy energy analysis. Provide permanent energy metering on all buildings utilizing the Owner's metering standards for every utility connected to the building. Metering of building sub systems may be needed based on project or LEED requirements. Provide the capability to monitor and analyze post-occupancy performance in comparison to energy analysis predictions. Provide a 1-year and 2-year post occupancy energy use analysis for Tier 1 and Tier 2 projects (see below for more information on Tiers).

6.2.18. Preliminary Water Budget Analysis:

In regards to projects that effect NAU's water systems, perform a preliminary water budget analysis before the completion of schematic design that explores how to reduce potable water loads in the building and accomplish related sustainability goals. Assess and estimate the project's potential non-potable water supply sources and water demand volumes, including indoor water demand, outdoor water demand, process water demand, and supply sources. Non-potable water source evaluations can include on-site rainwater and/or graywater, and HVAC equipment condensate.

Document how the above analysis informed building and site design decisions in the project's BOD. Demonstrate how at least one on-site non-potable water supply source other than reclaimed water was analyzed to reduce the burden on municipal supply or wastewater treatment systems by contributing to at least two of the water demand components listed above.

6.2.19. Climate-Responsive Materials:

Specify materials that are durable under high-altitude desert climate conditions (UV radiation exposure and freeze/thaw).

6.2.20. Embodied Energy:

Minimize the use of high embodied-energy materials.

6.2.21. Reused & Repurposed Materials:

Present opportunities for installation of reused and repurposed materials, including the building shell, structural materials, finishes, fixtures, etc.

6.2.22. Maintenance:

Specify low maintenance materials and assemblies. Material and building maintenance, and special cleaning procedures, shall be reviewed with Owner in the design development phase for integration into the NAU sustainable cleaning program standards.

6.2.23. Building Construction Supervision

Schedule on-site quality control inspections to check for/assure freedom from heat bridges. Assure that insulation layers are continuous, and without air pockets. Check joint details for air tightness while they are accessible. Have a building shell pressure test performed as part of the building commissioning.

6.3. ASHRAE 189.1

New construction must adhere to the most recent version of American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) ASHRAE 189.1.

6.4. USGBC LEED CERTIFICATION

The State of Arizona mandates for all state facilities achieve LEED Silver certification as established by the United States Green Building Council on all new buildings and renovations.

All projects will adhere to the most recent version of USGBC LEED standards as of date of DP contract. Projects will use the most recent LEED project management software to register, document and certify projects. The DP must register the project with USGBC within five (5) days of the execution of the DP contract.

The requirements and recommendations for LEED [sustainability] elements to be incorporated into major renovations projects are organized into four categories that align with NAU project tiers as described below.

Tier 1	Tier 2	Tier 3
New Building or Major Renovation	Partial Renovation	MEP System Upgrades
New Buildings and Building-Wide Full-Gut Renovations	Partial Building Interior Fit-Outs HVAC, Lighting, and Materials Within the Scope	Limited Scope Projects with Energy and GHG Impact

Design Professional shall clarify with Owner on what Tier is to be used on a project.

6.4.1. Tier 1 – New Building or Major Renovations

6.4.1.1. Mandatory LEED Points

Owner has identified explicit LEED points (LEED Silver certified) for mandatory consideration and inclusion in Tier 1 projects. Those points are listed below.

The below credits should be pursued for all LEED certification projects. If unable to achieve those credits, a thorough written explanation of the reasons why, shall be provided to Owner.

6.4.1.1.1. INTEGRATIVE PROCESS

a. **Credit – Integrative Process -** Adhere to the requirements of the LEED Credit: Integrative Process (based on ANSI Consensus National Guide 2.0 for Design and Construction of Sustainable Buildings and Communities – 2012).

6.4.1.1.2. LOCATION AND TRANSPORTATION

a. **Credit – Surrounding Density and Diverse Uses**
b. **Credit– Access to Quality Transit**
c. **Credit – Bicycle Facilities -** Public transportation access should be consistent with Owner's Campus Master Plan. Provide ample bike rack space to accommodate both staff and student use of the building. Consider need for roof, area drains and lighting for bicycle storage areas/racks. Consider snow removal and bike storage.

6.4.1.1.3. SITE DEVELOPMENT

a. **Credit - Open Space** - Ensure that the percentage of outdoor space on campus is not decreased below 30%. Consider building heights greater than 3 stories.
b. **Credit - Heat Island Effect: Roof and/or Non-Roof**
c. **Credit - Light Pollution Reduction**

6.4.1.1.4. WATER EFFICIENCY

a. **Credit– Outdoor Water Use Reduction**
b. **Credit– Indoor Water Use Reduction -** Provide opportunities for rainwater harvesting and condensate collection. Refer to Division 22 of the Technical Standards for low-water usage plumbing fixtures
c. **Credit– Cooling Tower Water Use -** Any buildings requiring air-conditioning should be connected to the chilled-water distribution systems. Owner exceeds the minimum 10-cycles.

6.4.1.1.5. ENERGY & ATMOSPHERE

a. **Prerequisite - Building-Level Energy Metering -** The Owner will commit to sharing with USGBC the resulting whole-project water usage data for a five-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes firs**t.**

b. **Credit - Enhanced commissioning**
c. **Credit - Optimize Energy Performance -** Thirty-four percent (34%) improvement in building performance beyond current LEED requirement is the preferred minimum level for new facilities. Additional improvements may be required based on LEED objectives**.**
d. **Credit - Renewable Energy Production -** If renewable energy installation is cost prohibitive, assess the potential for buildings and roofs to be "solar ready."

6.4.1.1.6. MATERIALS & RESOURCES

a. **Prerequisite - Storage & Collection of Recyclables** Recyclable materials must include mixed paper, corrugated cardboard, glass, plastics, and metals. NAU's current commingled recycling pickups does not allow for inclusion of glass. A separate area and receptacle is recycled for glass storage and pickup. Provide locations for recyclable materials collection bins on floor plans. Such collection bins shall match tech' standards section Division 12.90.0 – Furnishings. Take appropriate measures for safe collection, storage, and disposal of at least two of the following: batteries, mercury-containing lamps, and electronic waste.
b. **Credit– Building Life-Cycle Impact Reduction**
c. **Credit– Building Product Disclosure: Environmental Product Declarations -** Select materials that are manufactured as close as possible and avoid materials coming from oversea with long procurement lead-time. Think globally about the total carbon footprint of the selected materials.

   For permanently installed products (including mechanical fixtures and fittings and rough-in materials), consider products with Environmental Product Declarations which conforms to ISO 1 4025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to grave scope.
d. **Credit– Building Product Disclosure: Sourcing of Raw Materials**
e. **Credit– Building Product Disclosure: Sourcing of Raw Material Ingredients -** Consider the use of products with ingredient reporting programs such as "Cradle 2 Cradle".
f. **Credit– Construction Waste Management** - Divert at least 80% of new construction from disposal, consisting of three of the five previously defined waste streams, as designated in project planning. Collect weekly waste reports for the waste stream of the three specified materials, as well as the total weight of all materials

recycled or sent to disposal for a particular project. Waste and diversion data should be regularly shared with the University.

6.4.1.1.7. INDOOR ENVIRONMENTAL QUALITY

a. **Credit– Enhanced Indoor Air Quality -** Will required printers to be in dedicated rooms. MERV 13 filters will be required for these spaces.
b. **Credit– Low-Emitting Materials -** Low emitting materials should meet the requirements of CDPH Standard Method V1.12010 and applicable chemical content requirements of the SCAQMD Rule 1168.
c. **Credit– Construction IAQ Management Plan -** These filters shall be replaced prior to occupancy and shall be MERV 13.
d. **Credit–IAQ Assessment**
e. **Credit– Daylight**

6.4.1.2. Recommended LEED Points

It is required that the credits below be assessed for potential achievement. If unable to achieve these credits, a thorough written explanation of the reasons why, will be provided.

Assessment is Required for the Following LEED Credits to Determine appropriateness for

- SS: Rainwater Management
- SS: Site Assessment
- EA: Enhanced Energy Metering
- EA: Enhanced Refrigerant Management
- IEQ: Interior Lighting Controls
- IEQ: Thermal Comfort Controls
- IEQ: Acoustic Performance
- **Credit– Advanced Metering -** Coordinate with Owner to identify the benefit of installing permanent water meters for two or more of the following water subsystems, as applicable to the project: irrigation; indoor plumbing fixtures and fittings; domestic hot water; reclaimed water; boiler; and/or other process water.

6.4.2. TIER 2 – Partial Renovation

6.4.2.1. Identify sustainability goals and tracking mechanisms

Specifically address sustainable goals and tracking that sets expectations and evaluates project success in meeting pre-defined goals.

6.4.2.2. Integrated Design

Projects are encouraged, but not required, to adhere to the requirements of LEED IP credit 1: Integrative Process.

6.4.2.3. Energy Modeling and GHG Emissions Calculations

6.4.2.4. LEED / Sustainability Requirements

Owner has identified sustainability requirements outlined within the LEED v4 Rating System that Tier 2 projects

6.4.2.4.1. Water Efficiency

a. Indoor Water Use Reduction – Reduce potable water use by 35% (minimum, from a calculated baseline)
b. Outdoor Water Use Reduction – Sub-meter irrigation separately from all other potable water use. Strive for a 100% reduction in outdoor potable water Use.

6.4.2.4.2. Optimize energy performance by 35%

a. Lighting retrofit and motion detection switching
b. Evaluation of existing building insulation and addition of insulation
c. Replace windows
d. Replace roofing
e. HVAC upgrades with better air handling units (AHU)
f. Equipment and appliances are ENERGY STAR compliant

6.4.2.4.3. Energy and Atmosphere

a. Enhanced commissioning
b. Enhanced refrigerant management
c. Building management systems
d. Measurement and Verification – Sub-metering of major systems

6.4.2.4.4. Materials and Resources

a. Construction Waste Management – Reduce waste by 50%
b. Building Product Disclosure/Optimization – Environmental Product Declarations
c. Building Product Disclosure and Optimization – Sourcing of Raw Materials
d. Building Product Disclosure and Optimization – Materials Ingredients and Product Manufacturer Supply Chain Optimization

6.4.2.5. Recommendations

The following sustainable elements are not required for consideration within Tier 2 projects, but are strongly recommended as project scope, budget, and other considerations allow; especially for projects in the Tier 2A category.

a. SS: Rainwater Management
b. SS: Heat Island Reduction
c. SS: Light Pollution Reduction
d. SS: Sustainable Sites Initiative (if project is primarily a landscape project)
e. MR: Storage and Collection of Recyclables

6.4.3. Tier 3 – MEP System Upgrades

6.4.3.1. Energy Modeling and GHG Emissions Calculations

Projects are encouraged, as appropriate to the project type, to estimate the energy demand and consumption impacts, as well as GHG emissions, from the proposed design options and propose a strategy to verify energy performance.

6.4.3.2. LEED / Sustainability Requirements

Owner has identified sustainability requirements outlined within the LEED v4 Rating System that Tier 3 projects should always strive to incorporate, when appropriate.

6.4.3.2.1. Energy Efficiency

a. Building Envelope - Opaque and/or Glazing
b. HVAC Equipment Efficiency – Zoning and Controls
c. Interior Lighting Power – 10-25% Reduction in Lighting Power Density
d. Interior Lighting Controls – Daylighting and Occupancy Sensor Lighting Controls
e. Equipment and Appliances – ENERGY STAR Equipment and Appliances: 70-90% Compliance

6.4.3.2.2. Water Efficiency

a. Indoor Water Use Reduction – Reduce potable water use by 35% (minimum, from a calculated baseline)
b. Outdoor Water Use Reduction – Sub-meter irrigation separately from all other potable water use. Strive for a 100% reduction in outdoor potable water Use.

6.5. ENERGY MODELING

Energy modeling is essential to understanding the contribution of an element to the system function efficiency. Energy modeling captures the advantages of certain materials in reduction of energy during facility operation. The systems included are primarily mechanical, electrical and plumbing as well as heating, ventilation and cooling (HVAC). For the elements included in the building envelope: subflooring, walls, roof, insulation, and glazing the cost/benefit is realized in energy savings due to better performance of the material for insulating, moisture management, and heat transfer. The energy model provides information that the building owner needs to properly evaluate different design alternatives.

The energy model will be based on LEED requirements for the baseline building. Utilize eQuest or Energy Plus platforms to model proposed building design, assist with life cycle costing, estimate greenhouse gas (GHG) emissions, and facilitate measurement and verification.

At a minimum, the following deliverables or reports summarizing these deliverables are required:

Schematic Design	Initial model results of massing, orientation, and/or major HVAC systems with sensitivity analysis
Design Development	Multiple parametric runs comparing options of systems and strategies as determined in the initial and/or subsequent integrated design charrettes
Construction Documents	Complete design and base case models used for LEED and/or code compliance verification
Building Turnover	As-built energy model & electronic files

The HVAC system described in Technical Standards Section 23 00 00 (variable air volume, single duct, with terminal reheat) must be modeled. Any additional alternative to the LEED baseline HVAC system will be modeled and evaluated based on efficiency and maintainability. Owner requires the energy savings data to be compared between the LEED baseline HVAC system, Owner preferred HVAC system, and any proposed alternative HVAC system. The model inputs and reports will be submitted at each stage of design and with every design submission. Modeling based on ASHRAE 189.1 is required.

The energy model should capture the role of components in the system performance. A Total Cost of Ownership analysis of components that are part of an energy system without an appropriate model included will be deemed incomplete and inconclusive. Providing a complete energy model and Total Cost of Ownership report is a requirement for progress payment to the DP.

6.6. BUILDING LIFE CYCLE COST (BLCC) ANALYSIS AND BUILDING COMPONENT SELECTION

6.6.1. "Total Cost of Ownership"

Throughout the process of scoping, design, and sometimes during construction, building components are selected and included in the building design. Rather than base decisions for inclusion of components in the project solely on the construction budget and initial installed cost, elements included in the project must be evaluated for building life cycle cost (BLCC). The BLCC analysis includes the costs and benefits for the lifetime of a building for a product or a system including but not limited to: the initial cost of material and installation, energy savings, maintenance costs, and product life. BLCC analyses provide the Owner with a true cost of alternatives under consideration. These analyses can then be used to compare acceptable construction materials and to differentiate the actual cost of materials to the Owner.

6.6.2. Building Life Cycle Evaluation Process and Procedure Guidelines

The Design Professional shall identify the elements to be evaluated for BLCC Analysis based on the performance goals established for the building and the available options. Any alternatives considered shall be viable options acceptable to Owner. BLCC Analysis

shall be formally documented in the reports as required in the project development, schematic design and design development. Final selections will be made by the project team, with final approval by Owner, as part of construction plan completion and BLCC may not be the sole criteria used to perform selection of building systems and building materials.

Energy escalation rates and the discount factor will be derived from the latest *Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to NIST Handbook 135,* published by the National Institute of Standards and Technology (NIST), or as directed by the Owner. Owner recognizes that proposed alternatives may not prove cost effective based on BLCC analysis but the alternative may be deemed necessary to meet the energy reduction goal and minimize the carbon footprint of the building. This situation occurs predominately in the "Optimize Energy Performance" credit of the LEED certification process. The BLCC analysis and LEED energy savings impact will be evaluated on a case by case basis. Utilize the building energy model report in the creation of the BLCC.

The following building systems shall be considered for BLCC analysis at conceptual and schematic design and again if major changes occur in later design subphases:

1. Energy systems
2. Electrical Systems
3. Building Envelope
4. Sitting/Massing Strategies
5. Structural Systems
6. Mechanical Systems
7. Water Systems
8. Interior Materials

Goals shall be established for each of the systems as listed above. Specific required studies include: roofing alternatives within the building envelope category, HVAC system alternatives within energy systems, and flooring as part of interior materials. No more than three studies shall be completed within the same category.

6.6.3. Resources

The following resources were identified as potential methods for BLCC Analysis:

- The US Department of Energy provides a life cycle cost analysis program through The National Institute of Standards and Technology and provides a program to assist in BLCC Analyses.
- BLCC conducts economic analyses by evaluating the relative cost effectiveness of alternative buildings and building-related systems or components. Typically, BLCC is used to evaluate alternative designs that have higher initial costs but lower operating costs over the project life than the lowest-initial-cost design. It is

especially useful for evaluating the costs and benefits of energy and water conservation and renewable energy projects. The life-cycle cost (LCC) of two or more alternative designs are computed and compared to determine which has the lowest LCC and is therefore more economical in the long run. BLCC also calculates comparative economic measures for alternative designs, including net savings, savings-to-investment ratio, adjusted internal rate of return, and years to payback.

The software can be used to evaluate projects for both new and existing buildings. While BLCC is oriented toward construction-related decisions, it can be used to evaluate alternative designs for almost any project type in which higher capital investment costs lead to lower future operating-related costs (NIST website, 2009).

Designers are expected to be well versed in modeling and to have the ability to demonstrate the accuracy of the proposed model using existing facilities and locally and regionally appropriate data.

6.7. OPERATION & MAINTENANCE

6.7.1 Building "Owner's Manual": Provide a Building Owner's Manual (in digital format) on how to operate and maintain the building and site to optimize the building systems and design.

6.7.2 Operation & Maintenance Education: Conduct a workshop for Owner, including building occupants and maintenance staff, prior to occupancy to review the "Building Owner's Manual" and direct building users on how to optimize the building systems and design.

6.7.3 Post-Occupancy Evaluation: Post-occupancy evaluations will be performed by the DP or a consultant retained by the DP at the end of the first year of occupancy. The evaluation shall include performance and satisfaction assessments of building comfort, HVAC systems operations & controls, water and energy use, lighting, etc.

6.8. BUILDING EDUCATION

6.8.1 Resource Usage Information Display: Buildings are not static in nature and therefore it is important to provide feedback to the users on their effect on energy, water and other resource consumption as they use the buildings. Provide smart meters to educate and influence user behavior with the goal of reducing energy consumption.

6.8.2 Interpretation: Buildings should be an educational opportunity for the users, to educate the users on energy savings and resource saving features of buildings. Provide

innovative ways to educate users about the sustainable building design, through the use of signage, displays (green screen or other form) and any other appropriate communication device to explain design strategies, techniques, technologies, etc.

7. CAMPUS METERING

Utility metering is required for all new construction and renovation projects that include energy or water consuming components. Utility meters shall be designed and specified by the Design Professional. Contractor shall furnish and install all utility meters. Utility meter commissioning shall be a joint effort between the Contractor, Design Professional, Commissioning Agent (where applicable), and the Owner. Owner will not accept any utility meter until it has been shown to be fully functioning and operational. Refer to section 23 05 19 for Mechanical Meter Standard and 26 09 13 for Electrical Power meters.

Utility meters shall communicate with the Owner's Energy Management System (EMS), which is Alerton. Specify all necessary components and communication protocols to assure meter information can be mapped to campus Building EMS Web Page.

8. CAMPUS ACCESSIBILITY AND UNIVERSAL DESIGN

8.1. Universal Design

Owner is committed to universal design (UD) in all construction projects whether they are new facilities or facility renovations. Owner is committed to providing equitable access to its working, learning and cultural activities for all individuals. Universal design serves to create usable and sustainable spaces which are usable by all members and guests of the Owner's community.

Universal design "is not a design style, but an orientation to any design process that begins with a responsibility to the experience of the user" (Institute for Human Centered Design, 2010). It is a proactive approach to design considerations in the physical environment, as well as the information, policy, and learning environments. Considering the experience of the user prior to making design decisions can create long-term efficiencies for the institution by minimizing the need for future adaptations and retrofitting.

The Center for Universal Design at North Carolina State University has defined universal design as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design, 1997). In supporting this definition, it has identified seven primary principles of universal design for products and environments.
(see http://www.ncsu.edu/www/ncsu/design/sod5/cud/about_ud/udprinciples.htm)
These principles are:

Principle 1:	Equitable use
Principle 2:	Flexible use
Principle 3:	Simple and Intuitive Use
Principle 4:	Perceptible Information
Principle 5:	Tolerance for Error
Principle 6:	Low Physical Effort
Principle 7:	Size and Space for Approach and Use

These principles are described in detail at the website listed above. This information, and other reference material, can also be found on Northern Arizona University's Commission on Disability Access and Design website at http://nau.edu/cdad/.

Projects involving building/sites on the National Register of Historic Places must comply with the Universal Design principles and accessibility standards in such a way that impact is minimized and a building/site's historic integrity and character defining features are maintained. The determination of building/site's historical integrity and character defining features shall be discussed with the Owner and the State Historic Preservation Office.

Due to potential range of existing conditions – and the ability of renovation (or historic renovation) project to address such conditions – it is imperative that each project involving an existing building undergo evaluation early in the design process to outline the scope of accessibility compliance which can be achieved.

All construction projects – new, renovation and historic renovation – must comply with the ANSI 117.1 accessibility requirements (as a referenced standard in the IBC). In addition, must comply with the 2010 ADA Standards, as adopted by the Department of Justice (DOJ) in September 2010 and their related standards as they apply. Compliance shall also conform to the requirements of the latest editions of all state regulations and the various codes which have been adopted by the Owner at the time of bid or qualifications-based selection.

New construction projects must comply with mandatory standards throughout both the building and site. Additions to existing buildings must comply with mandatory standards throughout the building and – if provided with new building entrances from the exterior – the site. Renovation projects must comply with mandatory standards within the physical boundaries of the renovation.
In regards to achieving accessibility as part of renovations, Owner recognizes that there are some challenges renovation projects cannot overcome, such as:

- Conditions physically beyond the limits of the renovation
- Spatial/structural/technical conditions which make accessibility infeasible to achieve, and/or
- Conditions which cannot be addressed within a defined project scope or budget.

Many of the UD accessibility standards become preferences – rather than mandatory – when there are significant constraints to achieving accessibility. However, Owner expects Design Professional to bring an innovative and resourceful approach to renovation projects on campus, and strive to achieve compliance with the UD accessibility standards.

8.2. International Symbol of Accessibility

In lieu of utilizing 2010 ADA Figure 703.7.2.1 “International Symbol of Accessibility” for all accessibility signage; the following likeness and description of the “International Symbol of Accessibility” will be utilized, as found at the following website:
http://www.accessibleicon.org/icon.html.

The use of this International Symbol of Accessibility is mandatory on all new construction and major renovation projects, as well as for all parking facilities. Small renovations would continue to use the current 2010 ADA Figure 703.7.2.1 symbol as to maintain signage consistency within a building.

Sample Icon

NAU'S Equivalent Facilitation Notes: NAU has agreed that slight variations on the historical "International Symbol of Accessibility" could be generally permissible as long as the symbol clearly displays a wheelchair and signifies accessibility. Please reference 2010 ADA section "**103 Equivalent Facilitation.** Nothing in these requirements prevents the use of designs, products, or technologies as alternatives to those prescribed, provided they result in substantially equivalent or greater accessibility and usability."; and 2010 ADA "**Advisory 103 Equivalent Facilitation.** The responsibility for demonstrating equivalent facilitation in the event of a challenge rests with the covered entity. With the exception of transit facilities, which are covered by regulations issued by the Department of Transportation, there is no process for certifying that an alternative design provides equivalent facilitation."

8.3. Accessibility

8.3.1. Building Basics

8.3.1.1. ADA Guidelines

- All work must conform to the 2010 ADA Standards for Accessible Design: https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards_prt.pdf.
- Design Professionals must consider the effects of renovations on the existing space with regard to accessibility, and in particular the path of travel in "an alteration that affects or could affect the usability of or access to an area of a facility that contains a primary function" (ADA Standards 2010). The 2010 ADA Standards for Accessible Design have a disproportionality measure if the alteration to an area exceeds 20% of the cost of the alteration to the primary function area. A worksheet and calculation example developed by NAU is available for assistance on this matter at: http://nau.edu/Facility-Services/DP_Contract/.

8.3.1.2. Reach Ranges

- The operable portion of building equipment and controls (such as electrical switches, fire alarm pull stations, above-work-surface telephone and data outlets, thermostats, elevator call buttons, etc.) shall be located no higher than 44 inches above the finished floor.

- Proximity door access card devices shall be used in areas where required for security. They will be centered no higher than 38 inches above the finished floor.
- Control plates for automatic door openers shall be centered 36 inches above the finished floor.

8.3.2. Accessible Routes

8.3.2.1. During Construction

- Renovations that temporarily eliminate building-wide accessibility accommodations (i.e. change of building entrance, access through building, accessible restrooms, elevators, etc.) shall provide comparable, temporary replacements-including temporary directional signage-for said accommodations.
- Construction fencing/staging, earthwork, temporary drainage conditions shall be designed to maintain existing accessible routes or alternative, temporary accessible routes-including temporary directional signage-shall be provided.
- Temporary ramps used during construction must comply with ADA Accessibility Guidelines (ADAAG) regulations.
- Refer to Division 1 for additional Contractor requirements.

8.3.2.2. Surface Materials

- Decorative ground surface treatments (i.e. exposed aggregate concrete, unit pavers, stone paving, etc.) shall not be on an accessible route.
- Granular surface materials used to create exterior paths of travel shall provide a stable surface that is usable during all weather conditions.
- Changes in surface material-both inside and outside-shall be provided with a durable transition/threshold that will meet the change in elevation height requirement throughout the life of the building/space.
- Granular surface materials may not be used on path of travel surfaces with a slope greater that 1:20.
- Owner's standard for detectable warning surface is truncated domes pavers.

8.3.2.3. Building Entrances

- The main entrance of a building shall be universally accessible via a single route.
- All building entrances shall be accessible-including employee entrances or entrances other than the main entrance.

8.3.2.4. Doors and Doorways

- Kick-plates shall be provided on non-latching/push-pull hardware-type doors.
- All latching door hardware shall be lever handle type.
- In the case of revolving doors being used, an adjacent single door, minimum 36 inches wide, mechanically operated, shall be provided.

8.3.2.5. Ramps

- Where changes in elevation are encountered (including courtyards and open spaces) full consideration shall be given to universally accessible design that addresses elevation change.
- Where grades/space allow, sloped sidewalks (slope 1:20 or flatter) shall be used to overcome changes in elevation.
- Ramps (defined as anything steeper than 1:20 slope) shall have a maximum of 1:16 slope.

8.3.2.6. Curb Ramps (curb cuts)

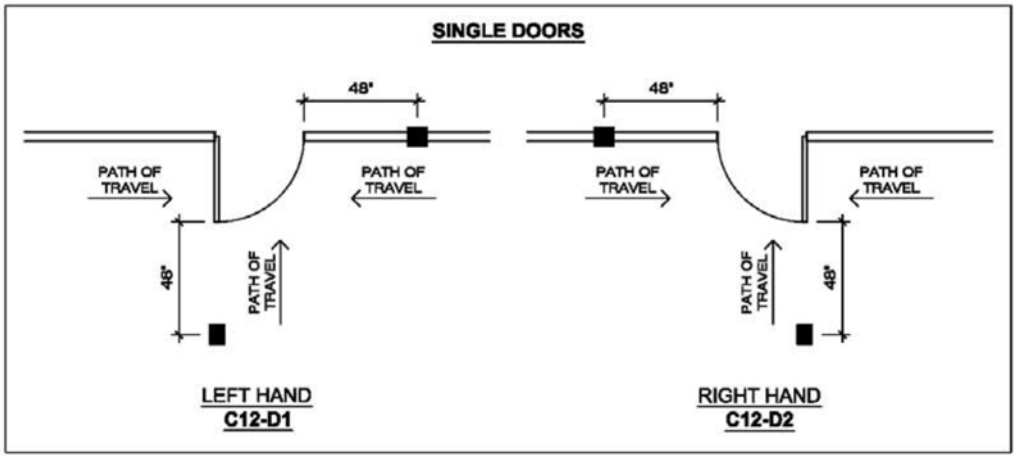
- Curb ramp slopes shall be 1:12.
- Concrete aprons shall be provided at the bottom of the curb ramps.
- Curb ramps within sidewalks (parallel to the path of travel) shall be provided with a 1:16 slope.
- Owner's standard for detectable warning surfaces is truncated domes in a contrasting color.
- The depth of detectable warning surface in the direction of travel shall not exceed 24 inches.

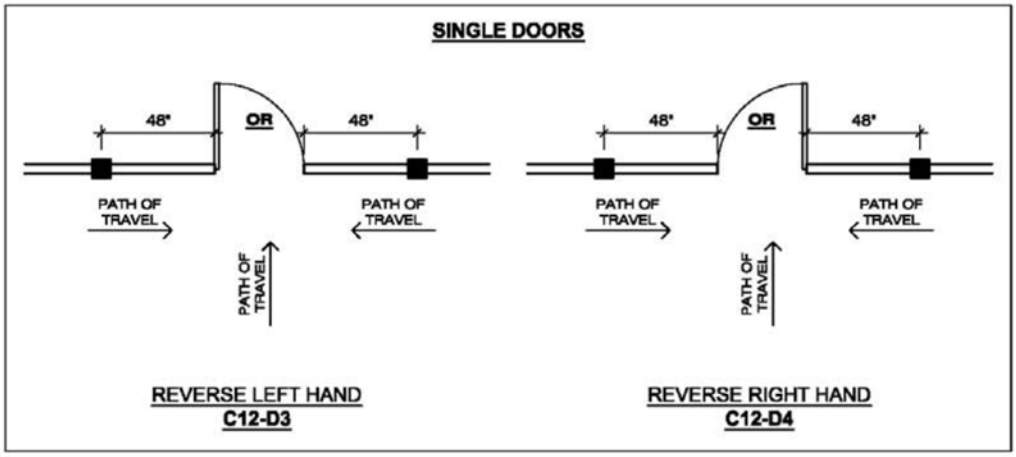
8.3.2.7. Automatic Door Operators

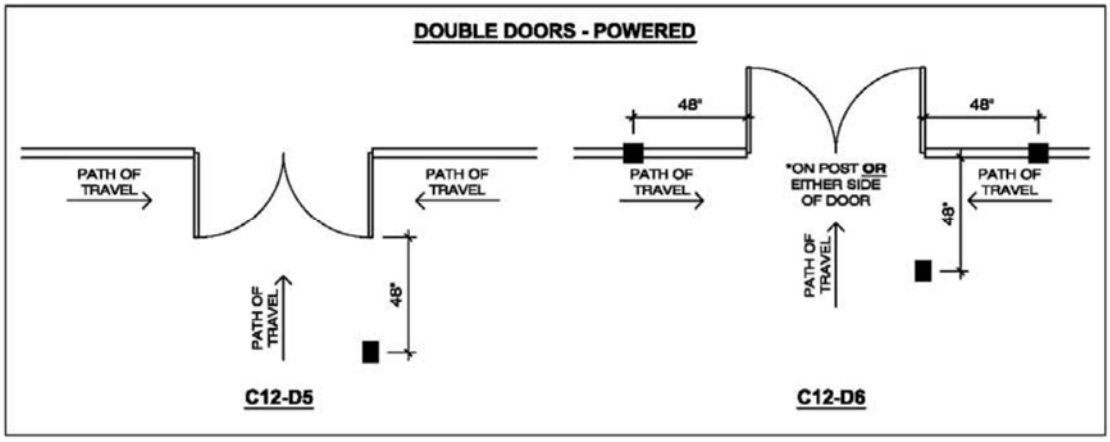
- Automatic door operators shall be installed at each entrance to a building.
- For guidance on horizontal placement of control plates for Automatic Door Operators, refer to diagrams C-12-D-1 through C-12-D-6 on next page. For vertical placement of control plate for Automatic Door Operators, refer to Section 1-Building Basics-Reach Ranges of the ADA Accessibility Guidelines (ADAAG 404.3).

8.3.2.8. Elevators and Lifts

- Elevator cabins shall be accessible.
- Platform lifts shall not be used.


SINGLE DOORS
48"
PATH OF TRAVEL
PATH OF TRAVEL
48"
PATH OF TRAVEL
LEFT HAND
C12-D1
48"
PATH OF TRAVEL
PATH OF TRAVEL
PATH OF TRAVEL
48"
RIGHT HAND
C12-D2


SINGLE DOORS
48"
OR
48"
PATH OF TRAVEL
PATH OF TRAVEL
PATH OF TRAVEL
REVERSE LEFT HAND
C12-D3
48"
OR
48"
PATH OF TRAVEL
PATH OF TRAVEL
PATH OF TRAVEL
REVERSE RIGHT HAND
C12-D4


DOUBLE DOORS - POWERED
PATH OF TRAVEL
PATH OF TRAVEL
PATH OF TRAVEL
48"
C12-D5
48"
48"
PATH OF TRAVEL
*ON POST OR EITHER SIDE OF DOOR
PATH OF TRAVEL
PATH OF TRAVEL
48"
C12-D6

8.3.3. General Site and building Elements

8.3.3.1. Parking Spaces

Intent, Purpose and Goals: The intent and purpose of these requirements are to establish minimum requirements to safeguard the public health, safety and general welfare of those individuals making use of "Accessible Vehicle Space(s)" and "Accessible route(s)" at vehicular traffic areas. They are not intended as a complete set of specifications for their construction.

It should be noted that the following items are in addition to Owner's adopted Codes and mandatory ADA requirements (see NAU Technical Standards Division 1, section number 01 41 13, "Codes"). For the purpose of clarity, additional items such as code & ADA requirements may have partially been replicated within these technical requirements.

General and Owner Technical Requirements: Accessible parking spaces and required accessible routes shall at least comply with Owner's adopted codes and mandatory ADA requirements. Additionally, it shall comply with the following additional Owner requirements, listed in subsequent sections.

Exception - Owner Technical Requirements: Where Owner determines that compliance with any section/item of the following Owner technical requirement(s) would create an unreasonable hardship, a variance or waiver may be requested in writing and granted when equivalent facilitation is provided. Approval must be granted by the enforcing organization. The enforcing organization shall at least include the NAU Project Manager, NAU Parking Services, NAU Equity and Access Office, and NAU Building Official (Additional approvals may be required, as determined by NAU Project Manager.)

8.3.3.2. Location of "Accessible Vehicle Spaces" and "Accessible route(s)" at vehicular traffic areas:

Accessible parking spaces shall be located so that persons with disabilities are not compelled to wheel or walk behind parked cars other than their own.

Exception: Parking spaces may be provided which would require a person with a disability to wheel or walk behind a parking space other than that person's own accessible parking space when the NAU enforcing organization determines that compliance with these regulations or providing equivalent facilitation would create an unreasonable hardship. The enforcing organization shall at least include the NAU Project Manager, and NAU Parking Services, and NAU Affirmative Action, and NAU Disability Resources, and NAU Building Official (Additional approvals may be required, as determined by NAU Project Manager.)

Crosswalk At Hazardous Vehicular Areas. When practical, the accessible route shall not cross lanes for vehicular traffic. When crossing vehicle traffic lanes is necessary (for example, such as but not limited to the following situations: Local fire engine access requirements prohibit parking immediately adjacent to a building. etc.) then the accessible route shall be designated and marked as a crosswalk. The crosswalk shall run perpendicular to the vehicular route.

Accessible Routes Located Alongside Hazardous Vehicular Areas. If an accessible route adjoins a vehicular way, and the walking surfaces are not separated by curbs or other elements (e.g. planters or other streetscape designs, parking spaces, etc.) between the pedestrian areas and hazardous vehicular areas, the boundary between the areas shall be defined by an approved continuous railing or other approved type of vehicle barrier.

Advisory note: Please be advised that as per the, "Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way" R208: "Detectable warning surfaces are not intended to provide way-finding for pedestrians who are blind or have low vision." https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/guidance-and-research/detectable-warnings-update

8.3.3.3. Dimensions, Marking and Identification of Surfaces, located at Accessible Parking Space(s) and Access Aisle(s):

Width: Accessible car parking space(s) shall be 108 inches (9 ft) wide minimum and van parking spaces shall be 132 inches (11 ft) wide minimum. Access aisles serving car and accessible van parking spaces shall be 60 inches (5 ft) wide maximum.

Non-Accessible parking spaces shall be 102 inches (8 ft 6 inches) wide minimum and 108 inches (9ft) maximum. The objective is to minimize the width of parking spaces, and maximize the total number of parking spaces in the space available.

Length: The minimum length of each accessible parking space shall be 18 feet (216 inches).

Marking of Ground or Surface at Accessible Parking Space: The accessible parking space shall be marked by a border painted with lines in yellow. The yellow painted lines shall be at least 4 inches wide, and shall be one consistent color.

Each accessible parking space shall have a surface identification duplicating the following scheme: By outlining an International Symbol of Accessibility on

the ground in the space in yellow on blue background. The International Symbol of Accessibility shall be a minimum 36 inches high by 36 inches wide (3 ft x 3ft) and shall be aligned with the end of the stall or space adjacent to the traffic aisle so that it is visible to a traffic enforcement officer when a vehicle is properly parked in the space.

Marking of Ground or Surface at Access Aisle: The accessible loading and unloading access aisle shall be marked by a border, whereas the painted lines are yellow and at least 4 inches wide. Within the border, hatched lines a maximum of 36 inches on center shall be at least 4 inches wide and painted Yellow. The words "NO PARKING" shall be painted on the ground within each 5-foot wide loading and unloading access aisle. This notice shall be painted yellow in uppercase letters, no less than 10 inches high, and clearly identifiable as written, and located so that it is visible to traffic enforcement officials.

Identification Signs: Marking symbols & wording (as noted above) painted over parking surfaces / access aisles must also be used to supplement the following identification sign requirements. Parking space identification signs shall include the International Symbol of Accessibility (please reference adopted codes and ADA for further requirements), and shall be installed in front of each accessible parking space. The signs shall be displayed on fixed mountings in an area where they are not hidden from view, and so they cannot be obscured by a vehicle parked in the space. An additional sign or additional language below the International Symbol of Accessibility shall state “NAU PERMIT REQUIRED”.

Directional Signage, Located between Accessible Parking and Building Entrances: Where there are inaccessible building entrances and inaccessible exterior routes, directional signage should be provided, indicating the nearest available accessible route to the nearest accessible building entrance or like accessible element. These directional signs shall include the International Symbol of Accessibility and directional arrow.

8.3.3.4. 8.3.3.4 Approvals & Permit Requirements:

Construction permits and plan review approvals are required for all new and existing “parking facilities” on campus, and under any one or more of the following circumstances:

- Re-striping, new striping.
- Resurfaced, resealed, newly surfaced, newly sealed.
- Addition or deletion of parking spaces.

- Newly installed or altered or changes to signs (those signs required by ADA, codes and these requirements.)
- Newly installed or altered or changes to accessible routes (those routes required by ADA, codes and these requirements.)
- As per ADA, the term "parking facility" is used instead of the term "parking lot" so that it is clear that both parking lots and parking structures are required to comply.
- Please be advised that all of the above circumstances trigger ADA mandatory requirements. It should also be noted that what some may consider as “only maintenance” may trigger ADA mandatory requirements.

Restriping and new striping: When a new or existing parking facility is striped or re-striped, all work must comply as required by the ADA requirements and applicable codes as well.
Re-striping (without resurfacing or resealing) also requires a permit from the Building Official. The new striping must exactly match the old striping. However, if the old striping and/or the sloped surfaces did not meet the current code and ADA requirements, then the new striping and/or the sloped surfaces will have to be modified to meet current code and ADA requirements. Plans submitted for permits shall identify whether any changes will have to be made to the current striping and/or the sloped surfaces to meet current code and ADA requirements.

Resurfacing and Resealing: Parking facility resurfacing and resealing requires a permit from the Building Official.

Parking Facility Layout: Fire lane requirements may need to be updated. Parking facility layout and aisle widths may be contingent on or determined by fire apparatus access route requirements. The location of fire hydrants shall also not be obstructed. Therefore, prior to striping and/or re-striping of any parking area, the requirements for fire apparatus access routes and location of fire hydrants shall be taken into consideration and approved as determined by the Fire Marshal.

Before allowing striping and/or re-striping of any parking facility on campus, an accessible route must be installed as required by the ADA requirements.

Although not a complete list of ADA scoping and technical requirements, here are a number of items to keep in mind. For a comprehensive and up to date list of requirements, please reference applicable NAU adopted codes and ADA mandatory requirements.

- There is no "grandfathering" for the required number of disabled parking spaces at existing or new parking facilities. The number of accessible spaces required is regulated by the ADA.
- Where more than one parking facility is provided on a site, the number of accessible spaces provided on the site shall be calculated according to the number of spaces required for each parking facility.
- Where parking spaces are marked with lines, width measurements of parking spaces and access aisles shall be made from the centerline of the markings. EXCEPTION: Where parking spaces or access aisles are not adjacent to another parking space or access aisle, measurements shall be permitted to include the full width of the line defining the parking space or access aisle.
- Accessible parking spaces and access aisles are required to be nearly level in all directions, except slopes not steeper than 1:48 shall be permitted for drainage purposes.
- Access aisles shall not overlap with the vehicular way. For safety reasons, it is important that the access aisle not overlap the road or driveway where vehicles could possibly strike the person emerging from their vehicle. This is especially important when parallel parking is provided.
- Two accessible parking spaces shall be permitted to share a common access aisle, and placed on either side of the car or van parking space. Except where van parking spaces are angled, access aisles shall be located on the passenger side of the parking space.
- Access aisles shall adjoin an accessible route. Accessible routes must connect parking spaces to accessible entrances. Accessible routes shall consist of one or more of the following components: walking surfaces with a running slope not steeper than 1:20, ramps and/or curb ramps not steeper than 1:12 (unless very specific exceptions are applicable), etc. In any event, cross slopes shall not be steeper than 1:48. Ramp runs shall always have landings at top and bottom, and in most cases curb ramps will require the same. Handrails and guard rails must also be considered.
- Parking spaces that serve a particular building or facility shall be located on the shortest accessible route from parking to an entrance.
- Where parking serves more than one accessible entrance, parking spaces shall be dispersed and located on the shortest accessible route to the accessible entrances.
- In parking facilities that do not serve a particular building or facility, parking spaces shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility.
- Parking spaces shall be permitted to be located in different parking facilities if substantially equivalent or greater accessibility is provided in terms of distance from an accessible entrance or entrances, parking fee,

and user convenience. Factors that could affect "user convenience" include, but are not limited to, protection from the weather, security, lighting, and comparative maintenance of the alternative parking site.

- In residential parking facilities, the requirements differ, therefore please reference Owner's adopted codes and ADA for these particular requirements.

8.4. Plumbing Elements and Facilities

8.4.1. General

- No vestibule (i.e. doors in series) entries into restrooms.
- All gender restrooms shall be accessible for the purposes of privacy and/or assisted use.
- Mirrors shall be full length or no more than 40 inches from floor to bottom of mirror.

8.4.2. Restroom facilities

- Single occupant public/employee restrooms shall be fully accessible.
- Private toilet rooms for employees shall be accessible for approach, entry and exit, and provided with a 5 foot turning radius.
- An all gender restroom shall be provided in all facilities as reasonably feasible (refer to Section 9 of these Design Guidelines for further information)A side approach toilet with a 5 foot turning radius located completely in the compartment shall be provided.
- Toilet paper dispensers shall be located:
    - With the front edge of the dispenser no further than 32 inches from the rear wall of the compartment.
    - Centered 26 inches above the finished floor
    - Below the side grab bar
- Toilet paper dispensers in accessible toilet compartments shall be continuous feed type dispensers; no separate sheet, controlled feed, or large roll dispensers shall be used.
- A coat hook 44 inches above the floor must be provided in the accessible toilet compartment.
- For wheelchair accessible door, door shall open in.
- Latching mechanism for accessible toilet compartment doors shall be operable with a closed fist.

8.4.3. Lavatories and Sinks

- The operable portion of soap dispensers, paper towel dispensers, and electric hand dryers shall be not more than 44 inches above the finished floor.
- Soap dispensers shall be operable with one hand, located within an appropriate reach range, and provided with clear floor space.

- A 29-inch knee clearance shall be provided under accessible sinks. "Extended" sinks (those with a deep front to back dimension) shall not be used to achieve the 29 inch knee clearance.
- Faucet must extend over the sink so there is sufficient space for hands to get wet.
- Adaptable sinks with accessible cabinetry (such as sinks found in employee kitchen areas, laboratories, dwelling units, etc.) shall be provided with a finished flooring surface in the under-cabinet space.

8.4.4. Shower Compartments

- In non-residential conditions, accessible showers shall be:
  - At least 60" X 36" with 60" X 60" being ideal
  - Transfer type entry
  - Provided with padded, fold down bench with integral support legs that extend the full width of the stall and located on the wall opposite of the controls/shower head
  - In communal showers, all the showering areas will be accessible to include hand-held showers, grab bars and fold out shower benches.

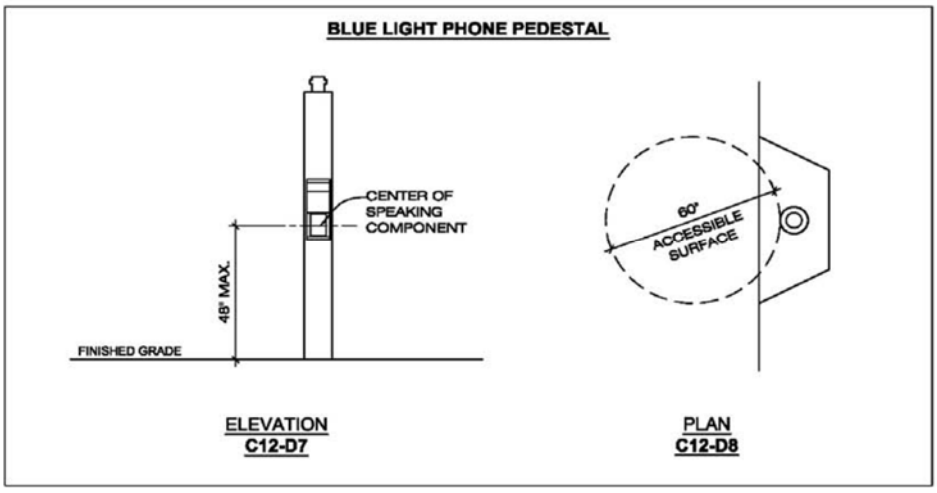
8.5. Communication Elements and Features

8.5.1. Assisted Listening Systems

- For ANSI or ADAAG required assisted listening system installations, consult with Owner (Office of Access & Equity) on the appropriate type of system for the building/space.

8.5.2. Emergency "Blue Light" Phones

- Access shall be provided to the emergency "blue light" phones. There should be an accessible approach and clear ground space in front of the phone with a 60 inch turning radius.
- Pedestal mounted emergency "blue light" phone shall be installed such that the center of the speaker is no higher than 48 inches above the surface of the clear ground space.



8.6. Rooms and Spaces

8.6.1. Signage

- All permanent rooms and spaces shall be identified with visual and tactile signs mounted 60 inches above the floor on the latch side of the door.

8.6.2. Auditoriums, Classrooms, Tiered Classrooms, and Assembly Areas

- A minimum 10% of total seating shall be accessible.
- Wheelchair accessible seating and companion seats shall be provided in a variety of locations throughout the seating area.
- Wheelchair access shall be incorporated in the primary access route to the stage/teaching station areas.
- In fixed seating situations, seats with fold up arms shall be provided.

8.6.3. Office Spaces

- Each individual office space in new facilities shall have sufficient clear floor space to accommodate a 5 foot turning radius.

8.6.4. Academic Laboratories

- Academic (teaching) laboratories shall be accessible. The accessible work stations shall provide, or have the capacity to provide, those elements of laboratory furnishings and equipment specific to the type of teaching expected to be conducted in the laboratory in question.
- Provide at least one wheelchair accessible workstation in each lab. The workstation shall include:
    - A bench space which is 7 feet long, adjustable in height.

  - A sink with faucet controls located on the side with single action lever controls or wrist blade handles.
  - Lab gases and power outlets located on the side of the bench or within 18 inches of the front edge of the bench with single action lever controls or wrist blade handles.
  - Storage facilities (for lab equipment/materials to be utilized by students in the lab) within ADA reach ranges.
- Where academic laboratories utilize fume hoods, provide at least one accessible fume hood with:
  - An adjustable height work surface.
  - Gas/services within the hood located on the side of the hood or within 18 inches of the front edge of the hood, with single action lever controls or wrist blade handles.
- Eyewashes/safety showers shall be independently accessible and operable by a wheelchair user.
- Aisles 42-48 inches wide are required for accessible benches and fume hoods.
- Where non-laboratory teaching amenities (writing surfaces, lecture areas, etc.) are provided within academic laboratories, at least one accessible workstation which includes such amenities shall be provided.
- Specific purpose teaching facilities (balance or tissue culture rooms, etc.) shall provide a wheelchair accessible space with:
  - A 5-foot diameter radius within one room.
  - An adjustable bench space.

8.6.5. Research Laboratories

- Research laboratories shall have provisions for wheelchair accessibility. The accessible workstation(s) shall provide, or have the capacity to provide, those elements of laboratory furnishings and equipment specific to the type of teaching expected to be conducted in the laboratory in question.
- Individual research laboratory rooms assigned to specific employees are considered employee work areas. For employee work areas, basic access is required for approach, entry, and exit.
- Research laboratory rooms with open assignment workstations/bench space shall be provided with at least one accessible workstation with:
  - A bench space 7 feet long, adjustable in height.
  - A sink with faucet controls located on the side (not rear) with single action lever controls or wrist blade handles.
  - Lab gases and power outlets located on the side of the bench or within 18 inches of the front edge of the bench with single action lever controls or wrist blade handles.
  - Aisles 42-48 inches wide for accessible bench space/hoods.
  - Storage facilities within ADA reach ranges.

- Shared, specific purpose research laboratory rooms in open assignment research laboratories shall be provided with at least one wheelchair accessible workstation/hood with a 5 foot turning radius and an adjustable table.
- Shared fume hoods in open assignment research laboratories shall provide at least on accessible fume hood with:
    - A maximum of 32-inches high work surface with 29-inch clearance below.
    - Gas/services within the hood located on the side of the hood or within 18 inches of the front of the hood, with single action lever controls or wrist blade handles.

8.7. Built-in Furnishings and Equipment

8.7.1. General

- When unfixed furniture may be moved into the path of travel, 42-48-inches aisles for clearance/maneuvering shall be provided.

8.7.2. Seating at Tables, Counters and Work Surfaces

- The top of built-in work surfaces (computer tables, study carrels, etc.) can be of varying heights, but at least 10% of the surfaces must be ADA accessible that blend with the overall space.
- The minimum clearance below built-in furniture shall be 29-inches above finished floor.
- Accessible height service/reception counters 34-inches above finished floor-shall be located at the primary queuing point or staffing location.

8.8. Dwelling Units

8.8.1. General

- Residence halls shall provide all residents and visitors access to all publically available areas of the facility.

8.8.2. Entrances

- All accessible building entrances to residence halls shall be provided with the infrastructure to permit unlocking the doors with a proximity card and permit opening with an automatic door operator.

8.8.3. Paths of Travel

- Stairs and elevators shall be located on a common route within the building.
- Interior doors along the path of travel to accessible rooms and those to building-wide amenities/services (i.e. kitchen, laundry, study/common rooms, etc.) shall be provided with automatic door operators.

- The location of accessible rooms [1] in residence halls shall be:
    - On a convenient path of travel from the main entrance and elevator.
    - Close to building-wide amenities/services.

8.8.4. Doors

- Accessible rooms on all floors of a residence hall shall be provided with the infrastructure for automatic door operators.
- If "peep holes" are provided to residence rooms, provide an additional "peep hole" at 48 inches above the finished floor in the doors of accessible rooms.
- Infrastructure of door knock signalers (i.e. strobes) shall be provided for the entry doors to accessible rooms and the doors to bathrooms attached to accessible rooms.

8.8.5. Bathrooms

- Shower compartments in residential condition accessible bathrooms shall be:
    - Roll in showers
    - A 60" X 60" dimension
    - Provided with a padded, fold down bench with integral support legs installed on the wall adjacent to the controls/shower head.
- Accessible lavatories in residential condition accessible bathrooms shall be provided with counter top space (to accommodate personal care items).

8.9. Codes and Standards

It is the intent and purpose that all construction projects conform to the requirement standards for persons with disabilities as set forth in the 2010 ADA Standards, as adopted by the Department of Justice (DOJ) in September 2010 and their related standards as they apply. Compliance shall conform to the requirements of the latest editions of all state regulations and the various codes which have been adopted by the Owner at the time of bid.

9. ALL GENDER RESTROOM REQUIREMENTS

The Owner is committed to designating and maintaining a minimum of one all gender restroom (AGR) in as many of its buildings as reasonably feasible. Therefore the following criteria should be followed:

9.1. WHERE REQUIRED

- **New Buildings** - A minimum of one AGR shall be provided in each new building.
- **Building Expansions** - Major building expansions should include an AGR unless it is determined that the existing facility has a restroom that can be designated or converted as part of the project scope.
  - If only one AGR can be provided in an existing building, that AGR must meet all ADA code and regulations.
- **Renovations** – For purposes of determining the need of an AGR, renovation projects are defined as those projects involving the alteration of a portion of an existing building. Renovations range from simple aesthetic improvements to complex physical reconfigurations and systems replacement. Due to the potential range of existing conditions – and the ability of a renovation project to address such conditions – it is incumbent that each renovation project undergoes an evaluation early in the design process to outline the scope of compliance which can be achieved.
  - If only one AGR can be provided in an existing building, that AGR must meet all ADA code and regulations.

In general, addition of AGRs should be considered for all projects including minor renovations. For projects where major bathroom renovations are part of the scope, addition of one AGR, should be included. For major renovation projects affecting entire floors or buildings AGRs should be provided if reasonably feasible.

- **Residential Facilities** - Because of the variety of facilities that Owner manages, the Design Professional shall discuss with the Owner specific project requirements and criteria.

9.2. DESIGN CRITERIA

- An AGR consists of a single room with its own door and shall have a privacy latch.
- Accessible AGRs shall not be used as a substitute for providing accessibility to multi-stall restrooms.
- The plumbing fixtures in AGR restrooms shall count towards the total fixture counts required by code. Only one (1) toilet shall be provided.
- In new construction, **all** AGRs must be ADA compliant.
- In new construction, each AGR shall include one (1) baby diaper changing table. ADA clearance is required even with baby changing station down (clear floor space).

- In a renovation where a single gender restroom is converted to an AGR, new construction standards shall be followed.
    i. If there is only one AGR in a building, it needs to be ADA compliant.
    ii. If there is more than one AGR in a building, AGRs beyond the first ADA compliant do not have the requirement to be ADA accessible.
- Refer to other sections of these Design Guidelines as applicable for plumbing and bathroom accessory criteria, but at a minimum must follow the following:
    i. All gender restrooms shall not contain more than one lavatory, and two water closets without urinals or one water closet and one urinal.
- All other applicable codes and regulations shall be incorporated.

9.3. SIGNAGE

All AGRs will be designated as "ALL GENDER RESTROOM" with the following standards:

- There shall be no male or female symbol.
- If the AGR is ADA accessible, the ADA wheelchair symbol shall be used.
- A baby changing station symbol.
- All Gender Restroom in Braille.

Below is a sample of an acceptable sign for the door and the baby diaper changing station:

10. LACTATION ROOM REQUIREMENTS

A lactation room is a non-bathroom space allocated for the privacy of expressing breast milk.

10.1. WHERE REQUIRED

- **New Buildings** - Must have one lactation room.
- **Building Expansions** - Major building expansions should include a lactation room unless it is determined that the existing facility has a room that can be designated or converted as part of the project scope.
- **Renovations** - Due to the potential range of existing conditions – and the ability of a renovation project to address such conditions – it is incumbent that each renovation project undergoes an evaluation early in the design process to outline the scope of compliance which can be achieved.

10.2. DESIGN CRITERIA

- The room shall be fully ADA accessible.
- It shall be a private room, free from intrusion of co-workers, students, the public, etc. This shall be achieved through:
    - SCHLAGE CO-200 Series (code access) on the outside entrance of the room.
    - Ability to lock it from the inside of the lactation.
    - Occupation signage on the outside of the room to indicate if the room is in use or not.
- It shall be located in a safe area accessible to all. It should not be located in areas that would not be suitable for the preparation and storage of food.
- A flat surface or table (not the floor).
- A place to sit (not the floor).
- A sink with hot and cold running water
- A refrigerator
- Access to electricity
- A trash receptacle
- A storage cabinet or locker
- When possible, the design should provide:
    - Soft and/or natural lighting
    - Calming décor

10.3. SIGNAGE

The room shall be designated as “Lactation Room” with braille and the international symbol of accessibility. There shall also be a switch sign to indicate the room is in use. An example is illustrated below.


VACANT

11. CUSTODIAL PLANNING AND DESIGN

11.1. GENERAL

Custodial services are inherent to the operations of buildings and proper service areas must be considered with all other areas during the programming and planning stages of each building.

Universally accepted standards have yet to be set for custodial closets and storerooms. Certain criteria however, for size, shape, location, and special appurtenances, have been developed which are compatible with present cleaning procedures and today's cleaning equipment.

Comprehensive custodian operations encompass four major areas:

- Custodial closets
- Custodian storage areas
- Recycling and solid waste disposal systems
- Vertical transportation of custodial equipment

11.2. CUSTODIAN CLOSETS

The custodial closets should be planned to function primarily as the workrooms of people responsible for cleaning the interior surfaces of the building. CO-LOCATION OF UTILITIES IS NOT ALLOWED: Telephone switching gear, elevator controls, electric panels water heaters, pipe chases or other service functions are not compatible with custodian operations, and should not be located inside custodian closets. Openings to pipe chases or mechanical equipment areas should also not be located inside custodian closets.

Northern Arizona University has developed the following criteria for custodian closets:

- Size should be a minimum of 92 square feet, with an eight-foot minimum width.
- Recessed light fixtures (to allow for clearance of long broom and mop handles) providing 75-foot candles of light.
- Adequate ventilation for code requirements.
- Pegs for storage of rotary brushes.
- Hangers for wet mops over the sink.
- Hangers and wall space for dust mops and brooms.
- Where a mop sink is needed, the mop sink shall be mounted at floor level.
- Hard surface walls impervious to water at wet walls (i.e. around sinks). Floors of sealed concrete or epoxy flooring.
- Shelves in closet to accommodate supplies in case lots, and to allow for storage of liquids in original 5 or 6 gallon containers. Additional shelving (minimum 11-inches deep) shall be mounted at five-feet high to accommodate light containers and provide clearance for machines storage.

- A 36-inches wide door that swings out, not into the room.
- Reinforced hot and cold water outlets shall be provided with institutional grade hardware and shall be mounted not less than 24-inches above a floor type basin. Basin curb should be 8-inches minimum above the floor.
- A minimum of 5 feet x 2 feet open area to allow for the vacuum unit storage.
- A grounded 20 Amp. Duplex outlet in open wall space, not behind shelves, for recharging battery operated equipment. A minimum of three GFI duplex electrical outlets shall be provided.
- All floors sloped to floor drain at a minimum ¼ inch per foot to the drain
- At least one floor drain for the closet

Location of custodian closets is very important. They should be centrally located with multiple closets as needed so that no area in a building is more than 150 feet in walking distance from a "wet" closet. Each closet should not serve in excess of 15,000 square feet.

Buildings should have custodian closets on every floor. Good locations for secondary custodian closets are:

- Close to elevators
- Close to main pedestrian areas
- Between two restrooms

It is considered poor planning to locate a custodian closet:

- At the dead end of a corridor. A situation such as this results in many unnecessary steps for the custodian.
- On a stair landing. A stair-landing closet would cause the custodian to always carry utensils and equipment up and down stairs.
- Inside another room (unless that closet serves only that room).
- Under stairs. Low ceilings and narrow dimensions are hard to ventilate.
- In narrow spaces. The custodian must move equipment into the hall to utilize a narrow room. Square shaped closets are most efficient.

11.3. CUSTODIAL STORAGE ROOMS

- Every large building should have a storeroom for custodian equipment, bulk supplies and custodian lockers. Buildings larger than 150,000 sq.ft. should contain two such rooms. Storage areas should be designed specifically for custodian storage, <u>not for dual usage.</u> Planning should be done in consultation with those who will be responsible for maintaining the building.
- Locking cabinets should be provided for supplies.
- Dock or elevator facilities must be provided.
- Doors should be no less than 36 inches wide and open out. Storage areas should contain a minimum of 144 square feet. 12 feet x 12 feet are good dimensions.

11.4. RECYCLING AND SOLID WASTE DISPOSAL SYSTEMS

No special waste management rooms or areas are required for gathering or sorting materials.

The design of areas adjacent to the source of recyclable waste generation shall include additional space for collection of recyclable materials as follows:

- Copy Rooms: Paper from copy rooms: 24-inches deep x 22-inches wide minimum
- Common Areas: Newspaper collection bins: 24-inches deep x 22-inches wide minimum
- Vending Areas: Aluminum collection bins: 22-inches deep x 12-inches wide minimum
- Restrooms, break rooms, lounges, and vending areas: Wet waste collection bins: 24-inches deep x 22inches wide minimum

12. CLASSROOM AND OFFICE DESIGN GUIDELINES

This section is divided into the following areas:

12.1. Overview

The intention of the *Classroom and Office Design Guidelines* is to regard these spaces more judiciously, to ensure that new construction and renovation is planned realistically, efficiently, carefully and conservatively. Promoting optimum use and conservation of these spaces in existing and renovated buildings is imperative to the overall mission of Northern Arizona University. These guidelines are intended to help create a dialog during the early planning process and assist in determining the most important criteria that should be addressed during classroom and office design. It is also important for these guidelines to remain flexible for the needs of Northern Arizona University in the future.

12.2. Design Review and Approval

All classroom and office designs must be approved in writing by Owner (Planning, Design and Construction group [PDC]).

12.3. Classroom Space Design

12.3.1. Classroom Space Utilization

University classrooms are rooms used for scheduled classes that are not limited in their use to a specific subject or discipline. University classrooms include general-purpose classrooms, lecture halls, seminar rooms, auditoriums, and computer classrooms. In the calculation of space utilization, classroom space is defined as the square footage within the walls including the seating area, the circulation space, any instructor/demonstration area, and storage/service area associated with the room.

Utilization of classrooms is defined by the student station size, room use in terms of hours per week, and station/seat occupancy rate. Spaces can vary by academic program depending upon the existing or desired mix of classroom capacities, size of the program, hours of use and types of programs. The station/seat space factor includes an allowance for students, instructor, internal circulation and 5% service. It can vary by room subtypes and type of seating, and depends upon the desired mix of room capacities. Design Professionals

shall consider the geometry of the room, since form can also impact the capacity of the room rendering a less efficient space.

12.3.2. Pedagogy and the Learning Environment

Technological advancements and accessibility of media at a lower cost, and subsequent changes in pedagogy all place demands on the physical space. There is still a need for lecture type rooms where seat count can be maximized by the nature of the learning method (instructor in front with presentation area, rows of seats). Yet, there is also an increasing need for rooms that can accommodate a variety of teaching methods, quick reconfiguration, and technology.

Recent programming exercises for new buildings and subsequent feedback on the use of the current classrooms have rendered the following valuable information:

- Faculty demand for flexible space in classrooms
- Faculty and student demand for collaborative work spaces
- Faculty and student demand for advanced technology classrooms
- Ever increasing demand for special needs student furnishings.

12.3.3. Room Definitions – Space Standards

Different pedagogical techniques require different types of learning spaces. NAU has defined six basic classroom types that are prevalent on its campuses. The recommended square footage requirements reflect the pedagogical style, and take into consideration the diversity of cultural values regarding personal space.

12.3.3.1. Classroom: Traditional, Loose Seating

Traditional classrooms are the most common learning spaces. They have movable furniture, and are very flexible. Furniture can be rearranged to allow for lecture, seminar, group work, or anything else the instructor might require.

- Traditional classrooms contain 25 to 60 non-fixed seats.
- Flat floors are required.
- The first row of student seating should be a minimum of 1.5 times the width of the projection screen from the front of the room. Example: projection screen size 90”H x 120”W, first row of student seating would be 15’-0” from front of room. If not possible to maintain formula outcome, allow a minimum of 9 feet from the front of the room to the first row of seats.
- The instructor’s station is 10 square feet.
- 20 - 22 square feet per student accommodates some collaborative functions.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space.

12.3.3.2. Classroom: Traditional/Collaborative

Collaborative classrooms are a subset of traditional classrooms in which the teaching methods require group work. The furniture is movable and flexible.

- Traditional/collaborative classrooms contain 25 - 40 non-fixed seats.
- Flat floors are required.
- 25 - 30 square feet per student accommodates flexibility in furniture arrangement to meet most types of pedagogy.
- Larger, flat work surfaces (sometimes achieved by pushing desks together)
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space

12.3.3.3. Classroom: Seminar

Seminar rooms generally accommodate smaller numbers of students seated in any number of seating configurations.

- Seminar rooms contain 19 - 25 seats.
- A face-to-face seating arrangement is possible.
- The instructor sometimes sits with students.
- 25 - 30 square feet per student accommodates this type of pedagogy.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space.

12.3.3.4. Lecture Halls

Lecture halls are larger tiered classrooms, usually with either fixed seating or fixed tables and movable chairs.

- Lecture Halls contain 50 - 150 seats
- Tiered floors (aisles may be sloped but seating areas must be tiered)
- The dimensions of the seating tier or tray must easily accommodate movement behind seats
- Theater-style seating with attached tablets (preferably retractable) or fixed tables with freestanding chairs.
- A curved configuration is preferred where possible
- 18 - 20 square feet per student overall, but at least 10.5 square feet per students for the seating area, allows for ample circulation amongst the seats.
- The square feet per student ratio is proportionate to the space associated with the podium/front of room, and amount of circulation space required. If the function of the room requires a large stage area or specific circulation pattern, the overall square feet per student may be over guideline.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space**.**

12.3.3.5. Auditoriums

- Auditoriums contain more than 150 seats, with a practical upper limit of around 300
- Aisles may be sloped but all seating areas must be tiered
- Theater-style seating with attached tablets (preferably retractable) are allowed
- A curved configuration is optimum
- 18 square feet per student overall, but at least 6.5 square feet per student in the seating area, allows for ample circulation amongst the seats.
- The square feet per student ratio is proportionate to the space associated with the podium/front of room, and amount of circulation space required. If the function of the room requires a large stage area or specific circulation pattern, the overall square feet per student may be over guideline.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space**.**

12.3.3.6. Computer Classroom

Computer classrooms are specific to the prescribed instruction mode.

- 32 square feet per student accommodates the larger station sizes for equipment and writing space, and generous aisle widths to allow unobstructed instructor movement behind seated students.
- Design for future, and current cabling and electrical requirements.
- Design space for alternative technology set ups:
  - Desktop computer provided where furniture is typically fixed and technology secured, software is necessary.
  - BYO (bring your own) technology where the furniture is flexible and the room supports mobile technology.
- Rooms may need additional HVAC, because of the added heat from numerous machines. This can be reduced if using energy saving designs and software settings.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space**.**

12.3.3.7. Vocational & Laboratory Spaces

Reference the Laboratory Planning & Design section of these Design Guidelines for design specifications for this space type.

12.3.4. General Application

12.3.4.1. Locations

- Classrooms shall be located no more than one floor up or one floor down from the main entrance to the building.

- In such cases, elevator studies must be provided to satisfy movement requirements especially between class changes.
- Classrooms shall be located away from noise generating areas such as mechanical rooms, elevators, vending machines, and restrooms. If physical separation is not feasible, increased acoustical treatments are needed.

12.3.4.2. Hallways/Corridors

- Hallways should not only be part of the building design and aesthetics, but shall be viewed as an extension of the learning environment. They shall always be visually interesting.
- Egress hallways shall be sized to accommodate at least double the loads identified in code due to the large number of students leaving and entering the rooms.
- Gathering space shall be provided in the hallways for in between classes.
- Hallways are an opportunity to improve classroom acoustics.
- Non-recessed doors that open into the hallways are prohibited.
- Hallways are opportunities to incorporate built in seating for waiting space outside of large auditoriums or lecture halls.

12.3.4.3. Informal Interaction Spaces

The design of adjunct teaching/learning space for small or one-on-one collaborative and instructional interaction is encouraged. Small spaces can be incorporated within lobbies, hallways or any other architectural opportunities that might be present.

- **Touch down space**: these can be café height surfaces with a public access computer to briefly check email or to surf the web. Typically, they are not designed to encourage the user to stay for any extended period of time. This can be done by not providing a chair or by providing a high stool.
- **Space for quiet study:** Table space to spread out work, wireless and /or wired internet connection, plentiful outlets for power, comfortable ergonomic furniture, quiet surroundings, appropriate ambient temperature, natural light when possible, and location should be separated from busy areas but not cloistered.
- **Group study area**: Moveable furniture including tables, white board, wireless internet connection, plentiful outlets for power, comfortable, ergonomic furniture, appropriately quiet (no loud HVAC or other environmental noises,) appropriate ambient temperature, natural light when possible, location should be separated from busy areas but not cloistered,.
- **Informal meeting area:** includes areas outside of classrooms where students can continue classroom conversations with faculty: Some degree of privacy for conversations, white board, natural light when possible,

comfortable, ergonomic furniture, appropriate ambient temperature. Ideally these areas should also have power outlets, wireless internet, and either projectors or large display screens to plug into.

12.3.5. Universal Design Considerations

12.3.5.1. Principle One: Equitable Use

The design is useful and marketable to people with diverse abilities.

- Provide the same means of use for all users: identical whenever possible, equivalent when not.
- Avoid segregating or stigmatizing any users.
- Provisions for privacy, security, and safety should be equally available to all users.
- Make the design appealing to all users.

12.3.5.2. Principle Two: Flexibility in Use

The design accommodates a wide range of individual preferences and abilities.

- Provide choice in methods of use.
- Accommodate right- and left-handed access and use.
- Facilitate the user's accuracy and precision.
- Provide adaptability to the user's pace.

12.3.5.3. Principle Three: Simple and Intuitive Use

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- Eliminate unnecessary complexity.
- Consistency from one room to the next.
- Be consistent with user expectations and intuition.
- Accommodate a wide range of literacy and language skills.
- Arrange information consistent with its importance.

12.3.5.4. Principle Four: Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

- Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.
- Provide adequate contrast between essential information and its surroundings.
- Maximize legibility of essential information.
- Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).

12.3.5.5. Principle Five: Tolerance for Error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

- Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.
- Provide warnings of hazards and errors.
- Provide fail-safe features.
- Discourage unconscious action in tasks that require vigilance.

12.3.5.6. Principle Six: Low Physical Effort

The design can be used efficiently and comfortably, and with minimum fatigue.

- Allow user to maintain a neutral body position.
- Use reasonable operating forces.
- Minimize repetitive actions.
- Minimize sustained physical effort.

12.3.5.7. Principle Seven: Size and Space for Approach and Use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

- Provide a clear line of sight to important elements for any seated or standing user.
- Make reach to all components comfortable for any seated or standing user.
- Accommodate variations in hand and grip size.
- Provide adequate space for the use of assistive devices or personal assistance.

12.3.6. Classroom Interiors

12.3.6.1. Design

Classrooms should be developed and designed from the “inside out”. The following items shall be considered when creating a new classroom:

- The optimum orientation and shape of the classroom shall be determined by the primary expected teaching style, the capacity of the room, and the level of mediation.
- Designing for the flexibility of room use is necessary. The more square footage allotted to each student, the greater the opportunity for flexibility.
- The total square footage of each room is to be based on the type of classroom, the specific capacity and the type of seating, as specified in 12.3.3 Room Definitions.
- Classrooms with a capacity of 49 or less are to be as square as possible to allow for greater flexibility in furniture arrangement, and better sight lines.

- Generally, classrooms should be sized in a 2:3 or 3:4 width to length ratio. Long, narrow, "railcar"-style rooms are not acceptable.
- Every seat must have an unobstructed view of the teaching wall. No columns or other visual obstructions are allowed.
- In classrooms where the instructor's workstation is movable, adequate space must be provided to allow the workstation to be positioned at least three feet away from the teaching wall. In classrooms with fixed tables and/or fixed seating, the front edge of the instructor's workstation must be at least six feet from the front row.
- Thoughtful placement of utilities (lectern power and data cord, power outlets, room controls, network jacks, etc.) based on anticipated use and room flow patterns may be in the floor, on the walls, or mounted to fixed furniture. Shall be designed with consideration to possible spills, dirt, tripping hazards.

12.3.6.2. Door/Room Security/Floors

12.3.6.2.1. Door Hardware

All classroom doors shall conform to Division 8 of the NAU Technical Standards.

12.3.6.2.2. Doors

- Doors shall be located at the back of the classroom to ensure that students who are entering or exiting the space will not disrupt instruction. Exceptions include large tiered classrooms or auditoriums, since those types of spaces can require multiple doors. In rooms that require two or more egress points, the doors should be located as far from the presentation area as possible while still meeting current building codes.
- Each door leaf to be a minimum of 36" wide, including those used in pairs at double doors.
- No strike mullion on double doors. Where exit double doors require a strike mullion, the mullion must have the ability to be removed.
- Occupancy within the classroom should be clearly (but discretely) visible from the hallway. Any viewing device must be positioned to meet ADA standards. Door shall be equipped with a vision panel made of shatterproof glass and tinted to reduce light transmission. The area of the glass shall not exceed 100 square inches and should be double-paned with acoustically rated seals. Doors without vision panels shall have a sidelight to provide a view into the room to check activity.

12.3.6.2.3. Windows

Daylight is an important part of most learning environments. Windows should be included in classrooms whenever possible. Windows must comply with the "Glass and Glazing" specifications in Division 8 of the Technical Standards.

- For window covering specifications reference Division 12 of the Technical Standards.
- Interior windows shall be considered during the design phase of learning spaces in order to provide a sense of openness.

12.3.6.2.4. Flooring

- When selecting flooring finishes; refer to the specifications in Division 9 of the Technical Standards.
- If carpet cannot be installed underneath fixed seating, all aisles and other open areas must be carpeted.
- All aisle risers must be of contrasting color to the remaining floor to highlight level change.
- Aisle riser nosings are preferred to be vinyl, metal or rubber.

12.3.6.3. Wall and Ceilings

12.3.6.3.1. Walls

- Refer to the specifications in Division 9 of the Technical Standards.
- Internal classroom walls shall run deck-to-deck, with a Sound Transmission Coefficient (STC) rating of 50 minimum.
- Folding or moveable walls must meet the STC rating of 50 and shall be specified for unique use only.
- Walls in lecture halls shall be designed to provide the optimum acoustical environment.

12.3.6.3.2. Walls Protection

- Apply chair rail on the rear and side walls of classrooms that contain movable student furniture.
- Chair rail material shall be wide enough to work with tables and chairs of varying proportions and must be mounted at a height that will prevent damage to wall surfaces. Typically, the chair-rail will be 6" - 10" wide and the bottom edge will start approximately twenty-five inches above the finished floor.
- Rails shall match the design of the room.
- Outside wall corners (such as entry recesses) shall receive corner guards 4'-0" above finished floor (AFF) applied so that students cannot work them loose.

12.3.6.3.3. Ceilings

- Refer to the specifications in Division 9 of the Technical Standards.
- To accommodate classroom lighting and technology requirements, the ceiling height of all classrooms shall be no less than twelve feet above the finished floor.
- In large sloped or tiered classrooms, the ceiling height is directly related to the distance from the front of the room to the last row of seats. Ceilings in lecture halls should be at least nine feet high at the rear, and the ceiling height at the front of the room must accommodate the appropriate screen size.
- The ceiling should act as a sound mirror, reflecting sound downward to blend with direct sound.
- Access for the maintenance of technology, power, etc. must be included where applicable Running wide low-voltage cable conduits inside the drywall with regularly spaced access points can assist in rewiring.

12.3.6.3.4. Vertical Writing Surfaces

- For specifications for vertical writing surfaces reference Division 10 of the Technical Standards.
- Multiple boards may be required depending on programming.
- Boards should be located on at least two different walls. A board must always be installed on the front teaching wall; the other wall/walls should be selected as appropriate to the layout of the room.
- **NOTE**: Single boards may not be longer than 12 feet (accessibility to classrooms through doors and elevators)

12.3.6.4. Signage

12.3.6.4.1. Room Identification Sign

Each room will have a standard room identification sign mounted near the door on the lockset side (exterior of room), mounted at a height as indicated by the ADA Standards for Accessible Design. Braille lettering is required on the sign to identify the room as well. Standard room ID sign is a modular sign produced by Owner (Paint department) consisting of (3) 3” x 9” panels and (1) 9” x 11” clear plastic page holder. For signage guidelines reference Division 10 of the Technical Standards. Signage needs to be legible from a distance and while moving in the traffic flow. It should be of high contrast and self-explanatory. For

Room Numbering guidelines reference Section 4 of the Design Guidelines.

12.3.6.4.2. Bulletin Boards

- Provide at least one 48" x 48" bulletin board in each room.
- Location and finishes of the bulletin boards will be determined at design.
- The department reserves the right to review all posting and remove anything they deem inappropriate; such as postings for other universities, non-NAU sponsored events & for profit business advertising.

12.3.6.4.3. Maximum Occupancy Sign

Provide maximum occupancy sign to be mounted in rear of room at a height high enough to discourage students from removing it. Size to be 8" x 11" minimum.

12.3.6.5. Colors/Finishes

- Accent walls are desired. Avoid using accent color on walls that might reflect onto projection screen.

12.3.6.6. Reflectance Values

The following reflectance values for finish materials are required:

- Non-accent walls - between 50% and 70%
- Floors - between 20% and 40%
- Ceilings - 80% or higher

Reflectance values of paints, laminate and other finish materials should be selected to enhance ambient illumination and the illumination at the instructor's and student's work areas. Recommended value - between 40% and 60%.

12.3.6.7. Display of US Flag, US Constitution, and US Bill of Rights

In accordance with ARS, "All classrooms in the State of Arizona are to be equipped with a United States flag and copies of the Constitution of the United States and the Bill of Rights." United States flags must be manufactured in the United States and be at least two feet by three feet. Hardware must be specified to appropriately display the United States flag. Flags in classrooms shall be displayed in accordance with Title 4 of the United States Code. The legible copy of the Constitution of the United States and the Bill of Rights must be manufactured in the United States, and shall be displayed adjacent to the flag.

12.3.6.7.1. Flag Location

- Flags should be hung in the front of each room in a holder attached directly to wall.
- The flag should not interfere with the screen, the writing surface, or any other classroom activity.

12.3.6.7.2. Constitution/Bill of Rights

- Install the documents next to the writing surface in the front of each room, behind the instructor, adjacent to the wall mount flag or as appropriate for the layout of the room.

12.3.7. Furniture

Consult Owner for all current furnishing specifications.

12.3.7.1. Tables/Work Surfaces

12.3.7.1.1. Design Standard

- Tables shall provide a minimum of 30” width of space per student. The number of students per table is flexible and is determined by the type of classroom and the configuration of the classroom.
- To allow for note taking and reference materials the minimum work surface area should be 3.75 square feet per occupant.
- Depths of tables can vary from 18”-30” based on room layout.
- Modesty panels are allowed and encouraged when applicable.
- Fixed tables with cantilevered pivot arm seats are not allowed (because they are wheelchair inaccessible). If fixed tables are installed, provide loose seating with casters.
- Furniture must be able to interface with technology (i.e. pathway for power/data), based on Owner technical standards.
- When tablet arms are specified the following criteria must be met:
- Provided tablet size should be equal to or larger than 12 inch x 15 inch (1.25 square feet).
- 10% of the tablet work surfaces should have a left-handed orientation or be left-right reversible.

12.3.7.1.2. Construction/Fabrication

- Laminated work surfaces shall be constructed of plastic laminate applied to MDF (Medium-Density Fiberboard) or hardwood plywood. Tops shall have a non-glare, medium tone surface to reduce eye strain.
- The legs of fixed tables should not block the student’s knee space within the 30-inch work space allotment. Table legs should not

impede configurations that allow additional students to work collaboratively.
- Table edge to be a heavy-duty extremely durable material.
- Tables to withstand loading of 300 lbs. of applied load (people sitting on table) per linear foot.
- Rounded corners preferred over sharp 90 degree corners.

12.3.7.1.3. Clearances

Widths between aisles of tables to be 36" or greater depending on room layout and number of students serviced per aisle.

12.3.7.1.4. ADA

In cases where fixed tables and loose chairs are used or where fixed seating with tablet-arms is used, adjustable-height ADA tables must be provided.. Ensure that 72" clearance behind table is maintained for access.

12.3.7.1.5. Replacement Availability/Warranty

- Work surfaces/tables shall be procured from vendors approved through the Tri-University furniture Request for Proposal (RFP).

12.3.7.2. Seating

Seating should be selected that will satisfy the requirements of Uniform Building/Fire Codes, durability, functional comfort, appearance/finish, and performance over time. Chairs should accommodate both left and right-handed individuals. Chairs should be comfortable for use by the average-size person.

12.3.7.2.1. Design Standard

When selecting seating in order to achieve minimum standards of comfort, aspects such as width of seat, type of lumbar support, appearance, versatility of seating, replacement availability/ease of maintenance and cost should be considered.

12.3.7.2.2. Seating Width

- The selection of seating width shall be based upon the criteria set forth for the type of seating utilized.
- Seat width comfort will range from 18 to 22 inches for loose seating such as stackers, sled base chairs & chairs with casters (4-leg or star-base).
- Auditorium fixed seat width to be at 24 inches unless restricted by row curve.

12.3.7.2.3. Seating Back Support

All seating shall have proper lumbar support.

12.3.7.2.4. Seating Clearances

To ensure adequate circulation through the learning spaces, minimum clearances must be maintained as previously referenced in these Design Guidelines.

12.3.7.2.5. Appearance

- Light colors are prohibited.
- Upholstered seating is recommended in large auditoriums or lecture halls only where reverberation of sound is a problem.
- The construction and materials should be selected so that their color and surface are consistent with the other furnishing within the classroom and building, and meet the acoustical requirements for the space.
- For material specifications reference Division 12 of the Technical Standards.

12.3.7.2.6. Replacement Availability/Ease of Maintenance and Warranty

- Chairs shall facilitate easy cleaning of the floor surface, and require minimum maintenance of the seat covering (if applicable).
- When casters are specified on seating, ensure that the casters are the correct type for the floor finish (carpet, VCT, etc.).

12.3.7.2.7. Quality

High quality seating shall be specified to minimize the long-term life cycle costs since funding for equipment replacement, repair, and maintenance are becoming increasingly difficult to obtain.

12.3.7.2.8. ADA

All ADA accessible seating in classrooms should comply with ADA Standards for Accessible Design. Owner requires that Universal Design be applied.

- In classrooms with loose tables and chairs, a minimum of 10% of seats are to have height adjustable tables.
- In classrooms or lecture halls with fixed seats with or without tablet arms, minimum required accessible locations to be per 2012 International Building Code.

- In lecture halls with fixed tables and loose seats, the accessible locations are required to have height adjustable tables that coordinate with the fixed tables.

12.3.7.2.9. Versatility

- Fixed seating shall be provided in all large lecture halls, and shall be constructed of cast iron or steel frames. Auditorium seating shall have retractable tablet arms.
- Non-fixed lecture seating requires free-standing chairs with casters.
- In lecture rooms where programs will typically exceed 2 hours, padded seats and backs can be selected and passive ergonomic considerations should be made.
- Fixed auditorium seating may require electrical/data outlets, based on programming needs.
- 10% of seats must accommodate a left-handed student and should have a variety of locations available throughout the space

12.3.7.3. Computer Workstations

Computer workstations are used for teaching methods that require Owner-procured computers/laptops. Computer workstations should accommodate computer equipment, plus the necessary space for student materials.

12.3.7.3.1. Design Standard

- Allow for a minimum surface area of six and one quarter (6.25) square feet to be provided.
- Furniture selection for computer workstations shall have provisions for securing the equipment and the furniture in the room.
- Computer workstation classrooms shall have provisions for increased ventilation and conditioned air supply due to the increased heat load produced by the computers.
- Furniture may be arranged in a row or in collaborative pods.
- ADA tables must be provided according to ADA Standards.
- Computer classroom furniture is an extension of the programming requirement and should conform to the department's needs.

12.3.7.4. Instructor Classroom Furniture Accessories

When providing additional equipment, attempts should be made to maintain aesthetic and functional compatibility with the overall decor of the room.

12.3.7.4.1. Design Standard

For all rooms: Provide an adjustable height, instructor's lectern, a height adjustable table and a stool.

12.3.7.5. ADA

All tables and lecterns must comply with the *ADA Standards for Accessible Design*.

12.3.7.6. Miscellaneous Classroom Items

Reference Division 12 of the Technical Standards. Containers shall not encroach on circulation path.

12.3.7.7. Lighting and Electrical

12.3.7.7.1. Lighting Zones

As a rule, all classroom spaces will have lighting organized into a number of zones. These zones shall be combinable and dimmable to create any number of different lighting scenarios. Classroom lighting shall include multi-modal lighting, controllability, and optimize energy performance. Classrooms should utilize natural light where possible. A room shall be zoned based on the amount of day lighting available, with each fixture responding to the amount of light at any time and location. For lighting specifications, refer to Division 26 of the Technical Standards.

The zones described below are functional zones. There are five functional lighting zones in most classrooms:

Zone 1 — Main classroom lighting (student seating area) this zone services students and allows them to read and take notes in class. Use multi-directional recessed (lay-in) fixtures that cast a modest amount of light downward (35%) and a larger amount of light toward the ceiling (65%), provides a comfortable overall lighting with relatively high efficiency. Avoid pendant mount fixtures.

Zone 2 — Instruction area (front of classroom and lectern area). Design whiteboard and demonstration table lighting to provide visibility when the room lights are at full intensity. The foot candles is this area should be consistent with the overall lighting of the room.

Zone 3 — Non-projection white board (board that is not obscured by a lowered projection screen). Lighting of white boards during concurrent AV presentations allows instructor to write on the board while in projection, without light bleeding over onto the projected image.

Zone 4— Projection white board (board that is obscured by a lowered projection screen) Use the same requirements as Zone 3 during non-projection mode.

Zone 5 — Instructor workstation. The instructor should be able to read notes and use AV equipment with low-light conditions of projection mode

Foot Candle (fc) Guidelines*

	Day Lighting Mode	General Mode/Non-Day Lighting	AV Mode
Student desk	30 fc min 150-200 max	30 f min 70 fc max	10 fc min
Whiteboard	30 fc vertical min	30 fc vertical min	Na
Screen	Na	Na	8 fc vertical allow 8:1 video image with 3000 lumen projector
Walls	10 fc vertical	10 fc vertical	Na

* Based on the "lESNA Lighting Handbook Reference and Application", Ninth Edition

In larger auditoriums, install a down-light in a location that will provide adequate illumination on the face of the sign language facilitator when the AV mode lighting is in place.

12.3.7.7.2. Emergency Lights

Isolate emergency light radiation away from the projection screen.

12.3.7.7.3. Color Temperature

The color temperature for all light fixtures should be the same. The color temperature goal is 3200 degree Kelvin. Color temperature range of 3000-3500 degree Kelvin is acceptable as long as all of the fixtures are the same.

12.3.7.8. Electrical

For electrical specifications, including outlets refer to Division 26 of the Technical Standards.

12.3.7.8.1. Ceiling Outlets

- Install one AC power quad outlet attached by flexible conduit to a J-box located above the suspended ceiling to allow for the future installation of a data projector, wireless access point, wireless video receiver, etc. This quad should be sited 12'-15' from the screen.
- Design one single-gang data outlet above the ceiling 12'-15' from the screen.
- Provide 120V power capped at a J-box located above the suspended ceiling to allow for the future installation of a low voltage motorized screen controller.

12.3.7.8.2. Floor Outlets

- Provide floor outlets for every classroom to ensure optimum flexibility.
- Floor boxes are to accommodate AV, AC power, data.
- The number of floor outlets is determined by the size of the room, the capacity, and the function. Identify the likely furniture layout before placing outlets.

12.3.7.9. HVAC & Fire Prevention

12.3.7.9.1. Diffuser Location

Diffusers should be located as to avoid any movement of the A/V screens which would be caused by air flow.

12.3.7.9.2. Location of Above-Ceiling Mechanical Equipment

Mechanical equipment that requires service shall not be located within classrooms.

12.3.7.9.3. Noise

Excessive background noise or reverberation in classrooms interferes with speech communication and thus presents an acoustical barrier to learning. In all phases of the classroom design and construction process, careful attention must be paid to acoustics. Locate all mechanical equipment as far from the classroom as possible. If adjacency is unavoidable, provide for sound attenuation methods at doors, light fixtures, and all other ceiling or wall breaches. System components (fans, ductwork & diffusers) shall be selected to meet sound criteria of noise coefficient (NC) NC2O to NC25.

The "ANSI/ASA S12.60-2010 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools

(Parts 1 and 2)" sets specific criteria for maximum background noise and reverberation time in classrooms. Consistent with long-standing recommendations for good practice in educational settings, the standard set specific criteria for maximum background noise (35 decibels) and reverberation time (0.6 to 0.7 seconds) for unoccupied classrooms.

12.3.7.9.4. Fire Alarm Strobes

Locate fire alarm strobes away from projection screen to prevent sightline obstructions of fire alarm strobe when screen is extended.

12.3.7.10. Acoustics

When classrooms are located within close proximity to functions that generate significant noise levels, higher STC ratings and special wall-construction details must be included for all interior walls, elevated slabs, floors and exterior walls (including doors and windows). Provide for sound attenuation to contain noise generated from adjacent locations and from both above and below the classroom location.

- It is the responsibility of the DP to ensure the acoustical requirements are met, which may require services from a separate acoustical consultant.
- Minimum NC ratings: 0-59 seats: NC30-35 or less; 60 to 149 seats: NC 25-30 or less; 150+ seats: NC20-25 or less.
- In all cases, walls in classrooms should have a minimum sound transmission class (STC) of 50 as recommended: ANSI S1.4-1983 (R 2006).
- Individual equipment such as fans, ductwork and diffusers shall have ratings not exceeding NC 25 throughout the load range as recommended: ANSI S12.60-2002.

12.4. Recommended Technology Enhanced Formal Learning Spaces

Every classroom at Northern Arizona University should have a minimum configuration for technology enhancement in order to promote and support pedagogical and technological innovations that increase student engagement, learning, and success. The following recommended standards not only build upon the Owner's strategic goals, but look into the future as the Owner continues to provide outstanding undergraduate, residential graduate, professional programs, and sophisticated methods of distance delivery.

The following two tiers of technology for classrooms and selected enhancements, adopted as classroom standards, will also assist faculty with their expectations of technology as they consider the learning environment in which they teach, and will allow them to intuitively use the technology provided regardless in which building or department they teach.

All configurations included here are considered to be minimum requirements, and departments may choose to have additional hardware available in individual classrooms.

12.4.1. Equipment

Consistency and standardization of equipment across rooms is very important for ease of training, repair and replacement, and movement between rooms.

12.4.1.1. Tier 1 - Minimum Technology Enhanced Configuration

Note: All AV Control equipment must be Crestron, to facilitate AV Asset Management for NAU.

- A basic push button control system that adheres to ADA accessibility standards **(All Crestron)**
- A lockable lectern that can be adjusted with pneumatic or electronic risers for accessibility. **(EuroDesign Custom Lectern Item #MPD48EAR-NAU-3)**
- 3200+ Lumen Ceiling Mounted Projector **(Hitachi)**
- Podium or Desk rack mounted computer with a 17 inch flat panel display, minimum 4 GB RAM and Core i5 or better processor, Windows 7 or MacOS X. **(at least Dell Optiplex 7020 per NAU Central Standards)**
- Laptop connection with ethernet, VGA (or better, HDMI) output, and stereo sound output
- Video or RCA Composite Video Connection
- Pull Down or Powered Screen
- Tiered (Staged) Lighting (dimmable) around the front projection screen
- Small 20 watt amplifier and speaker system
- Portable microphone for instructor in classrooms with seating for 40 or more students
- Mini stereo plug for iPods and MP3 players
- Dedicated A/C 15amp power for Projector and Instructor Podium/Desk
- Podium task lamp to illuminate presenter materials
- Webcam (either integrated or external)

This configuration of technology includes integrated room control. There will be networking technology for at least the podium computer and laptop, and standard wifi for student connectivity.

12.4.1.2. Tier 2 – Standard Technology Enhanced Classroom Configuration

Everything in Tier 1 and the following:

- Powered Projection Screen **(Dalite Cosmo Electrol)**
- Upgraded to a professionally programmed touch screen control system **(Crestron 3 Series Digital Media Presentation System (200 or 300 as appropriate) and Crestron 7” Touch Panel)**

- Upgraded 4500+ Lumen Projector with power zoom **(Hitachi CP-WU8451 5000 Lumens as appropriate)**
- Multiple projectors, projection screens, or LCD displays for seminar and auditorium classrooms may be useful; ability to display different content or the same content on each screen
- Sound reinforcement to expand reach of instructor voice in large rooms
- Document Camera **(Lumens PS 751)**

Enhancements that will be installed in selected classrooms on an as-needed and strategic basis

- Web Conference room: wireless microphone and podium webcam for use with Bb Collaborate (Secondary camera located in the front of the classroom)
- Video in smaller rooms - two or three plasma or LCD 50" to 80" monitors (quieter than projectors, no bulb replacement costs)
- Shared Room Display (AppleTV, Kramer VIA, AirMeida, etc). Classroom Support currently evaluating enterprise solution.
- Lecture capture appliance or cloud based such as Echo 360 (appliance) or Tegrity (cloud)
- An interactive whiteboard system, such as eBeam, can be used with a normal dry-wipe board to replace the more expensive electronic writing devices used for front projection, such as a SmartBoard or Sympodium

Mobile Computer Labs (Technology Carts) can be used as an alternative to an instructional computer lab when computers are not needed every day. A cart that includes a network printer, wireless access point, and stored laptops that are charged when on the cart, allows the mobile lab to be wheeled into a classroom on a scheduled basis. This also eliminates the need to retrofit a classroom with power and data cables. For more information on Mobile Computer Labs, see the Learning Spaces Study – Fall 2007 (http://jan.ucc.nau.edu/~lrm22/learning_spaces/).

12.4.2. Instructor Station

A standard, approved Lectern should be ordered through EuroDesign: (EuroDesign Custom Lectern Item #MPD3048EA-NAU-R)

Classroom podiums need to allow instructors access to USB and CD/DVD devices along with connecting their own laptop, but should be robust against cable, computer, or peripheral damage. Other A/V equipment may include a microphone, a document/pad camera, and LCD projector controls. Designs with built-in security, such as podiums that house the computer and electrical connections inside a locked (but adequately ventilated) cabinet

with rear access, are a must. A phone in the room with departmental technical support contact information is recommended. Remote management software is also recommended.

When designing the room, it is critical to speak with those who will support and use it. Some instructors may prefer to sit and others will want to move around the room while teaching. Tables with a modified or recessed control panel, and electronics housed separately, are alternatives to the standard podium-style instructor station. A remote (wireless) mouse/slide advancer/laser pointer is essential for those who move around, and is recommended for all classroom instructor stations, need will be determined on a per room basis (as battery life and charging can present problems.

12.4.3. Lighting

Lighting controls for dimming and spot lighting need to be part of the standard installation in all renovations and new classrooms, sufficient to support quality display of projected images.

12.4.4. Windows and window treatments

Windows are not only used for natural lighting, but also for ventilation, and should be part of the design in both formal and informal learning spaces. All external windows should prevent glare by using UV reflective glass or by being retrofitted with a reflective material. Shades should be available on every external window in rooms used for teaching and learning to insure quality image projection. Window cranks should be in working order to provide adequate ventilation and should not prevent the window shade from being closed.

Interior windows should also be considered during the design phase of learning spaces in order to provide a sense of openness.

12.4.5. Network Requirements

Wired data connections are needed at the teaching station area, the projector, and to the fixed student computers if applicable. Wireless networks are considered a supplement to the classroom network. Presently, Owner wireless networks will not provide guaranteed shared multi-user and rich media over a network. Refer to Division 27 Technical Standards for current cable specifications.

12.4.6. Teaching Station

The teaching station or lectern must be height adjustable to meet the needs of any instructor. The teaching station can be wall fed or floor fed though a floor box depending on room size and requirements. When poke-thru devices are not feasible due to structural limitations or costly abatement, use Extron Electronics AVTrac low profile floor-mount raceway system or equivalent. With the proper conduit infrastructure in place, the teaching station can range from a simple table housing a laptop connection to a permanent PC

station offering rack mount equipment, microphone, document cameras, interactive monitor, audience response system, class capture (podcast), and videoconference gear.

12.4.7. Mediation Packages

Owner strives to provide the basic mediation package in each classroom. The level of mediation provided is based on such variables as size and shape of the room, teaching style and discipline-based need. Mediation package options are as follows:

12.4.7.1. Capacity and/or Discipline-Specific Requirements may include:

- Microphones for large capacity rooms (over 40 capacity)
- Document camera
- Assisted listening (over 40 capacity)
- Multiple projectors / screens
- Stereo audio
- Video conferencing
- Class capture
- Class streaming
- Annotative monitor

12.4.7.2. Screens

12.4.7.2.1. Location

- Multiple screens may be required. The type of seating, the capacity, the room configuration and the primary instruction style dictate the optimum number.
- The number of screens required is based on the seating capacity, the configuration of the room, and the primary instruction style.
- Owner recommends angling the screen in the corner of the classroom to both maximize the viewing angle to the audience and increase free whiteboard writing space. Angle-mounting the screen must typically addressed in building planning stages since it usually requires detailing reflected ceiling plan to address ceiling grid and lighting. If angle-mounting the screen is unfeasible, screen placement should still remain opposite from the teaching station area on the teaching wall to maintain whiteboard surface. Ceiling height is also critical when planning the layout of a classroom. Owner recommends a minimum of 12 ft. finished ceiling height to accommodate both lighting and technology.
- Screens should drop no lower than 48 inches from the floor.
- LCD multimedia projectors and motorized projection screens are recommended for use in all classrooms including computer labs, and wet and dry laboratories. Seminar rooms may opt to use LCD

panels for small group presentations, and video conference classrooms are configured as per the specifications set forth in section 12.3 of these Design Guidelines. Large auditoriums and lecture halls may require a secondary manual projection screen which can be used with an overhead projector or pad camera. This screen should be located so that the main screen can be used simultaneously. Two or three motorized screens shall be used in rooms with over 60 student seats.

- LCD projectors shall be mounted from the ceiling and not part of the instructor podium. Selecting an LCD projector that produces adequate lumens for visibility in a well-lit room is important, as is the ability for a projector to be flipped vertically and horizontally to allow for upside down mounting. Lockable security housing that is easy to open for servicing and changing bulbs, and a sturdy ceiling mount, is recommended due to the frequency that projectors are targeted by thieves.
- Window treatments and dimmers for lights above screens should be installed wherever LCD projectors or other document cameras are used for presentation.
- Projection screens and whiteboards should be located so they can be used at the same time. All screens should be installed in front of any lighting fixtures that are used to illuminate whiteboards. Control switches should be visibly accessible, and labeled, for ease of operation. Housing for motorized screen units should be recessed into ceilings with the ability to drop out components of the screen and the motor separately for repair and maintenance.
- Projection screens should align with student seating, the screen mounting heights, and screen sizes at NAU should adhere to the following general guidelines:
    - Align screen so that 45-degree sight lines left and right of the perpendicular centerline cover all student seats within the 90-degree cone.
    - The vertical angle for the front seated viewer to the top of the screen should not exceed 35-degree to floor at student viewing height.
    - A/V designs should include sightline diagrams that verify these requirements. Construction Documents should note angle and dimensions on plan to allow exact placement in field.
    - Screen Mounting Height – Set high and fully recess the housing to keep bottoms of viewing area 48 in. (preferably 72 in.) or greater above floor.

- Screen Size – size screen width to most distant viewer - use a ratio of 1 to 4.
  - Example – 32 ft. to most remote viewer gives an 8 ft. wide screen. Alternatively, the maximum distance to the back row should be 6X image height, and the minimum distance to the front row should be 2x image height." (Yale University Classroom Design Review Committee, 2007, p. 8).

12.4.7.2.2. Size and Automation

- To calculate the distance from the projection screen to the seats the following formulas are adequate:
  Minimum distance to front row = 2x the image size
  Maximum distance to back row= 6x the image size
- All projection screens must be tab-tensioned with aspect ratios of 16:10 to accommodate high definition format.

12.4.8. Writeable Surfaces

Whenever a writing surface is required, an electronic alternative to the whiteboard should be considered. With the availability of electronic presentation equipment in the classroom, blackboards and whiteboards are being used less frequently. Chalkboards are no longer a viable writing surface due to the dust created, and white boards require specialized cleaning chemicals that are irritants to some individuals.

Document cameras are a better alternative to whiteboards and are much easier to see from the back of a larger classroom. Newer and less expensive alternatives to electronic SmartBoards are available. eBeam is one example of a software product that can be installed on a desktop computer and used as it converts any dry-wipe board or any flat surface into an interactive whiteboard and advertises at about half the cost of a SmartBoard.

12.4.9. Wireless Access Points

Enclosure should be required within ceiling- or wall-mounted enclosure dependent upon room layout and ceiling height access.

CAT cabling & POE Ethernet according to Division 27 of the NAU Technical Standards.

12.4.10. Infrastructure

The AV designer is responsible for reviewing the potential cooling load changes with the Owner and Design Professional.

12.4.11. Special Conditions

There may be rooms that will require discipline-based equipment or additional technology, such as media systems, not listed in these guidelines.

12.4.12. Floor boxes and Poke-thru devices

- Poke-thru device to be Wiremold/Legrand 8ATCGY (or equivalent) with the following add-on features (required). Interior Device configuration to include #682A (device plate to accept up to 2 ports of communication devices), #68REC (proprietary 20-amp duplex power receptacle), #8AAP (mounting plate to accept up to 4 Extron AAP Series device plates, & #8ACT6A (mounting plate to accept up to 6 ports of communication devices in any one of 3 gang in the center area). Underside Device Configuration to include #5PTHA (1/2 gang pass through housing assembly), #1PTHA (1 gang pass through housing assembly) & #575CHA (1/2 gang ¼" conduit housing assembly). Cover color to be grey.
- Floor box to be Wiremold/Legrand RFB9 (for retrofit floor cuts) and RFB 11 (pre-construction and where depth permits).

12.5. Office Space Utilization

12.5.1. Office Space Design

12.5.1.1. Square Footage Ranges

The square footage ranges are provided to accommodate the varying programmatic needs of the listed positions. For example, a unit may assign an office on the smaller end of the square footage range to a person who is more likely to spend time working in a research lab than in an office. Conversely, a person may be assigned an office on the upper end of the range to accommodate frequent meetings with multiple individuals.

12.5.1.2. Applying the Guidelines in Shared Spaces

The recommended square footages of shared spaces specify the total amount of office space that should be dedicated to any one person. They do not necessarily indicate the actual size of the office or workspace. For example, a department should designate a cumulative 120-256 square feet for four temporary employees (30-64 square feet per person); this space may or may not accommodate all four persons simultaneously.

12.5.2. Private Offices, Shared Offices and Cubicles

General Guidelines: Color selection and finishes (carpet, wall covering, demountable wall, vinyl base, paint, fabrics and laminates, etc.) must be approved by Owner.

12.5.2.1. Private Offices

The size of the office varies depending on the type of work and the need to meet with individuals or groups frequently and in a private setting. These spaces should be able to accommodate a desk, files, bookshelves, and space to meet with an additional one to six people. The following positions would, in most cases, require private offices:

Executive	Academic	Administrative
President	Dean	Associate or Assistant Vice President
Vice President	Associate or Assistant Dean	Director
	Department Chair	Associate or Assistant Director
	Faculty, Tenure Track	
	Faculty, Research	
	Unit Administrative Manager	

Some positions in a unit or department may require private office space, while a person with similar duties in another unit or department may not. The following positions should be allocated private office space on a case-by-case basis:

Academic	Administrative
Faculty, Non-Tenure Track	Manager
Staff, Professional (Full-time)	Staff, Professional (Full-time)
Faculty, Emeritus (Active)	
Technician, Associate or Specialist (Research)	

12.5.2.2. Shared Offices and Cubicles

Shared offices, cubicles, and open workspaces are an efficient use of office space. Shared offices should be assigned to individuals who require a certain amount of privacy or reduced noise levels. Cubicles and open workspaces are particularly space-efficient, flexible, and can accommodate additional guests as needed. The following positions would, in most cases, be assigned a shared office, cubicle or open workspace

Academic	***Administrative***
Faculty, Visiting or Consulting	*Manager*
Research Fellow	*Staff, Professional (Full-time)*
Fellow, Lecturer, Visiting Scholar	*Staff, Administrative Support (Full-time)*
Faculty, Emeritus (Non-active)	*Staff, Professional (Part-time)*
Staff, Administrative Support (Full-time)	*Staff, Administrative Support (Part-time)*
Staff, Administrative Support (Part-time)	*Temporary or Student Staff*

Staff, Professional (Part-time)	
Graduate Student Instructor	
Graduate Student Research Assistant	
Temporary or Student Staff	

12.5.3. Space-per-person Recommendations

The following space-per-person recommendations are based on recent construction projects from the Owner and on space guidelines from other higher education institutions and the private sector.

Type of Room Occupants	Space Type	Recommended NASF per Person
Executive		
President	Private Office	400
Vice President	Private Office	300
Academic Units		
Dean	Private Office	240
Associate or Assistant Dean	Private Office	160
Department Chair	Private Office	160
Faculty, Tenure Track	Private Office	100-160
Faculty, Research	Private Office	100-160
Faculty, Non-Tenure Track [1]	Private Office, Shared Office, or Cubicle	80-100
Faculty, Visiting or Consulting	Shared Office or Cubicle	80
Faculty, Emeritus (Active)	Private Office, Shared Office, or Cubicle	64-140
Faculty, Emeritus (Non-active)	Shared Office or Cubicle	30-64
Fellow, Lecturer, Visiting Scholar	Shared Office or Cubicle	80
Unit Administrative Manager	Private Office	100-160
Technician, Associate, or Specialist (Research)	Private Office, Shared Office, or Cubicle	30-100
Research Fellow	Shared Office or Cubicle	30-80
Staff, Professional (Full-time)	Private Office, Shared Office, or Cubicle	64-100
Staff, Professional (Part-time)[1]	Shared Office or Cubicle	80
Staff, Administrative Support (Full-time)	Shared Office or Cubicle	64-100

Staff, Administrative Support (Part-time)[1]	Shared Office or Cubicle	64-80
Graduate Student Instructor	Shared Office or Cubicle	30-64
Graduate Student Research Assistant	Shared Office or Cubicle	30-64
Temporary or Student Staff	Shared Office or Cubicle	30-64
Administrative Units		
Associate or Assistant Vice President	Private Office	160-240
Director	Private Office	100-160
Associate or Assistant Director	Private Office	100-140
Manager	Private Office, Shared Office, or Cubicle	80-140
Staff, Professional (Full-time)	Private Office, Shared Office, or Cubicle	64-100
Staff, Professional (Part-time)[1]	Shared Office or Cubicle	80
Staff, Administrative Support (Full-time)	Shared Office or Cubicle	64-100
Staff, Administrative Support (Part-time)[1]	Shared Office or Cubicle	64-80
Temporary or Student Staff	Shared Office or Cubicle	30-64

[1]Part-time denotes the room occupant is 50% FTE or less. If the occupant is more than 50% FTE, it is recommended to follow the guidelines for a full-time room occupant.

12.5.4. General Applications

12.5.4.1. Locations

- Offices should be located to have access to common areas provided for the use of faculty and staff.
- Offices for faculty should be kept near the classrooms used for their associated departments, or near their research labs according to their duty assignments.

12.5.4.2. ADA

Design all offices to comply with ADA Standards for Accessible Design. Owner requires that Universal Design Standards be applied when possible.

12.5.5. Office Interiors

12.5.5.1. Design

The following items should be considered when creating a new office:

- Designing for the flexibility of office space is strongly encouraged. The more provisions made for flexibility, the more options there are for future use of the space.
- The total square footage of each office is to be based on the type of office, the room occupant and the expectations of that position, as specified in Office Types.

12.5.5.2. Door/Room Security

All office doors shall conform to Division 8 of the NAU Technical Standards.

12.5.5.3. Windows

Windows should be included whenever possible. Windows must comply with Division 8 of the Technical Standards.

- If easily accessible, window coverings can be manually operable; otherwise, coverings must be motorized with controls located at the instructor's workstation on the AV touch panel. Where applicable, the depth of the window should be designed to allow for the installation of motorized shade tracks.
- Vertical blinds and drapes are not desired. If necessary, they are to have non-plastic, heavy-duty operating components.
- All window treatments are required to have a non-reflective matte finish and unless otherwise specified, the color selection should match or blend with the window frame.

12.5.5.4. Flooring

- When selecting flooring finishes; refer to the specifications in Division 9 of the Technical Standards.

- Specify an anti-static, high traffic, commercial grade carpet tile. No solid or light colors are permitted.
- A four-inch or six-inch cove base must be included when carpet is specified.

12.5.5.5. Walls and Ceilings

12.5.5.5.1. Walls

- Walls to be painted in accordance with Division 9.
- No wall coverings should be used.

12.5.5.5.2. Ceilings

- The surface of the ceiling must be designed to accommodate the required acoustical properties of the room. Ceiling panels shall have a Noise Reducing Coefficient (NRC) between .65 and .85, and a STC of 50.
- The ceiling should act as a sound mirror, reflecting sound downward to blend with direct sound.
- Ceiling material to be non-sagging (humidity resistant) lay-in acoustical tile for most ceiling areas. Nominal size 24” x 24” or 24” x 48”.

12.5.5.5.3. Vertical Writing Surfaces

- Each whiteboard should have a continuous marker tray below each marker board. Do not mount marker holder to wall due to marker bleed ruining wall finish.
- At the top of the whiteboard, a tack board strip and clips for display materials are required.

12.5.5.6. Signage

12.5.5.6.1. Room Identification Sign

Each room will have a standard room identification sign mounted near the door on the lockset side (exterior of room), mounted at a height as indicated by *t*he ADA Standards for Accessible Design. Braille lettering is required on the sign to identify the room as well. Standard room ID sign is a modular sign produced by Owner consisting of (3) 3” x 9” panels and (1) 9” x 11” clear plastic page holder. For Room Numbering guidelines reference Section 4 of the Design Guidelines.

12.5.5.6.2. Bulletin Boards or Tackable Surface

- A tackable surface should be provided in each office.

- Location and finishes of the bulletin boards will be determined at design.

12.5.5.7. Color/Finishes

If an accent wall is incorporated, avoid using accent color on walls that might over power the room or be unappealing to future occupants.

12.5.5.8. Reflectance Values

The following reflectance values for finish materials are required:

- Ceilings - 80% or higher
- Non-accent walls - between 50% and 70%
- Floors - between 20% and 40%

12.5.6. Furniture

Consult the Owner for all current furnishing specifications.

12.5.6.1. Work Stations

Typical work stations should consist of a desk, return, task chair, 2 desk, storage pedestals, and one bookshelf or storage cabinet.

12.5.6.2. Clearances

Minimum of 36” for egress and path of travel throughout office.

12.5.6.3. Seating

Seating should be selected that will meet minimum passive ergonomic standards and still satisfy the requirements of Uniform Building/Fire Codes, cost, durability, functional comfort, appearance/finish, and performance over time. Chairs should be comfortable for use by average size people.

12.5.6.3.1. Design Standard

When selecting seating in order to achieve minimum standards of comfort, aspects such as width of seat, type of lumbar support, appearance, versatility of seating, replacement availability/ease of maintenance and cost should be considered.

12.5.6.3.2. Task Seating

Shall be ergonomic to include:

- Pneumatic height adjustability
- 5 star caster base

- Adjustable lumbar support
- Adjustable seat depth
- Arms to be height and width adjustable
- Seat width will range from 22 to 25 inches

12.5.6.3.3. Guest Seating

- Seat width will range from 18 to 22 inches.
- If 2 guest seats are provided one should be specified without arms and one with.
- 4 legged chairs with or without casters are preferred.

12.5.6.3.4. Seating Clearances

To ensure adequate circulation through the learning spaces, minimum clearances must be maintained as referenced in Room Definitions.

12.5.6.3.5. Appearance

- The construction and materials should be selected so that their color and surface coordinate with the other furnishing within the office.
- Light colors are discouraged.
- For material specifications reference Division 12 of the Technical Standards.

12.5.6.3.6. Replacement Availability/Ease of Maintenance/Warranty

- Chairs shall be procured from name brand manufacturers that demonstrate proven records of accomplishment in the marketplace, and maintain stock levels that insure replacement can be made without untimely backorder delays.
- Provide written warranty for all proposed furniture. NAU prefers 10 years or longer warranty on all furniture items.
- When casters are specified on seating, insure that the casters are the correct type for the floor finish (carpet, VCT, etc.)

12.5.6.3.7. Quality

High quality seating shall be purchased to minimize the long-term life cycle costs since funding for equipment replacement, repair, and maintenance are becoming increasingly difficult to obtain.

12.5.6.4. Types of Furniture to Avoid

- Furniture not on Tri-University or State contract.
- Furniture that does not meet warranty standards.

12.5.6.5. Miscellaneous Office Items

- Refer to Division 12 of Technical Standards for recycling and trash standards.
- Containers shall not encroach on circulation path.

12.5.7. Lighting and Electrical

12.5.7.1. Lighting Zones

All offices shall have sufficient lighting to provide visibility to the user. Foot Candle Guidelines must be followed for standard offices. For lighting specifications refer to Division 26 of the Technical Standards.

12.5.7.2. Electrical

For electrical specifications, including outlets refer to Division 26 of the Technical Standards.

12.5.8. HVAC & Fire Prevention

For other HVAC and Fire Life Safety specifications refer to Division 23 of the Technical Standards.

12.5.8.1. Location of Above-Ceiling Mechanical Equipment

Access to mechanical equipment for the building will not be located within an office.

12.5.9. Acoustics

Recommendations:

- The review of acoustical requirements for classrooms by an acoustical consultant is recommended whenever possible.
- Minimum NC ratings: 0-59 seats: NC30-35 or less; 60 to 149 seats: NC 25-30 or less; 150+ seats: NC20-25 or less.
- In all cases, walls in classrooms should have a minimum sound transmission class (STC) of 50 as recommended: ANSI S1.4-1983 (R 2006).
- Individual equipment such as fans, ductwork and diffusers shall have ratings not exceeding NC 25 throughout the load range as recommended: ANSI S12.60-2002.

13. LABORATORY PLANNING AND DESIGN

13.1. Overview

The primary objective in this laboratory design guideline is to provide a safe environment for all laboratory personnel to conduct their work including both research and academic use. A secondary objective is to allow for the maximum flexibility. Note that undergraduate teaching laboratories require other specific design considerations. This guide is therefore a resource document intended to be used by faculty, staff, and Design Professionals during the planning and early design phases of a project including both new construction and renovation projects. All health and safety hazards must be anticipated and carefully evaluated so that protective measures are incorporated into the design.

This guide is formatted to address laboratory design issues pertinent to *General Laboratories* (e.g. chemical laboratories) in Section 1, and *Biosafety Level 3 Laboratories* presented in Section 2 Within the sections, specific design criteria are provided. Comments are included under the specific design criterion to give the rational behind the design feature.

The guide is not all-inclusive as it does not cover all regulatory issues nor does it cover all design situations. It is important to note that specific use practices must be considered during the design process. Owner (Environmental Health and Safety department) should be consulted during the design process to help ensure items regarding health, safety, and code have been addressed.

13.2. General Laboratory Planning

- Utilize a central core for special spaces, shared spaces, and building service areas
- Laboratories should be placed on the perimeter of the building
- Locate offices and circulation spaces between the core and the perimeter labs or on opposite sides of the building from labs
- Maintain safe separation between office spaces and labs
- Maintain adjacency and visibility to labs
- Provide a hierarchy of office spaces that meets Owner's space planning guidelines
- Provide a variety of informal gathering spaces, with tack and marker boards in each
- Maintain all ADA access requirements in both research and teaching labs
- Identify noise and vibration concerns and mitigation thereof
- Consider and discuss merits of lab door recesses with cost
- Incorporate adequate drainage for safety showers
- Incorporate wrist blade faucet handles throughout
- Lab gasses should have wrist blade cock handles
- Identify need for lounges, break rooms, and access to them

- Account for all public restrooms and similar spaces (all-gender and lactation room)
- Separate public corridors with access/code requirements from all research or support corridors
- Discuss security options for access into restricted space (i.e. card or key access)
- Optimize occupant flow into and out of building based on current and future NAU Campus Master Plan
- Public corridors are restricted to people circulation
- "Research and Support" corridors cannot be used as secondary means of egress and used for:
  - Utility distribution
  - Laboratory equipment
  - Chemical deliveries
  - Chemical compounding areas
- Maintain air pressurization through:
  - Sealed lab spaces from adjacent rooms/corridors/building envelope
  - Required pressurization testing during construction (project dependent)
  - Emergency event planning as in loss of power or major equipment failure
- Account for restricted smoke movement both between rooms/corridors and between floors through mechanical chases, doors and stairwells, and elevators
- Required lab hood operation during emergency mode for minimum air flow through hoods while maintaining proper air balance
- Adequate relief of outside air during emergency events
- Appropriate door sweep design/inclusion related to floor flatness requirements
- Air pressurization hierarchies are critical. Ensure all understand design philosophy to be incorporated into project as well as monitoring equipment as necessary with particular attention to limitations of equipment
- Design to include adequate provisions for current and future equipment needs
- Ensure chemical delivery carts have adequate space for parking as well as path of travel
- Recess doors for corridor access from labs where possible/practical
- Identify bulk storage needs and incorporate both within labs and corridor access:
  - Chemicals
  - Gasses
  - Dry Goods
- Millwork to incorporate both secured and unsecured storage
- Coordinate needs and current lock/key requirements with Owner (building occupants and Building Access Services). Note that general lab drawer lock/key systems typically supplied for millwork cabinets and drawers will not be acceptable.
- Incorporate sound isolation as appropriate between labs and between labs or teaching spaces and mechanical rooms

13.3. Laboratory Safety

- Identify appropriate occupancy classification based on assessment of projected chemical inventory of the building, both current needs and future plans
- Design Professionals shall have appropriate professional licenses in area of expertise
- Incorporate appropriate chemical delivery routes and storage based on exposure risks and injury segregating laboratory from non-laboratory activities.
- Identify and incorporate adequate exhaust for all safety storage cabinets, both current and future needs
- Ensure overall security considerations are accounted for
- Incorporate securing regulated materials where applicable (including, but not limited to CDC Select Agents, radioactive materials, and DEA controlled substances)
- Floor must be non-pervious to ensure spills cannot penetrate underneath floors/cabinets.
- Each lab must contain sink for handwashing. BSL3 and above laboratories must have hands-free sink operation. Sinks shall have appropriate screens on drains.
- Chemical storage shelves shall not be placed above laboratory sinks
- Sufficient space or facilities (e.g., storage cabinets with partitions) shall be provided so that incompatible chemicals/gases (waste and non-waste) can be physically separated and stored. This will be based on the chemical inventory and use projection provided by the Owner.
- All labs should be designed to conveniently and safely accommodate the temporary storage of biological, radiological, and chemicals (non-waste and waste) based on laboratory use projections.
- All work surfaces (e.g., bench tops and counters) must be impervious to the chemicals used.
- Design bulk storage areas with appropriate fire resistance ratings for materials and quantities
- Vented cabinets with electrical receptacles and sound insulation shall be provided for the placement of individual vacuum pumps where their use is anticipated. A one- to two-inch hole for the vacuum line hose from the cabinet to the bench top shall be provided.
- Cabinet storage locations may need data and sprinkler connections. Future use considerations should be accounted for
- Conduits into electrical outlets should be sealed for air migration between labs
- Ergonomic considerations should be taken into account for all shelving regarding height and horizontal reach distances
- For renovation projects, all ADA issues are to be addressed
- Chemical hoods are not to be used for storage
- Canopy hoods or snorkels are to be used for heat removal only
- Canopy hoods over autoclaves should be designed as appropriate (i.e. BSL3 and above autoclaves should not be tied into general exhaust)
- All doors must be self-closing
- All doors shall meet required egress pull strengths for normal and emergency conditions
- Storage space for waste must be accounted for
- Eyewash stations must be coordinated with Owner (EH&S) for current requirements
- All lab doors to corridors should provide vision lites

- Fire extinguisher locations shall be coordinated with Owner (EH&S and FLS)

13.4. Biosafety Levels

Not all laboratories present a biohazard condition requiring primary and/or secondary barriers. All BSL2 or above laboratories should be coordinated with Owner (EH&S). Hazards are classified by biosafety level, and required physical barriers are described below. All biosafety level labs must incorporate at a minimum all requirements of lower level labs.

13.4.1. Biosafety level 1

- Handwashing sink, may need hands-free operation depending on use

13.4.2. Biosafety level 2

- Class I or II biosafety cabinets may be required
- Waste decontamination facilities

13.4.3. Biosafety level 3

- Sealing of labs from perimeter areas is essential. All designs shall take into account maintenance aspects to assist in maintaining integrity of rooms sealed from perimeter areas
- Class I or II biosafety cabinets are required
- Glove boxes may be required
- Access control to the laboratory may be necessary and not limited to card readers, cameras, vibration sensors, and motion detectors
- Access considerations may include mechanical equipment locations
- Ventilation must be approved through Owner (EH&S)
- Supply air must be single pass
- Doors may need to interlock
- Building Management System shall be approved by Owner (EH&S) which may include notifications of room pressure loses and/or audible alarms
- Annual testing may be required (case-by-case basis)
- Emergency mode operation must be considered
- Pressure cascade values must be approved by Owner (EH&S)
- All lab equipment, casework, walls, floors, and ceilings must meet current NIH standards for BSL3 or above laboratories
- Special security/access considerations may apply
- All drain designs must be approved by Owner (EH&S)

13.4.4. Biosafety level 4

- Class III biosafety cabinets are required (or personal pressure suit)
- Separate building or completely isolated zone
- Ventilation and waste management systems to contain hazards must be approved by Owner (EH&S)

13.5. Laboratory FF&E

13.5.1. Laboratory Casework

- Provide wood casework
  - Natural finish, no plastic laminate
  - Except where matching existing metal or areas requiring impervious surfaces
  - Animal care areas
  - Biohazard areas
  - Radioisotope areas
  - Chemical storage rooms
- Include utility chase behind wall/peninsula/island base cabinets
- Demonstrate functional usability of corner area where two base cabinets intersect
- Provide removable access panels at knee spaces and sink cabinets
  - Rear stretcher at knee space should be continuous
- Provide pull out writing tablet in casework, using drawer glides
- Provide heavy duty full extension drawer glides (100 pounds minimum)
- Provide pre-fabricated specialty chemical and flammable storage cabinets where required
- Verify specific casework sealing requirements for all BSL3 labs and above
- Verify casework placement does not hinder equipment move-in/out after project completion

13.5.2. Laboratory bench tops

- Epoxy resin tops at all wet or semi-wet areas
- Acid resistant plastic laminate at dry areas
- Provide dished top at all major lab sinks
- Provide lip at all sinks in labs
- Locate seams in tops coincident with seams in benches to allow for modifications
- Tops and curbs shall be non-glaring and black in color.
- Benchtops shall be 1-1/4 inch thick with drip grooves provided on the underside at all exposed edges. Further, all exposed edges, except as indicated below, shall be rounded to a 1/4 inch radius at front top edge and at vertical corners.
- Top set curbs at back and ends of benchtops shall be 4 inch high by 3/4 inch thick, bonded to the surface of the top to form a square joint.
- Sink cutouts shall be smooth and uniform without saw marks and the top edge shall have a uniform radius of approximately 1/8 inch.
- The bottom edge of the sink opening shall be finished smooth with the edge broken to prevent sharpness.
- Corners of sink cutouts shall be radiused not less than 3/4 inch.
- Indented bench tops shall be 1-1/4 inch thick at outer edge, indented 1/4 inch to provide a raised rim 1 inch wide around all exposed edges.
- The front top edge of the raised rim and exposed vertical corners of the top shall be rounded to a 1/8 inch radius.

- The juncture between the raised rim and the top surface shall be coved to a 1/4 inch radius.
- Physical properties:
  - Flexural Strength (ASTM Method 0790-71) - 15,000 PSI
  - Compressive Strength (ASTM Method D695-77) - 35,000 PSI
  - Hardness, Rockwell M (ASTM Method D78-65) - 100
  - Water Absorption (ASTM Method D570-77)
  - % by weight, 24 hours - 0.02
  - % by weight, 7 days - 0.04
  - Specific Gravity - 1.97
  - Tensile Strength - 8,500 PSI
- The benchtops shall be heat resistant and chemical resistant. Chemical resistance testing of the top may result in some discernible change in color or gloss, but no significant impairment of working surface function in life (an evaluation rating of "good" or better).

13.5.3. Wall / peninsula / island reagent shelving (above lab benches)

- Custom fabricated using unistrut-type system (not stock item)
- Extend unistrut from floor through bench top to structure above
- Seal penetration with epoxy seaming material
- Do not use a "wrapped splash"
- Earthquake lip (12" or 18" clear dimension)
- Acid resistant plastic laminate on wood substrate
  - Do not use an epoxy paint or clear finish
- Do not install reagent shelving above sinks

13.5.4. Enclosed wall reagent cabinet (above lab benches)

- 12" clear dimension
- Glass or opaque doors as requested by Users
- Do not install wall cabinets above sinks

13.5.5. Wall shelving (non-reagent)

- Must have backing in wall
- Clear finish wood
- Heavy duty adjustable kv-type brackets
- End caps
- Use unistrut-type reagent shelves for extra deep wall shelving
- Install top-most shelf 24” minimum below
- No wall shelving above sink

13.5.6. Laboratory Equipment and Appurtenances

- Provide a 3'-6" minimum single leaf at each lab/corridor door
- Discuss fume hood selection with Owner
- Investigate special user requirements
    - Laminar flow clean hoods
    - Radioisotope hoods
    - Perchloric acid hoods
    - Biosafety cabinets
    - Laminar flow clean hoods
    - Radioisotope hoods
- Special purpose fume hood with hepa-filtered exhaust discharge
    - Generally uses slightly higher face velocity than conventional fume hoods (125 fpm)
    - Requires welded stainless steel exhaust duct system
    - Can be open or gas-tight (glove box)
- Perchloric acid hoods
    - Straight exhaust duct run (no horizontal offsets) is mandatory
    - Requires automatic wash down system
    - Timer-controlled for washing once per week
    - Discharge must be carried to the lab waste system
    - Requires welded stainless steel exhaust duct system
- Biosafety cabinets
    - Class I biosafety cabinet: 100 fpm, single pass air, out through hepa filter
    - Class II-A biosafety cabinet: 100 fpm, 70% recirculated through hepa, 30% exhaust to room through hepa
    - Class II-B1 biosafety cabinet: 100 fpm, 30% recirculated through hepa, 70% exhausted to exterior through heap. All Class II B2 and above should be welded SS exhaust construction.
    - Class II-B2 biosafety cabinet: 100 fpm, 100% exhausted to exterior through hepa
    - Class II-B3 biosafety cabinet: 100 fpm, 100% exhausted to exterior through hepa, plena under negative pressure to room
    - Class III biosafety cabinet: gas-tight cabinet, supply through hepa, exhaust through 2 hepa

Biosafety cabinet exhausts may be manifolded together, but not with chemical fume hoods. Chemical fume hoods may not be User controllable, must be on 24 hours. Also includes radioisotope and perchloric acid hoods. Consider off-hours setback and vav systems, for energy conservation. Interior recirculation ("supply") fans of biosafety cabinets may be User controllable. All Class II BSCs must be interlocked with hood

and/or general exhaust fans to ensure that operator safety and room pressure are not compromised.

13.6. Laboratory Finishes

13.6.1. Floor finishes

- Choice of floor finish must be approved by Owner
- Vinyl composition tile is appropriate for most labs
- Epoxy sealer is also appropriate for most labs, including chemistry
  - Seamless vinyl provides a "pan" in very wet areas. Heat welded flooring may be required in some areas
  - Continue flooring under casework
  - Seal toekick of all benches (to prohibit water penetration)
  - Use topset cove base at toekicks
  - Provide epoxy wall paint in all wet labs and on ceilings, if hard surface
  - Provide a sealed sleeve with a lip at all floor penetrations

13.6.2. Ceilings

- Suspended acoustical tile ceilings are acceptable in most laboratories
- No ceiling is an option where appropriate
- Provide hard ceilings only where required by lab activity

13.7. Laboratory Utility Service and Distribution

13.7.1. Utilities distribution

- Overhead, in corridor ceiling where possible
- Valve on each utility stub, in corridor
- Shutoff valves must be clearly identified.
- Gas shutoff valves shall be easily accessible for each lab within lab
- Drop on wall surface or freestanding to each lab bench
- Distribute to positions in utility space at rear of casework
- Make joints in horizontal piping only at removable panels
- Visible and accessible
- Consider special delivery systems where appropriate
- Verify waste system requirements with Owner (EH&S)

13.7.2. Utilities on bench tops

- Place turrets toward rear of bench
- Use turrets with angled discharge to enhance hose management
- Utilities racked on reagent shelf
- Generally avoid hoses as they tend to get in the way
- If hoses are planned, rack them on unistrut verticals, not shelves

- Maintain 22" clear height above bench top

13.7.3. Lab sinks

- Confirm with User need for large/deep sinks
- Plan major sinks at ends of benches, in base cabinet
- Use gooseneck faucets with wrist blades at all sinks
- Cup sinks are not routinely needed on benches or in hoods
- Install only is specifically required
- Always provide lip
- In hoods, sink must be at rear to avoid trap being in under-hood storage cabinet
- Include removable lab sink screens for all teaching and research lab sinks

13.7.4. Electrical, lighting, & telecommunications typically required

- Coordinate overall lighting plan with Users and Facility Services
- Provide an adequate number and arrangement of circuits
- Provide an adequate number and arrangement of 120v receptacles
- Provide an adequate number and arrangement of 208v receptacles
- Provide wiremold electrical distribution above all lab benches
- Receptacles above bench must have GFCI
- protection *within 5' of water source*
- Install of data jacks as required by User in second raceway
- Label each receptacle's circuit
- Alternate circuits in each lab and in each wiremold run
- Provide wall phone jacks where required
- Provide date jacks along benches where required

13.8. Laboratory Air Management Technology

13.8.1. Preferred system

- Building AHUs are to supply make-up air to labs
- Ensure emergency mode makeup air is accounted for when AHU's shut down during emergency conditions (while minimum exhaust flows are maintained in all hoods)
- Identify minimum flow required at all hoods during emergency conditions with Owner (EH&S)
- Ensure access for AHU coil removal/replacement can be achieved without equipment modification
- Lab fan coil units may be used for sensible cooling load of lab equipment
- Investigate manifold and VAV exhaust system if project has many hoods to allow programmed maintenance

13.8.2. Basic system design requirements

- Provide pressure hierarchy between lab spaces

- Identify room pressure/sealing requirements for all lab and corridor spaces including acceptable leakage rates
- Provide capability to measure velocity and pressure downstream of terminal boxes
- Verify exhaust discharge velocity with Owner (EH&S)
- Provide wind study relative to exhaust stack locations and AHU intake locations with all buildings in the immediate area
- Provide bypass on manifold VAV systems at roof or in penthouse where appropriate
- Provide filtration or scrubbing for hazardous emissions
- Verify temperature and humidity controls with Owner
- Design exhaust system for noise reduction
- Discuss BSL3 or above supply and exhaust envelope with Owner prior to implementation
- Noise study and design must account for noise levels in teaching and all research labs. Maximum noise levels must be identified in all labs, both teaching and research

13.8.3. Filtration requirements

- Verify current filter requirements with Owner
- Provide minimum 4" deep 30% efficiency filter banks in 100% outside air systems
- Provide easy removal/replacement of filters

13.8.4. Ductwork materials

- Spiral 316L stainless steel shall be used for fume hood applications
- PVC coated galvanized may be used on manifold VAV systems applications
- Welded 316L stainless steel must be used for perchloric acid hoods and all BSL3 or above exhaust systems

14. LANDSCAPE AND EXTERIORS

14.1. Overview

This section covers Divisions 2, 3, 32 of the Technical Standards.

ALL EXTERIOR WORK MUST ADHERE TO THE 2015 LANDSCAPE MASTER PLAN AS WELL AS THE APPROPRIATE DIVISION'S TECHNICAL STANDARDS. THE LANDSCAPE MASTER PLAN CAN BE FOUND BY FOLLOWING THE LINK PROVIDED BELOW. IT IS THE CONTRACTORS' AND DESIGN PROFESSIONALS' RESPONSIBILITY TO IDENTIFY IN WRITING TO THE OWNER ANY DISCREPANCIES IDENTIFIED BETWEEN THESE TWO DOCUMENTS THAT MAY ALTER A PROPOSAL OR BID.

2015 LANDSCAPE MASTER PLAN LINK:
http://nau.edu/uploadedFiles/Administrative/Finance_and_Administration/Facility_Services/Documents/DP_Contract/2015%20Landscape%20Masterplan%20Final.pdf

14.2. Existing Conditions

14.2.1. Seismic Investigations

Design Professional shall determine, what seismic requirements are to be followed on this project based on Occupancy Category (A category used to determine earthquake design loads based on the nature of the occupancy) and Seismic Category (A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site as defined in IBC and ASCE 7).) Furthermore, using information such as but not limited to existing site-specific soil conditions provided by a soil or geotechnical engineering investigation, type of foundation system, building structural loads, type of building occupancy, etc. Design Professional shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents.

This topic includes information related to seismic inquiries and investigations required prior to design and performed prior to construction. Seismic investigations survey soil stability to understand soil composition, solidity and quality in addition to determining the depth of soil layers, bedrock and water table. The results define the suitability of land for development, volume of excavation, and structural requirements.

Typically, older projects on NAU Campus had been designed under "Seismic Zones"; and newer projects on NAU Campus are designed under "Seismic Design Categories". As-built construction documents may be available for review upon request from Facility Services. The International Building Code (IBC) classifies structures into *Seismic Design Categories* (SDC): this is different from the older Uniform Building Code (UBC) which classified them into *Seismic Zones*. Seismic Design Categories go much further than merely outlining various

regions of the country. Seismic Design Categories are site specific and include classifications of A, B, C, D, E and F and are based on the following three (3) basic criteria. 1. Probable Site Ground-motion: 2. Soil (Site Class): 3. Building Occupancy Use. The process to determine the Seismic Design Categories must be done by an engineer.

Registered Design Professional shall determine the Occupancy Category: One of the first considerations in the design of any structure starts with determining the occupancy category of the structure. The purpose of determining occupancy category is to set a particular amount by which something is multiplied (or safety factor) in calculating the structural requirements based on occupancy. This requires classification of the occupancy category of any building in accordance with the nature of occupancy as described in the International Building Code or ASCE 7. The occupancy category serves as a threshold for a variety of code provisions related to earthquake, flood, snow and wind loads. Particularly noteworthy are the importance factors that are used in the calculation of design earthquake, snow and wind loads. The value of the importance factor generally increases with the importance of the facility. Structures assigned greater importance factors must be designed for larger forces. The result is a more robust structure that would be less likely to sustain damage under the same conditions than a structure with a lower importance factor. The intent is to enhance a structure's performance based upon its use or the need to remain in operation during and after a design event. The impact of a higher occupancy category classification is not limited to increasing the design loads. Compared to Occupancy Category I, II or III, for instance, an Occupancy Category IV classification can lead to a higher seismic design category classification that can, in turn, require more stringent seismic detailing and limitations on the seismic-force-resisting system. This can also affect the seismic design requirements for architectural, mechanical and electrical components and systems.

Considerations:

The Occupancy Category and Importance Factor are outlined by IBC and ASCE 7 as minimum required guidelines, with the primary intent of protecting the life and safety of the public. This does not necessarily include protecting the aesthetics or functionality of the structure after a severe event. In other words, the structure is designed not to fail, but may endure significant damage (structural or otherwise). This damage may prevent full functionality of the facility after a severe event. This is the reason the code increases the Importance Factor for Occupancy Categories III and IV. A higher Importance Factor improves the reliability (safety factor) of the structure, which helps protect its occupants (School, Buildings with Public Assembly Areas containing greater than 300 occupants), as well as its function (Police, Designated Emergency Shelters), during and after a major environmental event. There may be instances where increasing these parameters above "code minimums" should be considered such as:

- Facilities' ability to function after a major environmental event
- Increased Safety Factor

- Future use of Facility
- Importance factor of closely situated structures, for the purpose of emergency egress and rescue efforts.
- Building design Life Span
- Insurance Carrier Requirements

The desire to increase the Importance Factor should be made aware to the Structural Engineer as early in the project as possible.

Registered Design Professional shall determine the Seismic Design Category:
A classification assigned to a structure based on its *occupancy category* and the severity of the design earthquake ground motion at the site. The seismic design category serves as a trigger mechanism for many seismic requirements, including such as the following:

1. Permissible seismic-force-resisting systems.
2. Limitations on height.
3. Consideration of structural irregularities.
4. The type(s) of lateral force analysis that may be used.
5. The need for additional special inspections.

Registered Design Professional In Responsible Charge of the project shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents that are to be followed on the project. The earthquake load design basis, indicated on the construction documents by the design professional, provides information that allows facilitating the plan review process. All buildings, except those indicated in the IBC exceptions (e.g. Section 1613.1), are to be designed for earthquake effects. The earthquake design data for a specific building are required to meet or exceed the minimum requirements established by NAU adopted codes (e.g. IBC Section 1613.)

14.3. Exterior Improvements

14.3.1. Roads and Parking Lots

Dead end driveways are highly discouraged, but if site restrictions mandate this design approach, there shall be a minimum of 20' of unobstructed pull in length; width equal to the driveway.

The DP is required to obtain all information regarding parking stall layout, flow and stall dimensioning from Owner (Parking & Shuttle Services, NAU Police Department and Access & Equity Office), along with formal written approvals of the design concept from these entities at the completion of the 30%, 60%,and 90% Construction Drawing phases.

15. MECHANICAL, ELECTRICAL, AND PLUMBING DESIGN

15.1. Plumbing

15.1.1. General

All new buildings and building expansion projects shall utilize the campus potable water and sanitary sewer systems see Division 33 for utility standards. Building potable water and sanitary sewer requirement shall be calculated at the programming or schematic design submittals to assure adequate services are available at anticipated connection points. Refinement is expected as design progresses and shall be finalized at the design development stage, with final interconnection requirements identified.

All backflow protection and water supply and sewage connections will comply with the City of Flagstaff building codes and amendments.

Currently, there are seven (7) connections to the City of Flagstaff municipal water supply system.

All service and supply systems, including, but not limited to, domestic water and waste, shall be sized for peak demand throughout the project and shall be sized as far back as the main meter or central distribution system. The adequacy of any central distribution system to carry all added peak loads shall be determined, and no loads shall be connected to any such system that is determined to be undersized.

The use of any electrical source domestic hot water heaters shall not be considered unless a minimum of 20 year life cycle cost analysis of all alternatives is performed. Electrical source equipment shall not be specified unless it is proven to be the most cost effective for the 20 year life cycle. The determination of energy costs must include both consumption and demand charges.

Transformer vaults and electrical rooms shall have no water, waste, storm drain, nor any other pipe conveying water (except fire sprinkler systems required for the vault).

15.2. Campus Energy Infrastructure

15.2.1. North Campus

A central steam generation plant is located in Building 24 on North Campus with a steam supply and condensate systems routed through a subterranean network of tunnels and enclosed pipe chases. Process, domestic, and comfort heating to all new buildings in proximity to the distribution grid is to be provided by the central distribution system. Maximum design steam pressure is 150 psig; design operating conditions are saturated at 60 psig. Heat shall be transferred from the campus distribution system to building hydronic systems via tube in shell heat exchangers. Condensate return is pumped from atmospheric receivers at each building to the plant. Pump discharge pressure varies from 25 psig to 50 psig and must be calculated for each new building system depending on location and head

required. Steam pipe and heating water extensions from the distribution system of greater than 100 LF shall be in walkable tunnels (7 ft x 7 ft minimum). Extensions less than 100 LF may be in enclosed concrete structures, provided reasonable access to serviceable components (i.e. valve expansion joints and drip assemblies) is provided from above, and the lid can be removed to allow pipe replacement. Compensation for thermal stress shall be considered in all steam and condensate pipe design. Pipe stress supporting calculations shall be provided.

A central chilled water production and distribution system is located in building 24 on North Campus with a direct buried supply and return water distribution grid. Process and comfort cooling to all new buildings in proximity of the distribution grid is provided by the central system. The chilled water system is configured as Direct Primary, Variable Flow, with a single set of distribution pumps located within the plant. The central utility pumping is controlled to provide a differential pressure of 15 psig across building piping entry point. Internal building piping and coils shall be designed to meet peak anticipated demands without the use of secondary booster pumps or hydraulic decoupling within the building. Central chilled water supply temperature setpoint in summer time is 42° F. The chilled water supply temperature may be reset upward to 48° F in wintertime to allow use of the plant hydronic economizer. Building coils designed for dissipation of internal winter loads shall accommodate elevated (48° F) chilled water supply temperature. The University prefers that new air handler coils be selected for peak-anticipated design at 42° F with a 20° F degree temperature split. At a minimum, all new building coils (including fan coils) shall be specified to provide a 16° F temperature rise under peak load with 42 F supply. All coils (including fan coils) shall be controlled with two-way valves that modulate based on leaving air temperature.

15.2.2. South Campus

A central high temperature hot water plant is located in Building 67 on South Campus with a heating water supply and return distribution system routed through a subterranean network of tunnels and enclosed pipe chases. Process, domestic, and comfort heating to all new buildings in proximity of the designated grid are provided by the central system. Any modification or extension to the high temperature heating water system shall be designed under ASME piping code for 600 psig pressure and 400° F temperature. The university operates the system at 160 psi, 250° F supply and 210 returns (40 degree split). Heat shall be exchanged from the high temperature loop to the building system via tube in shell heat exchangers, selected to meet peak anticipated building demand with 250° F campus supply and a 40° F temperature split.

A central chilled water production and distribution system is located in Building 67 on South Campus with a direct buried supply and return water distribution grid. Process and comfort cooling to all new buildings in proximity of the distribution grid shall be expanded by the central system. The chilled water system is configured as Direct Primary, Variable Flow,

with a single set of distribution pumps located within the plant. The central utility pumping is controlled to provide a differential pressure of 15 psig across building piping entry point. Internal building piping and coils shall be designed to meet peak anticipated demands without the use of secondary booster pumps or hydraulic decoupling within the building. Central chilled water supply temperature setpoint in summer time is 42° F. The chilled water supply temperature may be reset upward to 48° F in wintertime to allow use of a plant hydronic economizer. Building coil design for dissipation of internal winter loads shall accommodate elevated utility chilled water supply temperature. All building coils shall be specified to provide a 20 °F temperature split under peak load with 42° F supply. All coils shall be controlled with two-way valves that modulate based on leaving air temperature.

15.3. Heating, Ventilation, And Air Conditioning (HVAC)

15.3.1. Local Environmental Conditions

Building design shall account for the ambient environmental conditions in Flagstaff. The Design Professional shall familiarize himself with special altitude and climatic conditions experienced in Flagstaff, and adapt the designs and specifications to suit.

15.3.2. Important considerations for HVAC system designs are:

15.3.2.1. Elevation

All equipment, as appropriate, shall be de-rated for operation at 7,000 feet altitude. Design Professional shall request verification of BTU and specific gravity content of supplied gas in order to specify altitude corrections. Other equipment requiring de-rating includes, but may not be limited to, transformers, motors, fans, blowers and air moving equipment, ducts, controls, atmospheric heat exchangers, and motor speed controls. Motors, variable frequency drives and control equipment enclosures shall be specified to account for altitude effect on temperature dissipation.

15.3.2.2. Design Temperatures

Buildings shall be designed based on the ASHRAE 99% design criteria for Flagstaff. All air handling units with outside air shall be equipped with freeze stats with manual reset, outside air dampers and low-limit controls. All heating water valves shall fail to heating position. Any freeze protection designs shall use -20°F as the minimum temperature.

15.3.2.3. Diurnal Temperature Swing

Mechanical systems shall be designed to accommodate, and respond to, diurnal freeze-thaw cycle of as much as 50° F.

15.3.2.4. Solar Radiation

Characteristics of solar radiation shall be considered under all seasonal conditions. Solar gain effect of low winter sun angle on south facing vertical fenestration shall be evaluated.

15.3.2.5. Design maximum snowfall

Periodic occurrence of snowfall in excess of five feet and potential for drifting snow shall be considered in location of outside air intakes, along with relief and exhaust systems. Use of exterior ducting and equipment is prohibited.

15.3.2.6. Fly snow

Frequent occurrence of light, dry, crystalline "fly" snow shall be considered in design of outdoor air intake ducting and transitions. Baffles, stilling wells and drain pans may be required.

15.3.2.7. Wind Rose, gust velocity and intermittency

Seasonal wind direction shall be considered in location and design of building exhaust, intake, relief louvers and in placement of emergency generator exhaust. Wind gust velocity and intermittency shall be considered in design and location intake and exhaust louvers and of natural ventilation systems.

15.3.2.8. Design Professional Requirements

The Design Professional and consultants shall be responsible for defining the coordination of all systems including but not limited to: electrical systems, control systems, heating and cooling systems, plumbing systems, and any other mechanical systems included in the building design.

15.3.2.9. Hydronic Pumps

All pump motors shall be specified for high efficiency and sizing shall be compensated for altitude. Derating calculations shall be included in the BOD.

15.3.2.10. Steam and Condensate Piping and Pumps

Steam piping design shall include location and detailing of drip legs sufficient to ensure dry steam supplies, and to prevent water hammer.

Steam system design shall be such that use of steam pressure is not necessary to raise condensate through any heat exchanger, or in any area where steam hammer noise will be objectionable.

15.3.3. HVAC Air Distribution

15.3.3.1. Metal Ducts

Owner prefers low pressure, low velocity (2000 FPM max, 2" WC max) air distribution systems. Designs involving higher velocity and/or pressure shall be reviewed and approved in writing by Owner (HVAC Supervisor). Design Professional shall specify acoustic impact for higher velocity systems when requesting a variance.

Noise level volumes of air movement and equipment shall be designed and installed as compatible for intended functions within building spaces. The Design Professional will be held responsible for maintaining acceptable sound levels in all systems.

The design documents shall show locations for all dampers, fire dampers, extractors and other controls. Duct pressure classes are to be shown on duct layout drawings.

15.3.3.2. Supply, Return, General Exhaust

90° bends and offsets in ductwork will be kept to an absolute minimum. When they are required, they will be designed with long radius sweeps to avoid turbulence in the duct.
Design to utilize 45° branch duct entries with main duct size reduction downstream for medium and high velocity systems.

Design to utilize 45°branch duct entries or full conical taps for low pressure ductwork.

Design with 15° convergence and divergence preferred. Absolute maximum of 30° divergence or 45° convergence.

15.3.4. Heating Boilers

All facilities are to be connected to the existing central heating utilities. The use of standalone boilers is allowed only when permitted in writing by Owner. A full life cycle analysis is to be submitted to Owner for evaluation prior to approval. This analysis shall include all expenses including equipment purchase and anticipated replacement costs, maintenance, replacement, and disposal costs, and anticipated costs of energy and water. The efficiency of equipment shall be calculated, and used in the life cycle cost analysis, for all expected load ranges. Rates used in life cycle cost analysis shall be actual demand and consumption costs, not average costs. These can be requested from Owner.

15.3.5. Heat Exchangers for HVAC

Building heat, domestic heat and preheat exchangers shall have 100% redundancy. Dual heat exchangers are required for all applications.

Design physical layout of heat exchangers in building mechanical rooms to provide service access.

15.3.6. Central Cooling Equipment

Mechanical air conditioning systems shall be utilized only when specifically authorized by Owner in writing. Life cycle costing shall be utilized to determine the most appropriate type of cooling or mechanical refrigeration as described in 23 00 00 and below

The selection of the type of air conditioning to be used shall be based on a 15-year life cycle cost analysis of all viable alternatives. This analysis shall include all expenses including equipment purchase and anticipated replacement costs, maintenance, refrigerant handling, replacement, and disposal costs, and anticipated costs of energy and water. The efficiency of equipment shall be calculated, and used in the life cycle cost analysis for all expected load ranges. Rates used in life cycle cost analysis shall be actual demand and consumption costs, not average costs. These can be requested from the Owner.

As a baseline, summertime cooling systems shall have economizer cycles with 100% outside air capability. Enthalpy controls shall be provided on all systems that run continuously. Indirect evaporative cooling shall be considered as an additional capacity system. All central air conditioning systems shall have air-side economizers with enthalpy controls. Wet side economizers shall be evaluated using life cycle cost analysis.

Refrigerant receivers and suction line accumulators shall be used when needed by design. All "critical area" A/C systems shall be redundant or a parts inventory shall be included in close-out submittal requirements to cover emergency repairs. This inventory shall include any and all controls motors or equipment required to make the system operational in an emergency. DP to specify which parts are required.

All outdoor compressor units shall be located under permanent covers. Design Professional shall consider potential of snow drifting or falling icicles in placement of outdoor unit.

15.3.7. Packaged Water Chillers

Systems to be designed with scroll water chillers only when connection to central chilled water service is not possible, when full backup plant redundancy is required, and when with written permission of Owner.

15.3.8. Cooling Towers

Consider noise, wind drift and proximity to outside air intakes when locating cooling towers.

15.4. Electrical

15.4.1. Exterior Lighting

Lighting concepts and recommended illuminance levels per the Illuminating Engineering Society of North America (IESNA) Lighting Handbook and Recommended Practices (latest editions) shall govern the lighting design.

All building entrances shall be illuminated with photocell-controlled luminaires.

All outdoor site lighting shall comply with Flagstaff Lighting Code standards (Flagstaff Zoning Code Chapter 10-50, Division 10–50.70). Particular attention is drawn to the following standards (underlining indicates additional Owner standards, beyond the Flagstaff lighting code standards):

- Total Outdoor Light Output is limited to a maximum of 50,000 initial lamp lm per net acre (cf. 10-50.70.050.C.). For LED fixtures initial "fixture" lumens are to be multiplied by 1.4 for purposes of all calculations involving light, output, including the Total Outdoor Light Output and amber/white light mixing ratios (see below).
- Lighting used for general illumination such as in parking lots, step lighting, etc. must utilize narrow-spectrum amber LED (i.e. AlInGaP LED with peak emission at 590 nm +/- nm, spectral full width to half maximum less than 15 nm). Acceptable LED product numbers include the Philips LXML-PL01 or LXM5-PL01 and Cree XBDAMB. (Note: "phosphor-converted" or "PC" amber LEDs are not acceptable in any applications requiring amber LED.)
- Lighting used for the principal purpose of illuminating pedestrian walkways may utilize mixed sources where a minimum of 90% of the lumens are produced by "narrow-spectrum" or "limited-wavelength" amber LED, mixed with a maximum of 10% of the lumens from white sources such as compact fluorescent, metal halide, or white LED (see below for CCT limits for white lighting). Lighting used for the principal purpose of illuminating roadways, whether or not there are sidewalks adjacent to such roadways, shall follow the standards described below.
- Building entryway lighting and lighting used for interior decks of parking garages may utilize any lamp type, including white sources such as LED, compact fluorescent, or metal halide (see below for CCT limits for white lighting).
- All fixtures used for interior decks of parking garages must be fully shielded. Illumination levels on the interior decks must be 50 lux average maintained or less. Any fixtures located 10 feet or more from the nearest opening to the outdoors do not have their outputs counted toward the Total Outdoor Light Output of the site.
- White (non-LPS, non-amber LED) lighting is limited to 5000 lm per net acre, and must have a correlated color temperature (CCT) of 3000 K or less.

All roadway lighting is exempt from lumens per acre standards of the Flagstaff Zoning Code, but must meet the following standards:

- All fixtures must be fully shielded "narrow-spectrum" or "limited-wavelength" amber LED (see above).
- Illumination on roadways shall not exceed Illuminating Engineering Society of North America (IES) recommended practice for roadways, following illuminance standards, with average maintained illuminance of not to exceed 6 lux and average to minimum ratio of 6 or less. The illumination at any point should not exceed 20 lux. Illumination on roadways with limited vehicular access (such as fire lanes) shall either

be unilluminated, or illuminated to levels based on any other expected uses such as pedestrian walkways.

All sports field lighting is exempt from lumens per acre standards of the Flagstaff Zoning Code, but must meet the following standards:

- All fixtures must be fully shielded
- White light sources are permitted, and must have a correlated color temperature (CCT) of 3000 K or less.
- Illumination levels for the field/track/arena shall be designed to be no higher than recommended for Class IV play, as defined by the current edition of the Illuminating Engineering Society of North America publication IESNA RP-06-01.

Exterior lighting shall be coordinated with physical security, CCTV, and landscaping requirements. Exterior decorative lighting shall not be used for general illumination.

Minimize direct light onto windows; direct and reflective (disabling) glare; and spill illumination onto adjacent properties (use house-side shields when adjacent to residential property). LED lighting is preferred for parking garages.

Include conduits, and mounting provisions in pole bases and on poles, for camera or other security equipment as required. A concrete pull box is to be installed next to the base of each light pole. Street lighting circuits shall be 2” PVC conduits from box to box. Ensure that all wire installed in poles meets the minimum insulation requirements dictated by the voltage present on the lighting circuit. Provide complete pole base details on plans. Details shall indicate complete structural and electrical elements such as rebars, type of concrete, anchors, conduits, handholes etc. Structural elements shall be designed by a licensed structural engineer to meet all local structural conditions, such as seismic zone, soils, wind loading, etc. Coordinate pole locations with snow removal means, and hardscape and landscape features, including projected tree growth.

Provide outdoor, municipal-street-lighting-type control cabinets with a 200amp electrical panel to include a main overcurrent device, branch breakers, control components, stainless steel enclosure mounted on legs, and spare 2” conduits out of pad. Mount controller on a concrete pad, in an unobtrusive location out of the way of snow removal equipment or protected with bollards. Control components to have 3 phase contactors, a photocell with hand off auto switch and contain an electrical meter.

Design professionals must be aware of the impacts of interior lighting visible to the exterior environment through fenestration, particularly large "daylighting" glass surfaces. In general, all light fixtures visible through such fenestration must be fully shielded, and illumination levels in such areas at night must be kept to a minimum, with the guideline of 100 Lux average maintained illuminance or less.

END OF DESIGN GUIDELINES