

Wright State University

Design + Construction Standards

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Updated 5/24/2018

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Overview

Introduction

Wright State University has developed university wide Design & Construction standards for use by any individual (University administration, facilities planning, maintenance personnel, design professionals, etc.) involved with new construction projects, renovations, additions, site work, repairs or ongoing maintenance. Any and all projects at Wright State University, whether in planning, design, construction or maintenance repairs should follow these Design & Construction standards and fully adhere to the content. As design elements change or are improved, as construction techniques change or materials change over time, adjustments and updates will occur to this document. Any change request can be submitted to the WSU Design Standards Committee for final approval and adoption into the baseline design standards. Updated sections will be listed with new revised date in the master document and identified on the website.

As projects evolve they can be very specific in nature given a particular creative or innovative design or desires from the end users of a project or there may be maintenance restraints. We realize that some exceptions may be requested as a variance to meet these demands. Any requested variance must be submitted with request form provided in the Appendix. Variances will be considered and approved by the WSU Design Standards Committee. Any request for a design standards variance must be submitted by the end of project design development submittal.

Adherence to these standards will result in projects designed to reduce the campus impact on the environment during demolition and construction, maintain the safety and health of project workers, and create a final product that takes into consideration the safety, health, and environmental impacts during future use and maintenance activities.

These Design & Construction standards are organized into five parts with easy access from the Table of Contents. These five parts are as follows:

Part One – Overview

This section provides a general overview of the standards, technical A/E proposal guidelines, EDGE goals and frequently asked questions.

Part Two – State of Ohio Documents

This section provides a link to all the current State of Ohio documents for contracts, procedures, front end requirements, etc.

Part Three – Approach to Design

This section is all about the design and planning for projects and gives the design professionals very specific Wright State planning requirements and guidelines.

Part Four – Technical Standards of Design

This section has specific requirements for the performance of materials and equipment that are specified for a project. It is organized in a CSI (The Construction Specifications Institute) format for easy identifications. Each section has General Provisions that apply to that particular section and then performance standards for the key building components of that particular section. These are performance standards and not technical specifications. Standard project specific specifications in much broader outline and detail, based on best practices, will need completed by the design professional.

Part Five – Appendix

This section includes specialized campus requirements and forms.

The use of these performance standards does not, in any way, relieve the design professional of the legal liability and responsibility for the content in any bid documents created based on these Wright State University Design & Construction standards.

Overview

Technical Proposal Guidelines

GENERAL PROVISIONS

- The intent of the technical proposal is to demonstrate how your firm and all consultants will best implement the owners program and scope for the project.
- There is no formal outline to follow but specific information is required within the document. It must clearly identify the scope of the project, the target schedule (design & construction), the professional fees and the scope of A/E services.
- The technical proposal is required to be submitted to the project manager within 5 days of request. If additional time is needed please discuss with the project manager.
- Adapt the technical proposal for the selected project delivery method, general contracting or CM at risk, for the project.
- The consultant is to refer to the State of Ohio guidelines and instructions for requirements for required basic A/E scope services, allowable reimbursables and other special A/E services requirements.

GUIDELINES FOR SUBMISSION:

Your technical proposal should clearly and concisely include your understanding of the following:

1. The project goals, visions and basic scope of the project including any unique or special goals/visions/scope as expressed in the Program of Requirements provided by the University.
2. Outline the approach to staffing, communication and development of all project design & construction phases, including identification of the main point of contact throughout the project. This includes all of the consultants for the project as well as the architect.
3. Outline the management of the project as it relates to project schedule for design, bidding and construction, cost estimating development and construction administration. Identify the main individual or company responsible for each of these activities. Indicate any special assumptions the fees are based on relative to the scope of the project or the scope of services.
4. Provide a target project schedule that includes program validation, schematic design, design development, contract documents, bidding & award, construction schedule and identify all key milestone dates. Adjust schedule as required when a CM project delivery approach is identified.
5. The project budget (FLCC –Fixed Limit of Construction Costs) including additional special project costs for, fixtures, furniture and equipment, contingency, associate fees, reimbursable expenses, and any other special project costs.
6. Indicate your proposed fee structure including all consultants for review, evaluation. The fee should outline the basic A/E design services showing all consultants and broken into each phase of the project. Indicate special/supplemental fees as well as optional services as discussed with project manager for your specific project. Clearly indicate all supplemental and reimbursable fees. A basic sample outline for a general contracting delivery project are as follows:

Proposed Fee

% Total Design Fee

A/E Basic Design Fees (Must indicate architect & all consultants for each phase)

Schematic Design	\$ _____	_____ %
Design Development	\$ _____	_____ %
Construction Documents	\$ _____	_____ %
Bidding/Negotiation/Award	\$ _____	_____ %
Construction Administration	\$ _____	_____ %
Project Closeout	\$ _____	_____ %
Total Design Fees	\$ _____	% of construction _____

Special/Supplemental Fees

Identified Task & Consultant	\$ _____
Identified Task & Consultant	\$ _____
Special Services	\$ _____
Total Supplemental Fees	\$ _____

Optional Fees

Identified Task & Consultant	\$ _____
Identified Task & Consultant	\$ _____
Total Optional Fees	\$ _____

Reimbursable/Allowances

Plan Approval/Permits	\$ _____
Printing Bid Documents	\$ _____
Special Travel expenses	\$ _____
Total Reimbursables/Allowances	\$ _____
 TOTAL ASSOCIATES FEE	 \$ _____

NOTE: Provide a target fee for change orders for field conditions and owners request shall be ____% of the change order. Each change order will be reviewed for possible adjustment to this target fee based on scope of the change order.

- State the minimum number of hours per week of on-site construction observation by your firm and each of your consultants, exclusive of travel time, included in your fees for basic services.

8. Include a listing of hourly fees for staff and consultants staff (including mark-up) in the event that additional services are requested.
9. If requested include the cost to provide project specific professional liability insurance. If the University elects to purchase this insurance, the premium will be a reimbursable expense. Provide certificate copies of E & O insurance as well as general liability insurance naming the institution as additional insured. It is the responsibility of the Associate Architect to require all consultants to meet the project insurance requirements.

Your technical proposal together with all final negotiated fees will be made a part of the Agreement for Professional Design Services.

The following information is required for all associate architect-engineer firms and their primary consultants in order to complete the release of funds:

- a. EEO certificates for your firm and your primary design disciplines (consultants)
- b. Workmen's Compensation Certificate
- c. Proof of liability insurance including Wright State being shown as an additional insured.
- d. Specific details of your EDGE participation.
- e. Declaration of Material Assistance
- f. Provide information for all contracts that your firm has had with any state agency or university in the last 24 months

State Agency:

Contracted Services:

Percentage Completed:

Amount of A/E Contract: \$

Please provide this information with your technical proposal for your firm and all your primary design disciplines (mechanical, electrical, structural, construction management, etc., as applicable).

This Technical Proposal is to be furnished in duplicate and is to be limited to the information requested herein. Information such as previous communications, form 330, general information about your firm or your consultants, index tabs, etc. are not to be included.

Overview

Design Review Process & Expectations

GENERAL PROVISIONS

- All A/E teams providing professional design services to Wright State University shall participate in the established design review process as a part of their contractual obligations to the University. This participation shall be considered a part of basic services paid for under basic compensation and shall not be construed to lengthen the time to complete the design or to require additional fees. The University will complete its reviews in a timely manner as set forth in the Project Schedule prepared by the A/E and accepted by the University.
- The following outlines the required review process and expectations relative to submitted documents for reviews and permitting.

DESIGN PROCESS

- Design Phases

Unless otherwise agreed upon, the A/E will provide an opportunity for the University's review (including duration of review) at the completion of each of the following design phases:

Schematic Design – 10 working days

Design Development – 10 working days

Construction Documents – 10 working days, to commence not later than 20 working days before the project is to be advertised for bidding

Each of these phases and review periods shall be identified in the Project Schedule.

- Construction Budget and Estimates of Probable Construction Cost

The University will provide the A/E with the Preliminary Program of Requirements and the Construction Budget (Fixed Limit of Construction Cost) prior to the execution of the agreement for professional design services. The Fixed Limit of Construction Cost (FLCC) may be adjusted only in accordance with the terms of the Agreement.

In addition to drawings and specifications, the A/E shall prepare Estimates of Probable Construction Cost for submission to the University at each of the design review phases listed above. These estimates shall be compared to the Fixed Limit of Construction Cost (FLCC) by the

A/E and the University shall be notified in writing of any adjustments in the project that may be necessary, to either limit the scope of the project or increase the Fixed Limit of Construction Cost. It shall be the responsibility of the A/E to complete the project design within the original Construction Budget unless directed by the University in writing to do otherwise.

- Written Review Comments

The design review process is intended to be a formal one in that the University will solicit written comments from various reviewers, including the plan review process by University's property and casualty insurance carrier, edit them as to appropriateness within the program parameters, and submit them to the A/E for incorporation into the design documents. **The A/E shall respond in writing to each of the comments.** If the A/E takes exception to any comment, the reasons shall be stated in writing for further discussion and resolution. The University and the A/E shall agree before proceeding to the next phase of the design. The A/E will incorporate comments into the documents and provide the written responses to those comments within 10 working days after submission to the University for each design phase.

- Standard Document Format

The University maintains its records in standard print and electronic format based on the AIA CAD/BIM Layer Guidelines and CSI Master Format Specifications.

The A/E shall provide a test file and meet with the University CAD/BIM Specialist to assure that electronic drawing files will conform to University standards. At any time, when requested, the A/E shall submit an electronic copy of any requested project drawing file(s), and at the completion of the construction document phase he shall submit a complete set of all drawing files. A final complete set of electronic as-built drawing files shall be submitted on CDs (PDF & CAD/BIM) at the completion of construction and shall be identified as such. All electronic files will be furnished as a part of basic services paid for by basic compensation.

All electronic drawing files shall be furnished in CAD/BIM latest version or as directed in different earlier version by the University. Data Interchange Files (DXF) will not be accepted as an alternate. If another software program is used by the A/E to generate project drawings, the A/E will be responsible for furnishing a translation/conversion to CAD/BIM that will maintain the accuracy and inclusion of all drawing data and will plot identical to the Project print records. Text styles and style names allowed shall be from the standard CAD/BIM font set contained in the base CAD/BIM program; third party proprietary fonts shall not be permitted. All electronic drawings of physical objects shown in plan, elevation, section and detail shall be depicted as actual size; nominal sizes shall not be used which would create scaling problems or drawing distortions. Diagrams, schedules, symbols and drawing conventions shall be drawn so that they are clearly readable at their plotted sizes.

The A/E and associated sub-consultants shall submit separate electronic drawing files corresponding to, complete and identical to each sheet in the plotted project set. Irrespective of the processes used to create drawings, such as cross-reference files, paper space and other organizational tools, the contents of each sheet in the project plan set shall be written to a separate .DWG file. Each file shall be labeled the same as it is in the plotted set. All layers in each drawing file shall be visible. Extraneous information, unused layers and blocks shall be purged. Drawing files that do not meet the University's standards shall be returned to the A/E for correction at no additional cost to the University.

Electronic copies of all sections of the specifications shall be submitted in Microsoft Word.

- Document Completeness

The A/E shall prepare drawings and specifications at each phase of the design to correspond with the following criteria for completeness, and the inclusion of the various design disciplines. These shall be submitted together with the Estimate of Probable Construction Cost for each phase described above. Failure to provide complete documents for review will not relieve the A/E of his obligation to meet the Project Schedule and will result in an unfavorable performance evaluation. Payment of the last twenty percent (20%) of the Basic Fee...shall be made only after all documents and Drawings required for the respective Phase have been submitted...as applicable, in form and substance reasonably satisfactory to...the Owner. Refer to the Agreement.

- Document Review and Coordination

The A/E and sub A/Es shall conduct an extensive review of all drawings and specifications to assure they have been coordinated with each other and that the proper notes, references and cross references are present. The A/E will submit a written affidavit attesting to this review and coordination at the time of completion of final bid documents.

DOCUMENT SUBMITTALS

- FRONT END REQUIREMENTS

The front end of all specifications for Wright State University projects shall be arranged in the following manner, using the most up-to-date version of the State documents, which are indicated in Part two of this document. The following outline is based on General Contract project delivery. Refer to State documents for adjustments for other delivery methods. Specific questions concerning any of the items should be directed to the University Project Manager.

1. Cover Page listing project information, name, number etc.
2. Table of Contents

3. Solicitation
 4. Instructions to Bidders
 5. Supplementary Instructions (Specific per project)
 6. Geotechnical or Environmental Data (if applicable)
 7. Bid Form
 8. Bid Security Form
 9. Bidder's Qualifications
 10. EDGE Affidavit
 11. Agreement Form
 12. Performance and Payment Bond Form
 13. Contracting Definitions
 14. General Conditions
 15. Owner's Supplementary Conditions (Specific per project)
 16. Wage Rate Requirements
 17. WSU Safety and Health Program
 18. Hot Work Program
 19. Digging/Boring Permit
- SCHEMATIC DESIGN PHASE

All Disciplines

For renovation projects, the A/E and each of the sub A/Es shall be required to field verify all existing conditions including but not limited to the location and condition of structural, architectural, mechanical and electrical items. To the extent necessary, all drawings at each phase of the design shall accurately represent existing conditions.

Civil Documents

Submit a scale schematic site plan based on existing University topographic and utility mapping showing the relation of the proposed project to existing site features such as roadways, walks, parking, trees and plantings and any underground and overhead utilities that will be affected by the project. Submit an outline specification of civil work.

Architectural Documents

Submit scale drawings showing compliance with basic program requirements, room sizes, uses and spatial functions and identifying support spaces such as stairs, corridors, rest rooms, mechanical, electrical, telecommunication, custodial and storage spaces. Drawings shall demonstrate general compliance with the OBBC (current Ohio Basic Building Code) with respect to building use/mixed use and occupancy, construction type, fire protection requirements, means of egress and accessibility. Indicate by building section or other means, the structural system proposed or modifications required and the general relation of floor, ceiling, structural

and mechanical systems. Submit an outline specification listing those sections to be used for the project.

Mechanical, Plumbing and Fire Protection Documents

Submit drawings that indicate the location of all mechanical spaces, water service entrances, sanitary and storm water exits and the location of all large equipment within the building(s), on grade and roof mounted. Indicate the types of systems to be used in the project including, but not limited to, air handling systems, mechanical cooling systems, heating systems and specialized mechanical systems specific to the project. Submit cut sheets of representative pieces of equipment. Submit load calculations and design criteria for all systems. Submit cut sheets for plumbing fixtures and any specialized plumbing systems and/or equipment to be incorporated into the project.

Submit cut sheets for fire protection equipment, pumps, extinguishers, sprinkler heads, etc. Indicate zones and occupancy hazard requirements for each wet and dry and special system locations.

Electrical, Telecommunication and Special Systems Documents

Submit drawings that indicate the location of all electrical, telecommunication and special system spaces and the location of major equipment including transformers, switchgear, distribution panels, etc. Submit a brief narrative describing the various systems and their operations, the type of lighting proposed for each area and the power requirements for spaces and special equipment. Submit an outline of all electrical, telecommunications & special systems specification sections. Submit proposed standard drawing symbols for review and approval by the University.

- DESIGN DEVELOPMENT PHASE

Civil Documents

Submit scale site plan(s) based on an actual survey of the project area to confirm existing lines and grades and verification of existing features and utilities that will be affected by the project. Indicate which utilities will be disturbed, interrupted or relocated and a proposed schedule for site construction activities that would affect University activities and operations. Submit preliminary details of paving, landscaping and other site work proposed in the project. Show the proposed limits of construction and the location of any temporary fencing, barricades or construction facilities such as stockpiles, dumpsters and trailers. Submit specifications for civil sections of the work.

Architectural Documents

Submit final scale plans, elevations, building and wall sections to fix and describe the size and character of the project as to architectural, structural, mechanical and electrical systems, including materials of construction proposed, the placement of all doors, windows, partitions, equipment and special construction unique to the project. This shall include the location and extent of built in casework, fixed furnishings, and all other items provided in the Fixed Limit of Construction Cost that is related to the intended use of all spaces. Drawings shall be provided in sufficient detail, that while not complete for bidding, a reasonably qualified reviewer can ascertain the design intent for materials, finishes and the type of construction for foundations, structural framing, walls, floors, ceilings and roofs. The drawings shall be complete enough for submission for a preliminary code review by the Bureau of Construction Compliance if the University elects to do so.

Submit a draft preliminary specification including all sections to be incorporated in the Construction Documents.

The A/E and associated sub-consultants shall adjust the Estimate of Probable Construction Cost to reflect any changes in the design; program, schedule or other factors affecting cost resulting from the development of this phase of the design. Refer to the Construction Budget and the A/E's obligations described above.

Mechanical, Plumbing and Fire Protection Documents

Submit drawings that show the location of all mechanical, plumbing and fire protection equipment and fixtures. Mechanical drawings shall have ductwork systems laid out in their entirety, at a minimum, in one-line format. All major piping systems for all disciplines/trades shall be laid out in plan. Submit an outline specification for all sections of Mechanical, Plumbing & Fire Protection which covers systems and equipment for the project.

Electrical, Telecommunication and Special Systems Documents

Submit plans that show the location of all lighting fixtures, electrical equipment and panels and the general location of all devices, specialties and project specific items. Identify the location and space requirements for all major equipment and its relation to the system(s) that it supports. Submit cut sheets for all equipment, fixtures and devices proposed for the project. Submit the refined specifications for all Electrical, Telecommunications & special systems sections.

- CONSTRUCTION DOCUMENTS PHASE

Civil Documents

Submit complete drawings showing all site work, utilities, grading, landscaping and details to enable bidders to quantify all elements of the project. Indicate phasing of the work if included in the project schedule. Include all benchmarks, items to be removed, relocated and constructed by the site contractor. Clearly distinguish the work of the University, if any, and the work of other contractors. Submit completed civil specifications.

Architectural Documents

Submit complete drawings and specifications setting forth in detail all of the requirements of the project for bidding, construction and code compliance which shall incorporate all University review comments and shall coordinate the work of all sub A/Es to be fully integrated into the project. Conflicts and/or inconsistencies discovered during the bidding period shall be addressed and clarified by addenda. The Construction Documents shall include clearly defined add/deduct alternates as may be considered appropriate by the University and the A/E and sub A/Es. For all capital projects, the state front-end as published by the State of Ohio shall be used. Refer to Part Two. The A/E shall prepare all Front End specification sections per State of Ohio sections and in conjunction with the University that meet the project conditions.

Mechanical, Plumbing and Fire Protection Documents

Submit complete drawings and specifications, schedules, diagrams and details necessary for project bidding, construction and code compliance. Submit any additional documentation necessary to demonstrate that the systems will perform to the design criteria established in prior phases of the project. Submit final specifications.

Electrical, Telecommunication and Special Systems Documents

Submit complete drawings and specifications, diagrams, schematics and schedules and details necessary for project bidding, construction and code compliance. All drawing notes shall be on the sheets to which they pertain. Panel schedules, motor control center schedules, and distribution board schedules shall be complete and coordinated with other disciplines/trades. Submit foot-candle calculations for normal and emergency operating conditions. Submit feeder voltage drop calculations for panels, large motors and other major equipment. Submit building load calculations. Submit Arc Flash and Arc Flash Analysis including requirements for proper labeling for building, including the settings for any relays. Submit final specifications.

Submit final cut sheets for all lighting fixtures, electrical and special equipment. All cut sheets and calculations shall be submitted in a notebook with tabs indicating each section.

PERMITTING

- Documents for Examination by the Bureau of Construction Compliance and State Architect

Submit four copies of the drawings and three copies of the specifications, which are signed and stamped by the person(s) primarily responsible for their preparation to the Bureau of Construction Compliance. Building permit fees paid by the A/E are a reimbursable expense with no mark-up allowed.

- For State of Ohio administered capital projects, submit a copy of the drawings and specifications to the Ohio Facilities Construction Commission.

Overview

A/E Responsibilities

GENERAL PROVISIONS

- The intent of this section is to outline what is considered the A/E general responsibilities relative to a standard project, the tasks and the process. It also outlines some basic requirements for the Owner.
- These will not all necessarily apply to each and every project but are typical for medium and large scale projects. Coordinate with project manager on each project.
- The consultant is to refer to the State of Ohio guidelines and instructions for requirements for required basic A/E scope services and other special A/E services requirements.
- The listed guidelines are not inclusive. The A/E must adhere to the terms of the contract.

GUIDELINES FOR A/E RESPONSIBILITIES

- The A/E is to develop the technical proposal based on the project scope and scope of services. Guidelines are listed in another section.
- A detailed target schedule for design, bidding/award and construction is to be provided to allow continued review of the project progress and adherence of the entire project team to the schedule.
- The A/E is to identify the main point of contact for the project (PM), the project designer, project architect and main point of contact (PM) for each of the consultants. These main points of contact will be the individuals that will interface and coordinate with the University Project Manager.
- The main point of contact (PM) will be the person responsible for the communications throughout the project. A project team communications chart, listing all contact information, with all parties listed is to be developed and distributed.
- Design project kick off meeting will be required with the entire project team and is to be organized, coordinated and directed by the Architect PM.
- Set up a project team sharefile (FTP) site for use for distribution of files, notes, shop drawings, etc.
- Design project team meeting notes are to be developed and distributed as well as placement on the project team sharefile (FTP) site.
- Development of coordinated drawings and specifications. Provide required sets to owner for each design review phase. At schematic level provide equipment cut sheets in organized binder for key building components to allow review and approval by owner
- Coordinate the estimate of probable construction costs at each phase of the design process. This will be a detailed outline of the costs for each discipline. A summary construction cost sheet indicating each phase as design progresses is required indicating the differences from phase to phase and to the overall FLCC.
- At the conclusion of the final document review submittal to the owner the A/E is to submit the proper documents to the State and other required governmental agencies, for permit approvals. The A/E will coordinate and communicate the required information to the State plan reviewer

for final approval of the project. Updates throughout the construction process will also be required.

- The coordination of project shop drawings will be required including all consultants. This is to be completed electronically except for physical samples. A transmittal for each as well as maintaining a complete log of activities and approvals with dates will be required.
- Any and all RFI's generated on the project are to be answered by the design team within 48 hours. If more time is needed for complex RFI's a response is needed within 48 hours as to when the final response will be provided. A complete log of activities is required.
- Any and all bulletin requests by owner and change orders requested from general contractor are to be coordinated by the A/E. Maintaining a complete log for tracking and approvals is required.
- Project closeout responsibilities include final acceptance of all punch list items, project manual approved and turned over to owner, project record drawings reviewed and updated and turned over to owner.

GUIDELINES FOR OWNER RESPONSIBILITIES

- Develop the final A/E contract and coordinate the execution once the final technical proposal is accepted.
- Coordinate the users for the project and the University team members to be involved with programming and design. Coordinate access to the building for design team.
- Be actively involved with the design process through meetings, phone calls, conference calls, etc.
- Provide guidance on Bid Proposal format, alternates, and front end documents. Provide current wage rates.
- Coordinate the advertising of the project and the bidding procedures through the University contracting office.
- Execute any adjustments as required to the FLCC and project budget.
- Provide any and all existing documents, drawings and specs for existing buildings, utilities, site, etc.
- Coordinate all in house reviews of design and design document submittals.
- Coordinate the required FF & E for the project.
- Interface with Engineering & Maintenance on the MEPT requirements for site utilities and the building.
- Establish all room numbers for the building spaces to be used in the document preparation.
- Coordinate the final door keying for the building.
- Coordinate the final exterior and interior signage for the project.
- Secure and organize the final project close out documents required and archive at the University.

Approach To Design

Design Guidelines and Philosophy - A perspective on design

DESIGN PHILOSOPHY

Wright State University's Design Philosophy has an intimate correlation with its defined system of values. All design decisions and solution recommendations by a design team should start with a clear understanding of what these values are and promote each equally:

- **PEOPLE:** Promote the success of the students, faculty and staff
- **LEARNING:** Uniquely demonstrate a commitment to enabling discovery and fostering innovation
- **PARTNERSHIPS:** Maintain high ethical standards through open communication, trust and professionalism and a collaborative spirit
- **SUSTAINABILITY:** The pursuit of knowledge is inherently sustainable, be providers of ecologically responsible solutions.

CAMPUS CHARACTER

The 2011 Wright State University Campus Masterplan was created to provide direction on land use and development. It not only addressed planning, growth and capital investment opportunities for the next 10+ years but also identified some key campus design issues that are essential in defining the future quality and character of the campus fabric:

- **BALANCE:** Provide a balance between paved surfaces, roof surfaces and green spaces. This sensitivity is crucial in supporting an ecological and sustainable balance between architecture and site.
- **COMMUNITY:** Create spaces that deepen the sense of community on campus. Recognize the role and use of the existing woodland that bisects the campus.
- **CONNECTION:** Create clear and straight forward-connections, introducing unity, harmony, campus vistas and gateways. The campus pathways are the areas of interaction and "outdoor rooms" should be considered an integral point to relieve congestion, encourage group meeting, and create pause along your journey.
- **ART:** Art is an essential ingredient to recognize donor contribution. It should be considered a complement to the architecture and can be integrated to outdoor and/or indoor space.

A CONTEMPORARY LANGUAGE

Academic architecture is shaped by the evolution of curriculum, educational pedagogy, and the ever changing needs of the modern student. Understanding these variables and enhancing their evolution should be a role of the architectural language. A few of the current considerations in support of this language are:

- Support the Academic Mission by communicating the principle educational message of the program. Include graphics and branding as a means to integrate this message with the public spaces that support learning, collaboration and interaction
- Provide Places that transform Teaching and Learning, informal in nature and accessible to all.
- Create opportunity for Social Interaction, it is an essential stimulant of academic lifestyle. These opportunities are to be strategically located as to not conflict with sensitive private activities.
- Study and meditation spaces are critical to relieving the stimulation of large group activities and social interaction. These spaces should be well planned, private, quiet and if possible related to an outdoor view.

CONTEXTUAL SOLUTIONS

Wright State University has transformed into a place that embraces the aesthetic foundation of its campus while at the same time moving forward with innovative and complimentary design solutions that promote academic distinctiveness and quality. The campus has become of place that has a diversity of design, harmonious feel and unified landscape. In the evaluation and creation of new architecture and site solutions the design team should employ the following principles:

- New buildings shall be contextually complimentary in nature and take into consideration the impact of existing view and wind corridors of its immediate surroundings.
- Exterior materials shall promote lightness, authenticity, integrity and sustainability. They shall be what is respectfully appropriate to the expression of the idea and shall be considered essential in reinforcing the brand of the project. Aesthetic compatibility with the surrounding buildings will be reviewed on a case by case basis.
- Building massing, orientation and outdoor spaces shall be responsive to the environmental conditions of sunlight, wind and rain. A successful building shall protect and at the same time invite. A successful outdoor space shall invite sun in the spring and fall, and shade/breeze in the summer.
- Create a sense of Place, a sense of Purpose. Maintain and create more memorable spaces on campus.

Approach to Design

Space Requirements

OVERALL INTENT

In order to create a space that fully adheres to the needs of the users a special attention should be given to the greater context within which that space exists as well as the activities within that space serving the greater context. It is also important to recognize the ever-increasing digital literacy among both students and faculty and provide spaces that are supportive of this trend. All spaces, regardless of their function, should exhibit the ability to adapt to the ever-changing needs, lifestyles and expectations of today's world.

GENERAL PROVISIONS

- These space requirements are guidelines not mandates but should be followed within ranges indicated.
- Each project is unique and the support rooms square footage indicated should be adjusted based on the size and scale of the project.
- Major support functions size (Mechanical rooms/Switchgear rooms, etc.) will be designed per building.

OFFICES

- | | |
|--|------------------------|
| • Vice President – enclosed office with full height sound batt filled walls | 350 GSF |
| • Associate VP/Dean - enclosed office with full height sound batt filled walls | 180-240 GSF |
| • Associate Dean -enclosed office with full height sound batt filled walls | 180-220 GSF |
| • Director/Asst. Director – enclosed office full ht with sound batts | 140-180 GSF |
| • Directors of program – office or open work station | 130-140 GSF |
| • Staff/Faculty – office or open work station | 125-140 GSF |
| • Clerical – Classified – open work station | 64-80 GSF |
| • Clerical/Graduate/Teaching Assistant Students – open work station | 2 students per station |

CLASSROOMS – AUDITORIUMS - COMPUTER LABS

- WSU uses the following as guidelines for classroom spaces, recognizing that different learning environments will require different SF/person, room configurations and furniture requirements.
- 200-500 Students with fixed 18"D tables – 18-20 SF/person
- 100-200 Students with fixed 18"D tables – 20-22 SF/person
- 100-200 Students with loose 24"D tables – 25-26 SF/person
- 50-100 Students with fixed 18"D tables – 23-25 SF/person
- 50-100 Students with loose 24"D tables – 25-27 SF/person
- 30-50 Students with fixed 18"D tables – 25-28 SF/person
- 30-50 Students with loose 24"D tables – 27-30 SF/person
- 15-30 Students with fixed 18"D tables – 27-30 SF/person
- 15-30 Students with loose 24"D tables – 28-30 SF/person
- Computer Labs to be designed with 18"D x 36"W Tables and 40 SF/person
- Active Learning Classrooms – 25-35 SF/person average

SUPPORT SPACES

- Telecommunication rooms – Main room at appropriate floor at min. 144 SF and smaller secondary ones at other floors (See specific layout in Technology section)
- Electrical rooms – One major per building at minimum 570 SF with one per floor at minimum 120 SF
- Conference Rooms – typical for 20 people
- Seminar Rooms – typical for 8-10 people
- Huddle Rooms – typical for 4-6 people
- Corridors – typical main corridors 8'-0" minimum – internal corridors/hallways minimum 5'-0"
- Science Labs – 50-75 SF/person
- Maintenance/Attic stock storage rooms - 250 SF
- Recycling Rooms - 120 SF (to be determined with each project)
- Janitor/ Housekeeping – One large room per building - 150 SF with dedicated exhaust and one per floor of 75 SF with dedicated exhaust (if cost permissible).
- Vending Machines – 16 SF per machine. See 112123 for additional requirements.

NET TO GROSS

Office Building – 62-65%

Classroom or Lab Building – 58-60%

Interoffice – net x 1.25

Approach to Design

Classroom Standards

OVERVIEW OF DESIGN INTENT

In order to provide a creative and informed classroom design, teaching and learning must be at the forefront of all design considerations; learning environments must support learning content knowledge and allow for exemplary teaching. In addition, current and future faculty and students will expect socially-driven, less formal learning environments that encourage continuing learning beyond the classroom.

Spaces that transform teaching and learning:

- Provide a learning environment that will contribute in building a strong relationship between a student and faculty through increased engagement and interaction between the two.
- Allow for personalized education through flexibility of space, style and schedule.
- Preferred learning approach is a seamless blend between traditional face-to-face interaction and the ever-growing online based communication.
- Teaching and learning improve when learning spaces are student centered with collaborative based instructional methods used in a technology rich environment embedded in the pedagogical approach to learning.
- Consider SCALE UP (Student Centered Active Learning Environments for Undergraduates) classrooms that have shown to:
 - Improve Ability to Solve Problems
 - Increase Conceptual Understanding
 - Improve Overall Student Attitudes
 - Reduce Failure Rates
 - Improve performance of “At Risk” students

DESIGN PRINCIPLES

- **Emphasis on Preparedness** - Model best practices in teaching and learning so that students of today are prepared to meet the needs of tomorrow.
- **Hands-on Experience with Relevant Tools** - The audio visual systems should reflect technologies that are found in the real world allowing students to practice with real-world tools in a low risk environment.
- **Flexibility** - Important to reflect flexibility in diverse learning styles, curriculum choices and pedagogical approaches. Where practical, designated spaces must be easily reconfigured to change from class to class.
- **Adaptability** - Enable the systems and spaces to adapt over time in response to changes in curriculum, teaching and learning styles, and technologies.
- **Ease of Operation** - A/V systems shall be user friendly and designed appropriately for the end user.

LEARNING ACTIVITY PRINCIPLES

The following section describes each major learning space classification that can be used to define the learning activity and assist in clarifying the intent of how the space and the audiovisual systems can enhance specific learning activities. Discussion of learning “types” will help for improved planning and design of classrooms and should be evaluated on a “case by case” basis with project stakeholders.

- **Lecture/Didactic Instruction**-This learning activity involves the instructor delivering information through lecture or presentation. Students are typically forward-facing, listening and taking notes as needed, with the limited opportunity for student interaction and discussion.
- **Whole Group Discussion**-This learning activity gives the students an opportunity to internalize, apply, challenge and discover course content through conversation and discussion with the entire class. Often, the instructor acts as a moderator or facilitator for the entire group.
- **Small Group Activities with Technology**-Content is taught through small group activities such as problem solving assignments, simulations, case studies, role playing, “think-pair-share” assignments and other activities that encourage students to work actively within a small group. Group sizes are often 3-9 students and activities are supported by technology available to each group, such as a flat panel display or interactive white board with projector.
- **Small Group Activities without Technology**-These activities utilize the same pedagogical approach as the Small Group Activities with Technology but do not involve technology systems that are supplied by the University. Many of the same activities can be used-problem solving, role playing, etc... but without the benefits of technology resources. Personal technologies such as iPads, laptops and other mobile devices may be provided by the students but no provision is made for sharing or collaborating with such items.
- **Self-directed Learning / Research / Web-based Instruction**-Involves independent student work supported by technology. Working alone, students may be assigned to conduct research, solve problems, write compositions, and evaluate recordings of themselves or others performing specific tasks or other individual study activities.
- **Student Delivered Presentations / Demonstrations**-Students will have the opportunity to present or demonstrate their assignments, research and projects to other class members and faculty. This approach provides students valuable workforce skills as they develop the ability to communicate thoughts and ideas to groups. Providing students the opportunity to “teach others” helps increase retention of course content.
- **Distance Learning**-This approach allows students to actively participate with others located at remote locations. Live two-way audio, video and content are shared between two or more sites. The other site(s) may involve subject matter experts, guests or simply other student peers.
- **Asynchronous Learning**-this approach involves recording the proceedings of class period to a networked system that allows students and faculty to review sessions at a later date. Depending on the system used, recorded information may include audio of the instructor and possible students, video of the instructor and/or students and content such as PowerPoint presentations. This differs from Distance Learning in that any interaction is not real time.

GENERAL CLASSROOM PROVISIONS

- Electrical outlets are required within easy access for all students seating locations
- Classrooms that are tiered will have two rows per tier, have 1:20 accessible ramps, fixed tables and moveable chairs.
- Classroom door keying standards listed in Architectural division 08.
- Any requested flexible classrooms that require room division will be reviewed on a “case by case” basis. Accordion dividing wall partitions are not preferred.

- Multiple walls with writing surfaces and marker trays are to be integrated into the design and approved by WSU for each project.

FLOORING

- In general, for sound dampening/acoustical purposes, carpet is preferred in classrooms. Selected carpet shall be appropriately chosen based on durability and performance specifications.

GLAZING

- Clear or decorative glazing is to be adjacent to all classroom entrances to allow for visual connection from corridor to interior of classroom. This can be achieved with glazing in door(s) in limited space areas.
- Glazing can also be utilized, optionally, as instruction writing surface.

LIGHTING

- Indirect ambient lighting source via ceiling suspended linear system or lay-in fixtures with indirect source of light.
- Recessed fixtures at front of the room to wash the front display whiteboards. These to be separately switched.
- Dual level light switching required. Foot candle levels to be per code – refer to Division 26
- All light fixtures must be reviewed for accessibility and access for maintenance and lamp replacement.

FURNITURE

Selection of furniture to be primarily based on warranty and life cycle costs. The following examples are intended to set general guidelines with basis of design examples and final selection should take into consideration the intended use of space.

- Student Chair-Adjustable height on casters (Basis of Design Model: Steelcase Cachet)
- Student Table - 18" x 66" (on glides if over 40 students)
- Instructor Chair – Adjustable height on casters (Basis of Design Model: Steelcase Cachet)
- Instructor Podium – (Meets equivalent performance/standards or exceeds that of Model: Spectrum 55218 CHBHD)
- Instructor Table – On casters for front of classroom
- Instructor tabletop moveable lectern.

TECHNOLOGY

- Mounted projector (ceiling or wall) – Specification and projector by WSU CaTS, mount is to be provided by contractor.
- Location of projector and screen(s) to be determined to maximize line of sight. (front of room or corners of the room) Screens must not cover significant portions of whiteboard space.
- Monitors/Smart Boards/Video Conference equipment will be project specific.

WHITEBOARDS

- The whiteboard space in the classroom and the front of the classroom is to be maximized. Locating on minimum one additional side wall is encouraged as appropriate to maximize coverage in overall design with projection locations. (Basis of comparison Model: Claridge LCS Porcelain Enamel marker board with tray or equal with lifetime warranty)

SIGNAGE

- All classroom entrances are to allow for a signage zone in close adjacent proximity. All signage will be by WSU Signage shop with style, size, wording and colors selected by University and compliant with current ADA and OBC.

Approach to Design

Laboratory Standards

OVERVIEW OF DESIGN INTENT

In order to provide creative and informed laboratory design, research and discovery must be at the forefront of all design considerations; lab environments must support learning new principles of science, research, and equipment operation while at the same time allowing for collaboration and education. It is a delicate blend of controlled environmental performance and a stimulating environment for education.

There are various lab types (research VS educational) that are required on the campus and the function of each lab is unique to the discipline it supports. The University Standards address an overall philosophy on environments but it does not relieve the design team of its responsibility to incorporate these strategies into each project and tailor a solution that best meets the programmatic and design intention of each lab type.

Spaces that transform science/research and collaborative education:

- A careful look must take place at how the lab environment contributes to student and faculty engagement and interaction to assist building a strong relationship among them.
- Natural Daylight not only promotes energy savings but also enhances the interior environment. When deemed appropriate for the lab type, it should be carefully integrated into laboratory spaces based on the purpose and function of that space.
- Open sight lines, energy efficiency and benchmarking, review of equipment loads and infrastructure requirements are essential factors that must be reviewed.
- Open layouts, integrated huddle areas, visual connections within lab and also to the expanded corridor environment.

Lab environments of the 21st Century-LABS 21 demonstrates a valued process to how laboratory environments are assessed, planned and designed to respond to the environmental responsibilities of today. It is encouraged that this intricate process of energy demand critique and response be considered in the design and planning of appropriate lab projects. Specific performance criteria will be reviewed on a case by case basis.

DESIGN PRINCIPLES

The following design principles have been considered but should be reviewed by the stakeholders of each project and appended as appropriate:

- **Emphasis on Active Learning Lab Environments**-The laboratory environment is a Hands-on Laboratory rich environment. Lab planning and design should promote group activities-Students LEARN science by DOING Science.
- **Integration of Technology**-The lab environment should consider the integration of A/V to enhance the education of science based learning. Consideration of the “instructors demonstration stations” role and location within the lab and how it is integrated with A/V that can link the instructor actively to the students
- **Scientific Collaboration** -Importance of Peer Learning, Outreach Opportunities, Places for Students to Interact, Study, Eat & Drink.
- **Science on Display, Celebration of Science**-Activate corridors, communicate and expand function, engage building occupants and visitors, incorporate scientific art, put Science on Display and use art as an educational opportunity.

- **Sustainability**-Responsible Design & Stewardship, Educational opportunities, Project recognition and Standards, Long term energy and cost savings (Laboratory ventilation and ACR, Fume hood exhaust systems-low volume, Heat Recovery systems, plug and equipment loads).
- **Laboratory Programming**-This process should be an interactive consensus building process. For science and research labs verify and refine prior to any pre-design work. Develop the laboratory planning module, Prepare room by room program deliverables (RDS), Establish laboratory systems criteria, Conduct benchmark comparisons.
- **Laboratory Design**-Lay out options, bench preferences (fixed VS modular casework), distribution of utilities, review of laboratory/lecture flexibility, hoods and sinks (locate at perimeter to encourage open site lines and improve teaching environment) accommodation of equipment and computers.
- **Benchmarking**-Data base information (Critical ratios, Informing early programming decisions, Point of reference for program validation), Net/Gross area ratio (expectations VS. goals, impact on floor size and layout, trend towards interaction spaces), Laboratory support/Lab + Laboratory support ratio (proliferation of scientific equipment, influence of faculty-student research), Laboratory density: Total Laboratory NSF/Building GSF-(Higher density results in higher costs)
- **Room Data Sheets (RDS)**-Review all lab requirements including but not limited to: Room Information, Room Function, Lab Type & Classification, Room finishes, Lab Casework, Acoustics & Environmental Issues, Structural, Security, HVAC (Temp/RH, Air Flow/Changes, Air Quality), Plumbing, Gases, Electrical (Power, Emergency Power, Lighting), Communications (Tele/Data, Monitors/Alarms), Fire Protection, Equipment (Include detailed equipment list and matrix), Hood Types, Chemical Inventory List.

LAB PLANNING THEMES

- **MODULARITY**- Making laboratory design as modular as possible is in important consideration, particularly in terms of HVAC design, specialized systems and structural loading designs. This is important because, given the increasingly fast pace of change in science disciplines and techniques, flexibility to modify and improve lab settings as science evolves and changes is required
- **FLEXIBILITY** – While each lab is different and many specialized features are required, it is important to plan laboratory spaces as flexibly as we can both because of the changes in science mentioned above and also because research programs ebb and flow over time. Flexibility in design enables us to allocate additional space easily, as research programs grow or shrink. Often flexible planning enables us to co-locate similar laboratory programs, which furthers scientific goals and encourages collaboration.
- **SHARED LABORATORY SUPPORT AND RELATED SPACES**- Sharing of laboratory support rooms and functions is becoming increasingly common. Continuing to develop shared support spaces is critical in constraining costs, using space efficiently, and being able to provide state-of-the-art spaces. It is important that these kinds of shared spaces are planned well from the very start, so that sharing can be accommodated.
- **ACCOMMODATE STORAGE NEEDS**-It is important that the storage needs for the laboratories be carefully thought out and discusses so that the highest and best use of the laboratory space can be achieved.

DESIGN OBJECTIVES

WET LAB

- **DESCRIPTION** Wet Laboratory space types are defined as laboratories where chemicals, drugs, or other material or biological matter are tested and analyzed requiring water, direct ventilation, and specialized piped utilities. Wet Laboratory space types do not include biohazards in Levels BL-2, BL-3, and BL-4 as defined by the 2007 NIH/CDC guideline.
Wet Laboratory space types are unique in that they must accommodate simultaneous and separate ventilation and utility connections at individual lab modules to ensure both the reliability and accuracy of

results as well as occupant safety throughout the space. Typical features of wet laboratory space types include the list of applicable design objectives elements as outlined below.

- **AESTHETICS**-Resilient surfaces are in integral part of the Wet Laboratory space type design. Wall finishes should be discussed for durability, cleanability and appropriateness for the uses of the specific lab. It may include epoxy paint for walls and seamless, chemical resistant flooring with integral coved base.
- **FUNCTIONAL/OPERATIONAL**-Consider separate lab modules that contain individually controlled connections to HVAC, utilities and safety devices. Provide constant and reliable HVAC temperature and humidity control to ensure equipment can perform properly and that experiments produce accurate results. Evaluate Dust control requirements. Utility connections can include vacuum, pneumatic supply, natural gas, O2 and CO2 and distilled water-fittings and connections for each planning module are to be connected to the building distribution system.
- **SECURE AND SAFE**-All Laboratory spaces should contain a hand-held chemical emergency fire extinguisher in an emergency equipment cabinet. There should generally be one fire alarm pull station by each egress point and an audible and visible (strobe) alarm in each occupiable space (not including closets, storage rooms, or coat racks). Also include toxic gas monitors in each lab module and a gas storage area with audio and visual (strobe) alarms both inside and outside the lab. Eyewash and deluge shower should be located at each module quad. REFER TO EH&S STANDARDS SECTION FOR ADDITIONAL INFORMATION.

DRY LAB

- **DESCRIPTION** The Dry Laboratory space type is a laboratory space that is specific to work with dry stored materials, electronics, and/or large instruments with few piped services. The laboratories defined by this space type are analytical laboratories that may require accurate temperature and humidity control, dust control, and clean power. Dry laboratory space types are designed to accommodate project-specific work patterns and scientific equipment. As such, they tend to include design features that provide reliable working conditions in a somewhat mobile environment.
- **AESTHETICS**-Static dissipative surfaces are in integral part of the Dry Laboratory space type design. Wall finishes should be discussed for durability, cleanability and appropriateness for the uses of the specific lab. Raised access flooring with static dissipative tile may also be a discussion for equipment intensive spaces to allow for flexibility, access and support.
- **FUNCTIONAL/OPERATIONAL**- As some equipment and experiments are temperature- and humidity-sensitive, constant conditions are required in Dry Laboratory spaces to ensure that equipment can perform properly and that experiments produce accurate results. Just as experiments and equipment may be sensitive to changes in temperature and humidity, so might they be to dust and other foreign particulates.
- **PRODUCTIVE**- As working conditions will often change due to new projects and equipment, dry laboratories are usually fitted with mobile casework to allow for flexibility in the floor plan. This casework is generally a pre-manufactured laboratory casework system with cantilever support off of central service chase system. The chase system has metal channel support with a horizontal distribution of wiring. Due to the flexible nature of the Dry Laboratory, the distribution of critical wiring (power, voice data, and HVAC) should be clearly laid out, and easy to access and redirect.
- **SECURE AND SAFE**-All Laboratory spaces should contain a hand-held chemical emergency fire extinguisher in an emergency equipment cabinet. There should generally be one fire alarm pull station by each egress point and an audible and visible (strobe) alarm in each occupiable space (not including closets, storage rooms, or coat racks).

GENERAL PROVISIONS

- Research and laboratory space needs and guidelines vary widely between schools and departments, type of research being undertaken, and special requirements. There are a number of different types of laboratories that existing on campus, including (among others)-computational laboratories, wet laboratories, dry laboratories, teaching laboratories, special equipment or instrumentation laboratories.
- While laboratory needs vary widely between disciplines, as mentioned above, Wright State University's goal is to configure laboratory space in as flexible and modular a way as possible because of the fact that research needs and methods change and evolve over time. Laboratory space is typically configured in standard laboratory modules, which become space denominators that are designed to meet a variety of research needs. These modules allow for flexibility in planning the following:
mechanical/electrical/plumbing (MEP) systems; heating, cooling and ventilation (HVAC) systems;
casework; laboratory support spaces; specialized functions; partitions; fume hoods; etc.
- Electrical outlets are required within easy access for all students seating locations.
- The most recent published version of the *ASHRAE Laboratory Design Guide* shall be used as a reference for the planning, layout, and design of laboratories. Laboratory ventilation shall be designed consistent with the most recent published version of the *American National Standards Institute (ANSI) Z9.5 Laboratory Ventilation* standard.
- Consideration and review of flexible benchwork should be discussed on a "case by case" basis
- Utility distribution-overhead carriers VS in bench should be discussed on a "case by case" basis
- Equipment matrix is to be provided to ensure space allocation needs and coordination of all utility requirements.
- Lab separation requirements and negative pressurization shall be reviewed for each project.
- Cleanability requirements of floor, wall and ceiling finishes should be appropriated for the specific use of lab space.
- Handwash, eyewash/emergency shower locations should be reviewed.
- Hood Types and all optional items for control of flow, sash operation, hood liner, cup sinks, utility requirements, monitoring and alarm requirements.
- Safety cabinet types should be reviewed and located is required.
- Lab waste protocol needs to be considered.
- All primary piping and distribution ports quantity and location should also be reviewed.
- All lab entrances shall have signage in close adjacent proximity. All signage shall be by WSU Signage Shop with style, size, wording and colors selected by WSU FPD (adhering to current ADAAG and OBC).
- **If not specifically listed in this section, all applicable considerations from the EHS section shall be addressed.**

FLOORING

Flooring selections will dependant on the type of lab that is under consideration. Specific requirements based on the lab use will be evaluated on a "case by case" basis. Some preferred options include:

- Seamless vinyl flooring with chemical resistance rating and integral self-coved base. Seamless epoxy should also be considered in some conditions.
- Optional VCT chemical resistant floor may be acceptable but must be reviewed on a "case by case" basis.
- Static dissipative floors will be required in micro-electronics laboratories

DOORS

- Door material selection, operation and design will dependant on the type of lab that is under consideration. Specific requirements based on the lab use will be evaluated on a "case by case" basis.

- Laboratory doors shall be self-closing design for security reasons and to assist with keeping the lab air pressure negative to the hallways and in accordance with current building code.
- Coordination of door frame prep

GLAZING

- Clear or decorative glazing is to be adjacent to all lab entrances to allow for visual connection from corridor to interior of lab. This can be achieved with glazing in door(s) in limited space areas.

LIGHTING

- Indirect ambient lighting source via ceiling suspended linear system or lay-in fixtures with indirect source of light.
- Dual level light switching required. Foot candle levels to be per code – refer to Division 26
- Daylighting, or natural light, should be introduced into the lab environment whenever possible, unless projected images or computer screens are the intended lab use. Review specific opportunities on a “case by case” basis.

FURNITURE

- Furniture selection should carefully be evaluated based on the type of lab and use.
- All furniture within the wet laboratory must be capable of undergoing decontamination in the event of a spill event (no cloth-coverings allowed).
- All furniture with a dry lab that requires static dissipative flooring shall be on rollers.

TECHNOLOGY

- Mounted projector (ceiling or wall) – Specifications and projector by WSU CaTS.
- Location of projector and screen(s) to be determined to maximize line of sight. (front of room or corners of the room) Screens must not cover whiteboard space.
- Monitors/Smart Boards/Video Conference equipment will be project specific as approved by WSU FPD & WSU CaTS.

WHITEBOARDS

- The whiteboard space in the laboratory is to be maximized and coordinated for optimized clarity of instruction. Locating on side walls is encouraged as appropriate to maximize coverage in overall design with projection locations. (Model: Claridge LCS Porcelain Enamel marker board with tray or equal with lifetime warranty)
- Specified whiteboards shall be appropriate for the type of lab and not sensitive to chemicals/fumes when used within wet labs.

FUME HOODS

- All newly installed, or renovated, fume hoods should be designed following current ANSI guidelines and shall be commissioned under a performance test following current ASHRAE Standards.

- Fume hood location shall be designed away from doorways, high traffic areas, windows and not below or adjacent to supply/exhaust vents so the effectiveness of the hoods are not compromised due to airflow created by traffic patterns or other air flows.
- All newly installed, or renovated, fume hood systems shall be equipped with an airflow monitor and an alarm system that will allow notification to the user that the hood is not operating as designed and the system shall be designed to report alarm conditions to Physical Plant's building automation system.
- Fume hoods must be identified with appropriate fan information to allow for the coordination of safe shutdown procedures during future maintenance activities.
- Fume hoods requiring special equipment such as filters, washdown systems, etc... must receive approval from WSU Environmental Health and Safety prior to installation.
- Hazard Communication signs for hazards shall be in consultation with EHS.

Approach to Design

Sustainability/ LEED

GENERAL PROVISIONS

Wright State University (WSU) strives to preserve the health of our campus, neighboring communities, and our environment with the institution's ongoing commitment to sustainability. The overall impact of WSU's built-environment supports the university's mission and long-term success by emphasizing quality, maintainability and efficiency in the use of human and natural resources. In valuing unique campus assets like our 225 wooded acres, including the Biology Preserve in the heart of campus, WSU recognizes that long-term resilience, prosperity and sustainability is interdependent on complex, dynamic ecological systems.

Sustainability is central to the core values, priorities and decision-making that comprise the Mission of Wright State University. The 2008 Wright State University Strategic Plan states, "the necessity of preserving our planet [which] compels us to weigh the impact of our decisions, both short term and long term." With sustainability central to our institutional values, all infrastructure, construction and renovation projects will be evaluated based on industry standard criteria set forth in the U. S. Green Building Council Leadership in Energy and Environmental Design (LEED) Life Cycle Cost Analysis. The WSU campus built-environment will demonstrate sustainable long-term planning and design by meeting or exceeding Silver LEED certification standards for both new construction and renovation of existing buildings (unless prohibited by existing conditions). All aspects of the facility lifecycle processes will be aligned with LEED standards beginning with pre-design, to site selection through construction and building operation. This includes use of durable, non-toxic building materials, furnishings and furniture obtained from regionally-sourced manufacturers that employ sustainable processes for procurement, production and transportation.

In May 2010, President Hopkins signed the Talloires Declaration, committing Wright State to a series of ten actionable initiatives, serving as a tangible sign of our continuing dedication to sustainability. This commitment means that campus facilities such as food preparation and dining services, housing, grounds, maintenance and cleaning will embody sustainability to support the academic mission and promote the health and wellness of the WSU campus community.

Energy conservation and efficiency of facilities, and sustainability practices govern how we live and work on campus as we focus on operations that include but are not limited to: optimizing the use and reuse of our currently existing buildings; reducing greenhouse gas emissions; conserving resources; promoting active, healthy lifestyle choices by supporting consumption of locally grown foods; encouraging food waste composting and use of compost to nourish garden soils; improving walkability and use of bicycles and public transportation on and near campus; preserving our natural landscapes and open spaces; minimizing use of toxic materials; increasing overall reuse, repurposing and recycling to reduce landfill waste including during construction; thereby preserving natural resources while enhancing constructed spaces on campus. Established in 1964, WSU continues to exemplify the traits of tenacity and innovation embodied in the Wright Brothers' First in Flight heritage. Recognizing emerging technologies and innovative practices, WSU will deploy viable cutting-edge strategies to support our commitment to sustainability. True costs, derived from cost factor analysis and evaluation of life-cycle cost benefits, outweigh trendiness or novelty and override up-front expenditures when results demonstrate long-term success and durability.

At Wright State University being responsible environmental stewards means utilizing innovative approaches coupled with age-old sustainable practices to enhance WSU's commitment to academics, research and the university mission to prepare students for success, now and into the future.

Approach to Design

Accessibility/ ADA Requirements

GENERAL PROVISIONS

- The standards for accessibility and ADA are to follow the current building code.
- Additional provisions above these baseline code standards are as noted below.

BUILDING DESIGN STANDARDS ABOVE MINIMUM REQUIREMENTS

- Doors
 - Push buttons for automatic operators to be located 29" AFF
 - One set of double exterior main entry doors to a building to have automatic operators (single door on minor entries is acceptable)
 - No push buttons on glass mullions
 - No push buttons on railings – install post with push button at appropriate location
 - Locate automatic door operators at large auditoriums entrances
 - Door operators to be WSU standard – see architectural division 08
 - Closers not to exceed 5 Lb limit – WSU standard – see architectural division 08
 - Keep door handles and locks as low as possible – 31" AFF maximum. Location should not void warranty from door manufacturer or fail to meet current building code.
 - Standard door width is 3'-0"
 - Door view lite panels are good but keep as low as possible without voiding door manufacturer warranty
- Restrooms
 - The preferred design is no doors into public restrooms when in keeping with adjacent spaces.
 - All restrooms to have no visible entry door layout design with push pull door swinging out and recessed.
 - Locate hand wash and towel dispensers on side walls not front mirror wall.
 - Toilet paper dispenser to be located if single roll just below the grab bars or if a large roll type above the grab bar with bottom of tissue 2 " above grab bar for easy access.
 - Grab bars 36" AFF
 - Toilet stalls to be 5 X 5 with toilet on one side to allow chair on side for easy transfer
 - Shower stalls shall be a minimum of 42" x 78"
 - Paddle handles on sink fixtures preferred.
 - Unisex standard design for family use requirement is preferably one per building located on first floor.
- Tunnels
 - All new buildings connected with tunnels to allow full access between buildings and into buildings from tunnels. Currently this does not exist with existing system of tunnels and WSU will strive to achieve this requirement in existing buildings with projects in the future. Cost implications should be discussed with the University prior to being integrated into design.
- Exterior Sidewalks
 - Minimum width of 8'-0". Larger widths to be determined on per project bases.
 - Pavers to concrete walk or joints in concrete walks to be flush.
 - Pervious paving desired but hard to achieve with campus soil type and its use should be carefully analyzed.

- Provide curb cuts for total campus access. Locate in convenient pathways.
 - Maintain raised roadway walk at primary road crossings.
 - Provide tactile surface (rubber) at all crossings. Basis of Design: Armorcast Detectable Warning Panels.
- Parking
 - Disability office advocates for increase to ADA regulations for minimum for cars and vans, if cost permissible.
- Elevators
 - Locate cab controls under railing
 - Exterior call buttons to be located 29" AFF
 - For new buildings provide two elevators per building with two ways to access each floor.
 - Provide extended time for elevator door hold openings after car arrives to allow entry
 - Provide both sight and sound announcements at call locations
- Reception Counters
 - Provide minimum access but also flexible seating locations for people and wheelchairs
- Hallways
 - Disability office advocates main corridors @ 8'-0" and internal corridors/hallways @ 6'-0" where cost permissible.
- Stairways
 - Increase minimum light levels to 25% above current code.
 - Treads – provide color contrast at first step and last step to make easily seen
- Signage
 - WSU desires an increase in signs, locating exist signs low and possible Q codes, voice activated or phone applications to assist with way finding.
- Classrooms
 - No elevated stages
- Labs
 - One station ADA compliant including hood access.
- Security
 - Card swipes are OK if located properly but proximity detector preferred.
 - Push button door security access is OK but not preferred.
- Vending Machines & ATM Machines
 - Keep access to 29" AFF is preferred
 - Provide speaking or Braille controls
- Phones
 - Install all emergency phones at 29" AFF
- Housing
 - Locate all ADA rooms on first floor
- General locker rooms
 - Disability office advocates to locate ADA lockers low for access and provide greater quantity than ADA minimum.
- Building ramps
 - Entries to have all flush entry points. If ramps required they are to be 1 in 20 with no rails and no switch back designs if at all possible. Design any access as a sidewalk not a ramp.

Approach to Design

Environmental Health & Safety

GENERAL PROVISIONS

These standards have been developed by Wright State University's Department of Environmental Health and Safety (EHS) to serve as standards for all campus projects. Adherence to these standards will result in projects designed to reduce the campus impact on the environment during demolition and construction, maintain the safety and health of project workers, and create a final product that takes into consideration the safety, health, and environmental impacts during future use and maintenance activities.

General Comments Relative to all Planning, Design, Demolition, & Construction Jobs:

1. Environmental Impact Considerations

- a. In any area where physical demolition is to take place the project shall ensure a third party site assessment of the area be performed for the presence of asbestos containing material, lead paint and walls or shielding, PCB's (specifically in light ballasts but in other possible material), mercury containing fluorescent lighting, mercury containing devices (i.e. thermostats), mechanical system fluids in equipment requiring removal or demolition (i.e. oils, antifreeze, freon), tritium exit lights, miscellaneous left behind hazardous material, potential drain trap contamination, fume hood removal hazard safety, batteries, and any other potential hazardous material. Based on the assessment a plan for the safe and legal demolition as well as disposal of all identified material shall be developed, submitted and approved by the university prior to demolition or renovation.
- b. If the construction project results in the disturbance of greater than one acre of land the project will be subject to OEPA construction activity storm water discharge permitting. If greater than one acre is to be disturbed responsible parties must be determined and a permit procured prior to commencement of construction activities.
- c. Regardless of construction site size, post-construction storm water management strategies, or systems, should be designed as part of any project that will affect stormwater discharge. Maintenance procedures for all post construction storm water management systems must be included in the contractor's closeout documents.
- d. Any new storm water connections created during the project must be in compliance with WSU's storm water permit. A copy of the university's EPA NPDES storm water discharge permit which covers WSU's storm water discharge activities is available on Environmental Health and Safety's website (<http://www.wright.edu/admin/ehs/>) or can be accessed by contacting WSU Environmental Health and Safety. Any storm water connections that are not authorized discharge activities under the university's permit shall not be constructed.
- e. Any interior storm water drainage system (i.e. a system designed to collect wastewater or other discharge from an interior process) shall be removed or re-routed to prevent illicit storm water system discharges from the university in violation of the university's EPA NPDES storm water discharge permit.
- f. A list of any new equipment to be installed, or any existing equipment that is altered, that contains 55 gallons or more of oil must be forwarded to WSU Environmental Health and Safety. Examples of such equipment include, but are not limited to, elevators, electric switches, waste oil storage, generators and transformers. This information is needed to remain compliant with EPA spill prevention rules.
- g. Any emergency generator and/or boiler system that does not meet the exemption for air permitting pursuant to OAC 3745-31-03 or the "de-minimus" air contaminant source exemption

pursuant to OAC 3745-15-05 must be properly permitted prior to installation and all permits of such sources must be provided to WSU Environmental Health and Safety.

- h. Underground storage tanks are not to be designed into any projects without prior approval from WSU Environmental Health and Safety.

2. Research Laboratory Considerations

- a. The most recent published version of the *ASHRAE Laboratory Design Guide* shall be used as a reference for the planning, layout, and design of laboratories.
- b. Provide signage, warning lights and warning signals for any restricted spaces in coordination with University.
- c. Laboratory ventilation shall be designed consistent with the most recent published version of the *American National Standards Institute (ANSI) Z9.5 Laboratory Ventilation* standard. Per state law, the calculations shall not be provided by entity that is not an “end user” of the x-ray producing equipment, nor a “regulator” of that equipment.
- d. All laboratories designed for the use of biological materials should be designed and equipped to at least meet the recommendations for a biological safety level 2 (BSL2) lab as described in the most recent published version of the CDC/NIH publication *Biosafety in Microbiological and Biomedical Laboratories*. Where more hazardous biological work is to be performed additional facility design would be required.
- e. Tissue culture rooms, or other rooms designed to house biological safety cabinets, must be designed with laboratory air, or provisions for other means of lab air must be made, to allow for the required annual certification testing of the biological safety cabinets.
- f. No gas jets/valves shall be designed for installation into any biological safety cabinets.
- g. All newly installed, or renovated, fume hoods should be designed following ANSI Z9.2 *Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems* and shall be commissioned under a performance test following ASHRAE Standard 110 *Method of Testing Performance of Laboratory Fume Hoods*.
- h. All newly installed, or renovated, fume hood systems shall be equipped with an airflow monitor and an alarm system that will allow notification to the user that the hood is not operating as designed and the system shall be designed to report alarm conditions to Physical Plant’s building automation system.
- i. Fume hoods must be identified with appropriate fan information to allow for the coordination of safe shutdown procedures during future maintenance activities.
- j. Fume hoods requiring special equipment such as filters, washdown systems, etc... must receive approval from WSU Environmental Health and Safety prior to installation.
- k. No eating or drinking is permitted in any research or teaching lab space. An adequate space should be designed on each floor of lab buildings to allow faculty, staff, and students to eat and drink in an area outside of any new or renovated laboratory space.
- l. Office space, and other rooms suitable for eating and drinking, in laboratory buildings must be designed outside of the lab space. When made part of a laboratory design all office areas must have an entrance from the outside corridor. The integrity of the laboratory’s containment capability becomes compromised if entry into an office area requires a person to walk through a laboratory. This design is required to prevent occupants from bringing food and drink into or through the laboratory.
- m. OSHA and NIH regulations and guidelines call for labs to have sinks readily available for hand washing. At least one sink in each lab shall be designed with soap dispensing and hand drying capabilities. These sinks should be installed near the entrance/exit of each lab to allow for proper handwashing just prior to exiting, or upon immediate entrance, into labs.
- n. All furniture within the laboratory must be capable of undergoing decontamination in the event of a spill event.

- o. Laboratory doors shall be self-closing design for security reasons and to assist with keeping the lab air pressure negative to the hallways.
- p. Any project that will include the installation of chemical storage cabinets shall ensure the cabinets are adequately sized based on input from their end user. All flammable/combustible chemical storage cabinets must be designed per the specifications of NFPA 30 Chapter 4.3.3(a) and (b) and OSHA 29 CFR 1910.106(d)(3)(ii) through (d)(3)(ii)(a). Corrosive chemical cabinets must be designed as corrosion resistant cabinets, preferably the polypropylene or polyethylene type. Areas for the installation and use of chemical storage cabinets should be such that they are not near a lab egress so as to allow for emergency exiting in the case of a release of a chemical from the cabinet or a fire.
- q. Designated chemical storage areas, including cabinets, should be constructed with secondary containment capabilities.
- r. All compressed gas storage areas must be equipped with proper restraining systems with the capacity to restrain the number of cylinders designed to be stored within the area.
- s. The requirement to install, or keep, acid neutralization pits must be evaluated. Requirements to receive an exemption from the local plumbing authority should be verified and received if needed. Requirements that must be met in order to qualify for an exemption (i.e. lab sink labeling, acid use inventory, etc...) must be made part of the scope of work for any applicable project.
- t. All laboratory vacuum systems should be designed as local lab systems with filtering capability in the lab. No house vacuum systems shall be designed without filtering capabilities, preferably at each laboratory.
- u. Laboratory room signage shall be installed at the entrances of all laboratories consistent with lab signage used in other laboratory buildings on campus such that hazard communication information representative of the work being done in the lab can be posted.

3. Emergency Showers/Eyewash Stations

- a. Emergency showers and eyewashes must be provided for all locations where hazardous materials are used, including, but not limited to, laboratories and mechanical rooms. All emergency eyewash and shower stations must be designed, operated, and located compliant with the most recent published version of ANSI Standard Z358.1 *American National Standard for Emergency Eyewash and Shower Equipment*.
- b. Emergency showers and eyewashes should be accompanied with an appropriately designed drain to accept wastewater during testing and/or use. Consideration should be given to the fact a large volume of water will be discharged if the showers are designed to ANSI standards and they are operated for fifteen minutes as recommended after a chemical exposure. The drainage for the eyewash stations should be designed such that if direct flow to a floor drain does not exist a testing bucket can be easily positioned under the drain to collect water during testing, or install drains flush w/ floor and close to wall.
- c. All emergency showers or eyewash stations that are moved, newly installed, or altered in any manner shall be tested by the contractor, prior to release to the university for use, per the requirements of the most recent published version of ANSI Standard Z358.

4. Fall Protection Considerations

- a. Fall protection solutions must be designed into the installation of all new equipment when applicable. This shall include, but not be limited to, new light installations such that cleaning and maintenance can be performed in a manner that will not subject personnel to fall hazards. Design shall be such that maintenance and cleaning can be performed by personnel through the safe use of a ladder in compliance with 29 CFR 1910.26(c)(3) or engineering controls shall be

designed that will allow the equipment to be lowered, otherwise adjusted, or fall protection systems installed for safe access for cleaning and maintenance.

- b. Proper fall protection must be designed for any equipment that is to be positioned on the roof such that cleaning and maintenance can be performed in a manner that will not subject personnel to fall hazards. Fall protection for such equipment must be in compliance with 29 CFR 1910.23.
- c. Skylights shall be installed to prevent accidental breakage to workers on roof tops and occupants below. During construction and installation 29 CFR 1910.23(a)(4) shall be enforced. At a minimum, skylights shall have screens to protect workers from falls. Skylight screens shall be of such construction and mounting that they are capable of withstanding a load of at least 200 pounds applied perpendicularly at any one area on the screen. They shall also be of such construction and mounting that under ordinary loads or impacts, they will not deflect downward sufficiently to break the glass below them. The construction shall be of grillwork with openings not more than 4 inches long or of slatwork with openings not more than 2 inches wide with length unrestricted. Skylights shall be designed to protect occupants beneath a skylight. In the event of glass failure, the inboard glass shall contain screening **or equivalent** to contain and capture falling glass. Optimal design would utilize shatter proof glass that prevent workers from falling through a skylight and skylight glass from falling to occupants below. Any new or renovated skylight that must be installed, or remain, shall be constructed, or retrofitted, so as to be compliant with 29 CFR 1910.23(e)(8).
- d. Floor loading protection shall be provided in compliance with 29 CFR 1910.22(d) such that the loads approved by the building official for every building or other structure, or part thereof, shall be marked on plates of approved design and securely affixed in a conspicuous place in each space to which they relate.

5. Lockout/Tagout Considerations

- a. Contractors installing new, or renovating any, equipment must include a posted shut-down/lock out procedure designed to prevent accidental startup of the machine or equipment, and to prevent the release of stored energy during servicing or maintenance. All energy sources requiring lockout shall be labeled as such and the label shall correspond to the appropriate lock out method listed in the shut-down/lock out procedure for the piece of equipment it serves. All energy sources requiring lockout shall have a mechanism appropriate for lock out provided by the manufacturer or installer. These procedures shall be posted on the equipment or submitted in the contractor's closeout documents.

6. Drinking Water System Considerations

- a. For any project that will require shutdown of the campus drinking water system procedures must be developed for disinfecting and sampling of the system prior to startup. When applicable, the most recent published version of American Water Works Association Standard C651 or C652 shall be used to provide proper disinfection and sampling.
- b. A backflow prevention device must be designed and installed for any project that will create a new service connection to the campus water distribution system. The device shall be installed at the first possible location on the water distribution line after it enters a building.

7. Electrical Safety Labeling Considerations

- a. An arc fault analysis of the electrical system for any newly developed or renovated area shall be performed as part of any project and proper labeling of electrical equipment, panel boards, etc., for arc flash potential shall be provided in compliance with NFPA 70E.

8. Radiation Safety:

- a. All building designs, renovations, and radiation generating equipment must conform to applicable Ohio Revised Codes, Ohio Administrative Codes, OSHA, EPA, local, and institutional codes, including the most current Wright State University radiation safety policies. All shielding designs must have the final approval of the Radiation Safety Officer and the Radiation Safety Committee.

9. Laser Safety:

- a. All building designs and renovations must conform to applicable ANSI standard Z136, Ohio Revised Codes, Ohio Administrative Codes, OSHA, EPA, local, and institutional codes, including the most current Wright State University laser safety policies. All designs and renovations must have the final approval of the Laser Safety Officer.

10. Miscellaneous:

- a. New exit signage shall not be tritium exit signs.
- b. Any new or renovated equipment that will produce a sound level at or above 85 decibels (OSHA limit for the establishment of an employee hearing conservation program) shall be identified to WSU Environmental Health and Safety prior to installation. Sound reduction engineering controls shall be installed with this equipment where possible.
- c. Any project that will limit access to a previously designated storm/emergency shelter area must have a temporary area identified and the location communicated to building occupants prior to demolition/construction activities.
- d. Any project that will permanently affect the use of a previously identified storm/emergency shelter must have another area identified and communicated to building occupants upon completion of the project.
- e. Any project that will create a new, or alter an existing, confined space shall be identified to WSU Environmental Health and Safety prior to creation/alteration. A confined space is defined as any space that is large enough, and so configured, that any employee can bodily enter and perform assigned work, has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy. Confined spaces include, but are not limited to: storage tanks, pits, vats, vessels, sewer manholes, electrical manholes, vaults, pump or lift stations, septic tanks, boilers, pipelines, ventilation and exhaust ducts, trenches, elevator shafts and excavations. A list of identified confined spaces on campus is available through WSU Environmental Health and Safety.
- f. Any new building shall be equipped with an operating Automated External Defibrillator (AED). AED installation shall also be part of a redesign of any existing building currently without an AED. The AED shall be of make and model consistent with AED's used throughout campus, installed at a location consistent with the location plan initiated by the university AED Committee, and connected to the university's police communication system. Must meet all current codes and regulations.

11. Demolition/Construction Considerations

- a. Any project that is to include the removal and recycling of materials such as fluorescent bulbs shall be performed in accordance with all applicable federal, state, and local rules including, but not limited to, the OEPA Universal Waste rules of OAC 3745-273. The following must occur:
 - i. Prior to commencement of work the proposed recycling facility for the recycling of fluorescent bulbs shall be submitted and approved by WSU Environmental Health and Safety.
 - ii. Fluorescent bulbs are to be removed intact and immediately placed in contractor supplied

- cardboard boxes designed for the storage of fluorescent bulbs. Each box must be marked as "Universal Waste Fluorescent Bulbs" and include the date and the count of bulbs contained in the box.
- iii. Full and appropriately marked boxes shall be taped closed and stored in a centralized area and marked with barrier tape and signs denoting "Universal Waste Storage Area".
 - iv. Any bulbs broken during the removal and collection process must be immediately cleaned up and collected in appropriate containers acceptable for transportation and recycling by the recycling facility.
 - v. The contractor is responsible for the handling and transport of bulbs to the submitted Ohio EPA listed recycler. Transportation shall be in accordance with all applicable DOT and EPA regulations.
 - vi. Documents showing the proper handling, transport and receipt of materials to the recycling facility must be included in the contractor's closeout documents and shall include a copy of the recycling certificate noting the quantity of bulbs recycled. A copy of this documentation shall be forwarded to WSU Environmental Health and Safety.
 - vii. All costs associated with the management and recycling of fluorescent bulbs shall be the responsibility of the contractor.
- b. Any project that is to include the removal and disposal/recycling of any fluorescent lamp ballasts shall be performed in accordance with all applicable federal, state, and local rules.
- The following must occur:
- i. Prior to commencement of work the proposed disposal or recycling facility for the disposal or recycling of fluorescent lamp ballasts shall be submitted and approved by WSU Environmental Health and Safety.
 - ii. Fluorescent lamp ballasts are to be removed, wires clipped from the ends, and collected in appropriate DOT approved containers.
 - iii. The contractor is responsible for the handling and transport of fluorescent lamp ballasts to the submitted approved disposal or recycling facility. Transportation shall be in accordance with all applicable DOT and EPA regulations.
 - iv. Documents showing the proper handling, transport and receipt of fluorescent lamp ballasts to the disposal or recycling facility must be included in the contractor's closeout documents and shall include a copy of the disposal or recycling certificate noting the quantity of ballasts disposed or recycled. A copy of this documentation shall be forwarded to WSU Environmental Health and Safety.
 - v. All costs associated with the management, disposal and/or recycling of fluorescent lamp ballasts shall be the responsibility of the contractor.
- c. Any hazardous material brought on-site during demolition or construction activities, including fuel in aboveground storage tanks, must be stored within secondary containment devices and a material safety data sheet must be submitted to WSU Environmental Health and Safety.
- d. Any discharges of wastewater or other waste liquids to the sanitary or storm sewer system during demolition or construction activities must receive approval from WSU Environmental Health and Safety prior to discharge.
- e. Any hazardous material brought on-site by the contractor must be removed from university property at the end of the project and properly disposed of in compliance with EPA Standards. The university reserves the right to dispose of any hazardous material left behind at the expense of the contractor.

Approach to Design

Room Numbering Requirements

GENERAL PROVISIONS

To facilitate way-finding and to uniquely identify each space within University facilities it is necessary to determine appropriate floor numbers and room numbers based on the Floor Numbering Standard and this Room Numbering Standard. Room numbers in use in existing buildings will continue to be utilized unless there is the opportunity to renumber. Renumbering of any space should be done in conjunction with the Facilities Planning and Development Department to ensure that duplicate room numbers are not assigned and that consistent application of this standard occurs.

This standard should also be utilized to assign numbers during the design development phase for renovation and new construction projects. Working drawings for renovation or new construction should conform to this standard. Furthermore, it should be provided, and discussed if necessary, at all project kick-off meetings when other University standards are also provided to A/E.

Questions regarding this standard should be addressed to the Facilities Planning and Development Department. Please contact them to schedule reviews of any new room numbering requirements.

Principles

1. Each space within a facility needs an associated number. This includes both assigned spaces such as offices, laboratories, classrooms, residential rooms, etc. and unassigned spaces such as corridors, stairs, mechanical rooms, electrical closets, bathrooms and janitor closets, etc.

Unassigned Spaces	
Description	Room #
Corridors / Hallways	COR XY
Stairwells	STR XY
Mechanical Shafts	MEC XY
Elevators	ELV XY
Vending	VEN XY
Dead Space	DS XY
X = Floor	
Y = Number	

Figure - 1

2. All room numbers within a building (with a single facility ID) must be unique.
3. Room numbers in the Space Inventory and on digital plans (i.e. CAD, BIM) should match those found in the buildings whenever possible.

4. Room numbers should only consist of numbers with alpha suffixes, i.e., 101A. There should be no hyphens, commas, spaces, etc. Furthermore, room numbers should not be 0 or a single alpha character. Alpha characters L, O, and Q are not to be used due to confusion with the numbers one and zero.
5. In cases where two spaces are combined into one, the lower room number should be used to identify the new space.
6. Spaces opening onto corridors should receive base numbers such as 101, 102, 201, 202, etc. Base numbers proceed clockwise around the building with the lowest number near the principle entry to the floor. In a building base numbers should start at the same place on each floor whenever possible.
7. Interior spaces opening off base spaces receive the base numbers with suffix letters such as 101A, 101B, etc. Interior spaces are numbered clockwise about the base space with suffix 'A' being the closest to the principle entry.
8. Major interior spaces opening off interior spaces are treated as if opening directly off the base space. Therefore, a room opening off 101A would be 101B rather than 101AA. Minor spaces like small closets may be numbered in sequence or placed at the end of the series i.e., if 101A-101E are used for major rooms, a closet could be numbered 101F. The exception to this is minor spaces (like small closets) in large buildings like the residential colleges. In those cases a double suffix designation such as 101AA should be used.
9. Room numbers are part of a numbering sequence based on the floor. Basement rooms with physical numbers displayed are numbered from 001- 089, spaces that typically are not physically numbered, such as hallways and stairwells, follow the standards outlined in Figure -1 above; first floor rooms with physical numbers are numbered 100 – 189, spaces without physical numbers follow the standards outlined in Figure -1 above; etc. Sub-basement room numbers and mezzanine room numbers follow the same pattern and are covered further below under Room Number Prefix Options No. 2.
10. All doors opening off corridors or public spaces should receive a permanent identifying number including toilets, closets, mechanical rooms, etc.
11. Unenclosed spaces such as alcoves, oversized lobbies, etc. should receive separate numbers for the areas that are assigned such as reception desks, work stations, etc. The Facilities Planning and Development Department should define the boundaries of these spaces.
12. Spaces where numbers are not normally displayed such as lobbies, corridors, stairs, etc. must still have associated numbers. These numbers will typically only be seen on digital plans (i.e. CAD, BIM) and in the Archibus Space Inventory System. Numbering for these spaces should be done sequentially using the 90-99, 190-199, 290-299 series.

13. Where possible, rooms along a corridor should be numbered odd on one side and even on the other, with numerically close numbers physically close. To accomplish this, it is often necessary to skip certain numbers entirely. Normally, odd numbers would be on the left and even on the right.
14. Adequate provisions should be made for future rearrangement of interior spaces, particularly in laboratory and classroom buildings. This can be accomplished by numbering each bay with the main room number and using letter suffixes after the main number for the interior rooms.

Room Number Prefix Options

1. In cases where a facility is divided into wings or entryways, a one-letter prefix should be added to the room number. For example, Creative Arts Center is divided into wings, so numbers in the 'T' (Theatre) Wing would be T101, T190, etc.
2. In cases where a facility has a concourse, ground floor, lower level, sub-basement, mezzanines, or a penthouse a prefix should be used there as well to identify the rooms on those levels. Basement rooms do not need the 'B' prefix, but may have them to match existing signage. Concourse floor rooms should be identified with the "C" prefix, Ground Floor rooms the "G" prefix, Lower Levels rooms the "L" prefix, Sub Basement rooms the 'S' prefix, Mezzanine rooms the 'M' prefix (i.e. M101 for 1st Floor Mezzanine, M201 for 2nd Floor Mezzanine, etc.), and Penthouse areas the 'P' prefix (i.e. P1, P2, etc.). In cases where concourse floors, ground floors, lower levels, sub basements, mezzanines or penthouses are located in specific wings of buildings, a double prefix would be used with the wing prefix preceding the floor prefix, i.e., TS1, TM101, TP1, etc.

Physically Numbered Spaces

1. All major interior doors, including all lockable spaces, should receive permanent identifying numbers.
2. Room number signage should be applied to the adjacent wall such that the number is not concealed when the door is open.
3. All room number signage should comply with ADA Standards for size, height from floor, Braille lettering, etc.

Division 01

General Requirements

GENERAL PROVISIONS

- These specific General Requirements are in addition to the Standard State of Ohio front end contracting and general condition requirements that are identified in Part Two of these WSU standards.
- Specific special General Requirements for each project are to be discussed and reviewed with WSU project manager.

011200 – CONTRACT SUMMARY

- This section would describe and summarize the project details and specifics along with the project delivery method for the particular project.
- A scope of work of the main trade contractors is required to clarify responsibilities for a particular project.

012100 – ALLOWANCES

- All projects within bid form to identify allowances for key building elements of the project. Specific allowances to be determined with project manager. Examples as follows:
 - Scheduling
 - Environmental removals
 - Architectural removals
 - Architectural finishes
 - MEP scope items
 - Site Clearing
 - Building signage

012200 – UNIT PRICES

- All projects within bid form to identify unit prices for key building elements of the project such as:
 - Site utilities
 - Removal of partition (identify wall types)
 - New finishes – list specific items
 - MEP piping – list specific elements
 - Roof insulation
 - Soils removals
 - Electrical Duplex Outlet
 - Electrical Data Outlet

012300 – ALTERNATES

- This section would describe and summarize any project alternates desired by WSU.
- Alternates to be clearly written within bid form with references back to alternate specification section that would more fully describe the alternates.
- Alternates should preferably be presented as ADD alternates.

012500 – SUBSTITUTION PROCEDURES

- All building elements should strive to list a minimum of three manufacturers. A basis of design is desired for each building component specified.

- Any substitutions requested will be considered ONLY at time of bidding per front end documents.

013200 – CONSTRUCTION PROGRESS DOCUMENTATION

- WSU requires job meeting notes be written and distributed no later than 2 business days after meeting taken place.
- All correspondence requires involvement and communications copied to WSU Project Manager.

013233 – PHOTOGRAPHIC DOCUMENTATION

- WSU requires prior to the start of any project, renovation or new construction that the existing building and/or existing site be thoroughly documented with video and pictures. Final format to be coordinated with WSU.
- This documentation to be delivered to the WSU project manager prior to any disturbance on site or in existing building.
- Meeting notes shall be written with date and attendance recorded. Items discussed are to be separated into Old and New Business with open items and action plan noted.

013300 – SUBMITTAL PROCEDURES

- One copy of all submittals and samples are to be copied to WSU project manager.
- Electronic submittals preferred when possible, with both AE and WSU PM copied in.
- At conclusion of project 100% complete project manuals containing ALL shop drawings, samples, training information, warranties, etc., as required by front end sections will be required. Also required are; list of contractors, subcontractors, and suppliers with contact information and item they installed/supplied.
- Supply three copies of complete O&M in tabbed and indexed binder with building and project label on front and side.

014000 – QUALITY REQUIREMENTS

- Contractor prior to the start of any project is to prepare for WSU review their quality control plan and strategies for insuring quality and schedule adherence.
-

015000 – TEMPORARY FACILITIES & CONTROLS

- WSU requires 48 hour notice, in writing, for any major utility shut down.
- Occupied areas must be maintained with conditioned and properly ventilated air, access to handicap restrooms, access to exits at all times. All life safety features must be maintained or added to maintain within occupied areas.
-

015639 – TEMPORARY TREE & PLANT PROTECTION

- WSU requires temporary fence around the drip line of all trees located in construction area.
- Reference Division 32 of this document.

017419 – CONSTRUCTION WASTE MANAGEMENT & DISPOSAL

- WSU encourages recycling, re-use, and re-purposing of all possible construction debris. On projects that may not be LEED rated, the following minimum requirements apply (LEED projects will have specific requirements that may vary):
 - All cardboard must be flattened and stacked in a designated location for WSU to recycle. No cardboard shall be disposed of in dumpster unless directed by the WSU Project Manager.

- All metal and wiring shall be separated from construction debris and recycled off site by contractor.
- All recyclables plastic containers, glass bottles, and cans shall be collected from construction site by contractor and placed in WSU recycling bins.
- WSU reserves the right to salvage any item deemed of value to the University to re-purpose.
- Contractor shall work with WSU to find other uses for demolished items to keep as much material from landfill as possible.

017700 – CLOSEOUT PROCEDURES

- In addition to all closeout procedure and documents required by the state front end the following additional requirements must be completed prior to final payment.
 - Final Punch List checked and signed off by contractor and/or Construction Manager.
 - WSU Affidavit of Prevailing Wage from signed and notarized for Contractor and each Subcontractor employed on project.
 - Original copy of each form shall be submitted.

017823 – OPERATION & MAINTENANCE DATA

- Training is required for all equipment installed for WSU maintenance personnel.
- For non-equipment installations, Contractor shall schedule a walk through with WSU at the end of every project to show location of valves, electrical work, etc.

017839 – PROJECT RECORD DOCUMENTS

- WSU requires one (1) copy of record drawings, updated CAD/BIM drawings electronically, specifications electronically, and three (3) copies of O&M manuals.
- Refer to WSU CAD/BIM Design Drawing Standards in the Appendix.

017900 – DEMONSTRATION & TRAINING

- All installed equipment will require demonstration and training required per State & Bid documents.

Division 03

Concrete

GENERAL PROVISIONS

- Reference American Concrete Institute for minimum standards.
- Reference Ohio Department of Transportation for minimum standards.

033000 – CAST-IN-PLACE CONCRETE

- Sandblasted finish is not permitted unless specifically approved by the university.
- Rubbed finish on interior structural concrete painted surfaces is not permitted. If a smooth plaster-like finish is desired, specify a thin coat of veneer plaster over the concrete substrate.
- All exposed interior concrete floors are to be sealed. A hardener is required where the floor surface is subject to heavy traffic and/or rolling loads.
- Service room floors such as Mechanical rooms shall be completely sealed from water and moisture penetration.
- A continuous vapor barrier is required for all floor slabs on Grade:
 - 15-mil minimum thickness
 - Water Vapor Permeance less than or equal to 0.02 perms tested by ASTM E 96
 - Puncture Resistance greater than or equal to 3,000 grams tested by ASTM D 1709
 - Tensile Strength greater than or equal to 65 lbf/in tested by ASTM E 1745
 - Chemical Resistance “Unaffected” tested by ASTM E 154
 - All seams lapped and taped
 - Turn up at all slab perimeters and cut off flush with top face of floor slab.

Division 04

Masonry

GENERAL PROVISIONS

- Brick and concrete masonry units shall pass ASTM C 67.
- Portland cement and masonry cement shall be low in alkali.
- Mortar admixtures, especially calcium chloride, are not permitted.
- During construction all work shall be kept dry by covering with a strong waterproof membrane at the end of each workday or shutdown period.
- A/E team to include adequate Allowance for exterior masonry cleaning 12 months after completion of the work.
- Weep holes:
 - Meets equivalent performance/standards or exceeds that of Quadro-vent by Hohman & Barnard
- Any masonry shall be no closer than 4 inches to grade
- After exterior masonry is cleaned, seal all exposed masonry with silane/siloxane blend penetrating breathable sealer – Meets equivalent performance/standards or exceeds that of Weather Seal GP by PROSOCO Inc. or equal.

Division 06

Wood, Plastics, and Composites

GENERAL PROVISIONS

- All materials, colors and finishes to be coordinated and approved by the University prior to being specified in Construction Documents.
- Selection of products should meet or exceed LEED (Leadership in Energy and Environmental Design) criteria.
- All non-exposed wood used in building construction shall be fire resistant.
- Any treated lumber that is cut in field shall receive treatment at cut ends.

062023 – INTERIOR FINISH CARPENTRY

- Plastic Laminated countertops are not permitted in wet areas (kitchens, restrooms, etc.). – solid surface materials to be specified.

Division 07

Thermal and Moisture Protection

GENERAL PROVISIONS

- Refer to Environmental Health & Safety section of this document for fall protection requirements.
- Exterior Insulation and Finish System (EIFS) is not permitted.

071113-700 – WATERPROOFING

- Floors requiring waterproofing shall have membrane continuously extend 4" min. up vertical walls, pads and curbs.
- All floor penetrations shall receive 4" min. membrane sleeve above finished floor.
- All foundation walls around basements shall receive membrane waterproofing.

071900 – WATER REPELLENTS

- Exposed surfaces of masonry blocks and precast concrete shall receive penetrating, vapor permeable, colorless, mildew-resistant water repellent.
- Concrete masonry units exposed to the exterior shall include integral water repellent in the units and in the mortar.

072100 – THERMAL INSULATION

- Minimize use of fiberglass in areas needing to be accessed for inspections, maintenance, etc. Where exposed, use foil backing, plastic or gypsum board to encapsulate fiberglass.

075116-700 – ROOFING

- All roofs and equipment access on rooftops must meet current OSHA requirements for fall protection.
- Light colored, reflective roofs with 20 year (min.) warranty required.
 - All seams must be heat-welded
 - Adhesive seams are not permitted
- Rock ballasted roofs are not permitted.
- Roof edge parapet walls shall extend 42" min. above roof to prevent fall hazards.
- Specify 2'-0" min. service walkways appropriately located to service all rooftop equipment from the roof access.
- Secondary roof drainage system shall preferably be accomplished by exterior wall scuppers, as long as it adheres to current building codes.
- Downspouts shall tie directly to underground storm drainage system.
- All roof hatches to be anodized aluminum, insulated and lockable – size 36 x 36 min.
- All green vegetative roofs must be approved by University.
- For vegetated roof assemblies refer to Division 32 of this document.

078123-446 – FIREPROOFING

- Fireproofing materials in exposed locations, lower than 8'-0" to be protected/covered.

Division 08

Openings

GENERAL PROVISIONS

- Refer to current ADA standards and Accessibility/ADA Requirements section of this document for additional standards.
- Door hardware shall be standardized throughout the campus and all new buildings and renovations shall adhere to the specifications provided herein.
- 3'-0" (min) door width to be used on all new buildings and renovations.
- Areas that are known to receive large equipment should be specified to have openings capable of accommodating that equipment, and all corridors leading to that space should be designed to be large enough to accommodate that equipment.
- At least one exterior entry door to a building shall have automatic operator.

081113 – HOLLOW METAL DOORS AND FRAMES

- Exterior applications and high moisture interior areas are not permitted.

081216 – ALUMINUM FRAMES

- Aluminum doors and frames shall be factory finished
- Anodized finishes are preferred

081416 – FLUSH WOOD DOORS

- Wood doors are required to have fire rating as code dictates.
- Solid core wood flush doors shall conform to the requirements of the following codes and standards:
 - Architectural Woodwork Institute (AWI)
 - National Fire Protection Association (NFPA)
 - National Fire Code (NFC)
 - National Wood Window & Door Association
 - Underwriters' Laboratories (UL) Warranty for solid core wood flush doors shall be for the life of the installed wall assembly.

085113-086200 – WINDOWS/SKYLIGHTS

- Consult The Department of Energy's (DOE) Energy Star designation (guidelines for minimum requirements for U-factor and Solar Heat Gain Coefficient (SHGC) – (<http://www.efficientwindows.org/energystar.cfm>)
- Thermally broken, low E, 1" insulated glass min.

087100 – DOOR HARDWARE

- **Cylinders:** Schlage 20-740-IC (IC= interchangeable core) x 626 (satin finish) with appropriate keyway. Schlage Primus IC cores (removable cores) - Corbin keying is not permissible, unless where needed to match existing.
- **Lock Sets:** All locksets shall be Schlage ND Vandalguard Rhode handle, 626 finish with large format I/C (interchangeable core) with appropriate function.

- All lockset cores shall be Schlage Primus large format I/C cores. Keyway to be determined by WSU lock shop.
- **No twist lock permitted** - Push-button locks only.
- **No mortise locks.**
- **Dorma and Adams Rite** products shall **not** be acceptable.
- **Chexits** delayed egress hardware shall **not** be acceptable.
- **Continuous Hinges:** Roton brand for exterior and vestibule doors. Sizes and finish will vary.
- **Door closures:** LCN brand #4040XP (5 lb. max pressure limit).
- **Exit Devices:** Von Duprin 99 or 33 US26D rim device models with 626 satin finish.
 - Exit hardware shall be as manufactured by Von Duprin 9927 series SVR/LBR (Surface Vertical Rod/Less Bottom Rod).
 - Push pad exit rim devices shall be as manufactured by Von Duprin model 33/A US26D.
- **Automatic door operators:** Besam (primary) and LCN (secondary).
- **Electric strikes:** Hess brand with appropriate voltage.
- **Flush and Surface bolts:** Rockwell 500 or 550 FB and Glynn Johnson 1631xUS26D-SB
- **Hinges:** Ives or Hagger brand all heavy duty type with 5 knuckle ball bearing. Continuous Roton hinges for exterior and vestibules and finishes will vary. Pivot hinges shall **not** be acceptable.
- **Overhead stops:** Ingersol-Rand 7945-US26D
- **Keyless Entry:** Schlage C0100 series keyless entry with key bypass.
- Internal rod or cable latching devices shall not be acceptable on any door.

087113 – AUTOMATIC DOOR OPERATORS

- Push buttons for automatic operators to be located 29" AFF
- One set of double exterior main entry doors to a building to have automatic operators (single door on minor entries is acceptable)
- No push buttons on glass mullions
- No push buttons on railings – install post with push button at appropriate location or wall mounted

089119 – FIXED LOUVERS

- Aluminum louvers with insect/bird screens to be installed at all new buildings and renovations – open steel louvers not permitted.
- All exterior louvers must be drainable and be flashed accordingly.

Division 09

Finishes

GENERAL PROVISIONS

- All materials, colors and finishes to be coordinated and approved by the University prior to being specified in Construction Documents.
- Selection of products shall meet LEED (Leadership in Energy and Environmental Design) criteria.
- All finishes shall be Class A fire rated.
- All paintings in labs should seal the wall, ceiling and floor surfaces for humidity and vapor control.
- Assure adequate attic stock is built into plans for maintenance. Designer to specify percentage in each finish spec section per project (5% typical).

093000 - TILING

- Flooring to be commercial grade porcelain tile for high traffic areas, and meet coefficient of friction requirements.
- Wall tile in toilet rooms to be ceramic tile with gloss finish or porcelain tile.
- Keep grout joints as narrow as possible to minimize grout problems and failures.
- All grout to be a color in same tonal value as tile flooring, or darker to reduce dirty appearance over time of grout joints. All grout in wet areas is to be sanded grout with sealer if joint size permits.

095123 - ACOUSTICAL TILE CEILING

- Meets equivalent performance/standards or exceeds that of Armstrong
- Medium textured fine-fissured ceilings
- No snag performance and BioBlock paint inhibit surface growth of mold and mildew
- Fireguard options in an economical acoustical panel
- Special attention should be given to wet/high humidity areas with specifying appropriate tile and grid
- Lab or food and food preparation areas to receive vinyl faced, scrubbable tile.
- Ceiling grid to be building standard 15/16" in a 2'x2' or 2'x4' grid.
- Ceiling tile to have and NRC or .55 or higher and a CAC of 33 or higher and be Class A fire rated.
- All ceiling tile to be high humidity tile.

096340-6623 – FLOORING

- High traffic commercial grade only
- Entry level flooring and vestibules shall accommodate walk-off mats or built-in walk-off carpet.
- Hard surface flooring to be low maintenance/no wax floorings.
- All adhesives used to be recommended by the flooring manufacturer.

096513 – RESILIENT BASE AND ACCESSORIES

- Meets equivalent performance/standards or exceeds that of Roppe and Johnsonite
- Cove base, rubber only – vinyl is not permitted; 4" high typical
- Hot weld products should be utilized only where required to meet Health Department requirements
- High traffic commercial grade only

096813-6816 – CARPETING

- All carpeting to be high traffic commercial grade only.
- All adhesives used are to be adhesives recommended by the manufacturer.
- Installations shall be glue down installation – stretch installation and carpet padding are not permitted.
- Carpet requirements (minimum):
 - Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
 - Dye Method: High percentage solution dye yard
 - Fiber Content: 100% nylon 6,6
 - Fiber Type: Meets equivalent performance/standards or exceeds that of DuPontAntron Legacy
 - Pile Characteristic: As selected by Architect from manufacturer's full range Level loop, Multi-Level Loop, Textured Loop, or Cut & Loop.
 - Pile Thickness: 0.145 inches minimum for finished carpet per ASTM D 6859
 - Stitches: 8.3 stitches per inch minimum
 - Gage: 1/8" inch minimum
 - Face Weight: 18-oz./sq. yd. minimum
 - Backing: Water resistant demonstrating the following properties:
 - i. Dimensional stability
 - ii. Seams pass Lateral Seam Stress Resistance Test
 - iii. Seams are warranted
 - a) Extensive warranty from a responsible commercial carpet manufacturer and approved installer
 - b) Lifetime edge revel
 - c) Lifetime antistatic
 - d) Lifetime antimicrobial
 - e) Lifetime backing delamination
 - f) Lifetime anti-staining
 - g) Lifetime face wear
 - h) Lifetime tuft bind
 - Applied Soil-Resistance Treatment: Meets equivalent performance/standards or exceeds that of DuraTech Soil Protection by DuPont
 - Fiber Technology: Permanent Stain Resistance as passed by GSA using AATCC Test Method

097200 – WALL COVERINGS

- If wallcovering is warranted, it must be commercial grade type II vinyl that is highly wear resistant and scrubable, 21 oz weight or higher. All corners in high traffic areas must be protected with commercial grade vinyl corner guards that extend from the top of the cove base to a minimum height of six (6) feet.

099113 – EXTERIOR PAINTING

- Meets equivalent performance/standards or exceeds that of Sherwin-Williams
- Exterior materials requiring painting should be minimized or eliminated

099123 – INTERIOR PAINTING

- Meets equivalent performance/standards or exceeds that of Sherwin-Williams
- All paints shall be commercial grade and shall be highly washable.

Division 10

Specialties

GENERAL PROVISIONS

- Owner provided, contractor installed items (Design team is responsible for locating these items on the drawings and indicating required blocking):
 - Toilet paper dispenser
 - Sanitary napkin dispenser
 - Paper towel dispenser
 - Soap dispenser
 - Trash/recycling containers

101100 – VISUAL DISPLAY SURFACES

- Meets equivalent performance/standards or exceeds that of Claridge.

101300 – DIRECTORIES

- By WSU.

101419-1426 – SIGNAGE

- By WSU.

102113 – TOILET COMPARTMENTS

- Plastic laminate partitions are not permitted.
- Solid plastic partitions preferred.
- Floor mounted and overhead braced only.

102116 – SHOWER AND DRESSING COMPARTMENTS

- Curtain liners and hardware shall be thick gage, mildew resistant, weighted hem with non-rusting metal grommets

102233 – ACCORDION FOLDING PARTITIONS

- Not permitted.

102800 – TOILET, BATH, AND LAUNDRY ACCESSORIES

- All accessories to be placed on side walls for easier ADA access.
- Mount grab bars to meet current ADA and OBC requirements.
- Toilet paper and sanitary napkin dispensers to be placed (vertically) as close to grab bars as possible.
- Allow for side transfer at ADA stalls.

104000 – SAFETY SPECIALTIES

- Emergency key cabinets for fire department building access must be a “Knox Box”, manufactured by the Knox Company.

- Knox Box must be alarmed and monitored by an approved fire alarm panel.

104413 – FIRE PROTECTION CABINETS

- Fire extinguisher cabinets shall be incorporated into all projects as required by code and sized for the required extinguisher.
- Fire extinguisher cabinets shall be of stainless steel material only.

104416 – FIRE EXTINGUISHERS

- Fire extinguishers shall be provided and installed by WSU.
- Contract specifications and drawings shall identify the type, size and location of all fire extinguishers as required by code.
- Fire extinguishers shall be refillable.
- Plastic heads are not permitted.
- Handheld fire extinguishers must be 5 lb. ABC dry chemical unless otherwise required by code.
- All kitchens shall be equipped with a K-type fire extinguisher.

Division 11

Equipment

GENERAL PROVISIONS

- Locate both movable and fixed equipment on plans and specify all utility fittings for equipment shown.
- Locate all blocking, support and services required for installation of all items in this Division.
- Clearly define contractor responsibilities relative to receiving, storage and installation of equipment.

112123 – VENDING MACHINES

- Each vending machine requires one (1) 20 A breaker and one (1) data drop (network connection)
- Water and drain as required by machine type.

115213 – PROJECTION SCREENS

- Coordinate with WSU CaTS

Division 12

Furnishings

GENERAL PROVISIONS

- Building furnishings including, but not limited to desks, chairs, tables, lockers, window treatments, lecterns, etc. shall be identified by the A/E but not included in the building contract.
- Where appropriate, furnishings shall be shown on the contract drawings with a note indication “N.I.C.”.
- The A/E shall provide to the university minimal specifications and a budget cost estimate for furnishings specified to be owner furnished.
- Selection of products shall meet LEED (Leadership in Energy and Environmental Design) criteria.

123553.13-.19 – LABORATORY CASEWORK

- Metal or wood base cabinets with epoxy resin countertops. Final selection to be reviewed w/ University.

123616-3640 – COUNTERTOPS

- Plastic Laminated countertops are not permitted in wet areas (kitchens, restrooms, etc.) – solid surface material to be specified.

124813 – ENTRANCE FLOOR MATS AND FRAMES

- Provide entryway walk-off systems that follow the latest LEED guidelines.

129300 – SITE FURNISHINGS

- Wood furniture is not permitted
- Landscape Forms is the preferred vendor

Division 14

Conveying Equipment

GENERAL PROVISIONS

- Selection of products shall meet LEED (Leadership in Energy and Environmental Design) criteria.
- Work shall be performed in accordance with ANSI/ASME A17.1 – Safety code for Elevators and Escalators
- Submittals shall include shop drawings, schematic wiring diagram, product data and maintenance manuals. Maintenance manuals are required and shall minimally include operating and maintenance instructions, parts listing, recommended parts inventory listing, purchase source listing for major and critical components, and emergency instructions. Provide three sets of maintenance manuals for the Owner's use after approval of all shop drawings.
- Full maintenance shall be provided by skilled, competent employees of the elevator Installer for a period of 12 months following Date of Substantial Completion at no additional cost to the Owner. Full maintenance services to be included under this contract and at no additional cost to the Owner shall minimally include (1) monthly preventive maintenance performed during normal working hours, (2) repair or replacement of worn or defective parts or components, (3) lubricating, cleaning, and adjusting as required for proper elevator operation in conformance with specified requirements and (4) 24-hours-per-day, 7-days-per-week emergency callback service. Exclude only repair or replacement due to misuse, abuse, accidents, or neglect caused by persons other than Installer's personnel.
- Contract documents shall require a letter from the elevator manufacturer (on manufacturer's letterhead) verifying that the manufacturer acknowledges and will comply with all requirements of the specifications relative to repair and maintenance tools. Specifically, the letter shall include language that acknowledges the acceptance of the following:
 - Any and all maintenance diagnostic tools, electrical schematic wiring diagrams and any access codes and passwords required to perform any maintenance function over the life of the equipment such as diagnostics, adjustments or parameter reprogramming shall be provided to the Owner on the Date of Substantial Completion. Tools may be handheld or built into the control system and shall function for the life of the equipment without the requirement to return them to the Manufacturer. Provide complete operations and maintenance manuals including diagnostics instructions for troubleshooting the microprocessor system. The Owner shall not be required to sign licensing agreements related to the use or maintenance or repair tools.
 - It is the intention of the Owner to obtain competitive bids for all maintenance and repair services and material for the elevator provided. Accordingly, the use of proprietary equipment or equipment requiring the use of any proprietary items throughout the life of the equipment is unacceptable. In addition, any special tools, prints, technical data, layouts, hardware, software, etc. required throughout the life of the equipment and which cannot be obtained from multiple suppliers, must be provided by the manufacturer to the Owner at substantial completion of the project.
- An emergency telephone will be furnished by the Owner for field installed by the contractor.

142100-2600 – ELEVATORS

- Provide a 12 month warranty which begins on the date of Substantial Completion.
- Stainless steel doors and frames.
- Flooring is to be coordinated with adjacent surfaces.

- Whenever practical and cost permissible, provide 2 cars minimum per each building.
- Cab controls:
 - Exterior controls @ 29" A.F.F.
 - Interior controls should be placed under the rail
 - Penthouse or other floor controls shall be keyed to the University Maintenance key and not a manufacturer's key. Refer to Division 08 for University key specifications.
- Door opening/closing time should be adjustable.
- Provide sight and voice announcement at each floor.
- LED lighting is preferred.
- Provide elevator travel to Penthouse floor if there is large equipment at that level.

Division 21

Fire Protection

GENERAL PROVISIONS

- Installation of fire systems must comply with the current edition of the Ohio Building Code and all NFPA standards referenced within.
- All materials and performance shall meet the appropriate ANSI, ASME, and ASTM codes.
- All equipment installed shall be new and Approved by FM Global or Listed by Underwriters Laboratories for the specific application. Every major equipment item shall display the manufacturer's name, serial number, and the appropriate approval stamp.
- The Contractor shall coordinate the location of piping and devices with other trades to ensure proper fit of all building systems and adequate access to test stations, control valves and water flow alarms.
- The Contractor shall obtain and pay for all permits and other applicable fees.
- The Contractor shall perform a flow test to serve as the basis for hydraulic calculations in sizing of piping and other elements of the system.

(Note: Following may also be placed under 01 33 23 – Submittal Procedures/Shop Drawings)

SUBMITTALS

- Shop drawings for systems must be sent to the Architect/Engineer for review, and after approval submitted to the Authority Having Jurisdiction (AHJ) for review prior to construction. All informational, operating, and specification documents shall be provided for all fire protection equipment.
- List of required submittals shall include all components of a detailed shop drawing including (but not limited to): piping, pipe fittings, sprinklers, valves, tamper switches, flow switches, fire pumps, jockey pumps, fire pump controllers, and backflow preventers.
- Detailed shop drawings shall conform to NFPA 13, NFPA 14, NFPA 20, and NFPA 24 requirements and include sprinkler type and locations, pipe layout and sizing, hydraulic calculations, system controls, drain valves, zone valves, and any other component necessary for the complete operation of the system. Cut sheets of all components shall be submitted with, or prior to, the detailed shop drawings for review.
- All sprinkler and piping layouts must be coordinated onto reflected ceiling drawings and coordinated with other trades prior to submittal.
- Hydraulic calculations shall include not less than a 5 psi safety factor. Flow tests performed within 6 months of the date of permit will be acceptable. A copy of the flow test report shall be included with the submitted hydraulic calculations.

210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

- All inaccessible concealed pressure piping shall be welded or brazed.
- Each system zone shall be wired to the fire alarm panel and indicate trouble and alarm conditions
- Piping where possible shall be concealed above suspended ceilings where installed and shall not interfere in the function of other systems such as cable trays or HVAC ductwork. Piping shall not interfere with anticipated use of the building space.
- All exposed sprinkler and standpipe system pipe located in areas without suspended ceilings is required to be painted. Coordinate color of pipe with the University.

210523 – GENERAL-DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING

- Unless specified otherwise, all valves shall be FM Approved and/or UL Listed and be suitable for a minimum of 175 PSI or the maximum anticipated system pressure, whichever is greater.
- All indicating valves on the suction side of a fire pump shall be of the OS&Y type.
- All valves in the sprinkler system shall be FM Approved and/or UL Listed OS&Y or butterfly-type indicating valves except where noted otherwise on the contract drawings.
- All water control valves shall be installed with a tamper switch for supervision of the open position. The switch shall be monitored by the building fire alarm panel.
- All valves shall be located in a readily accessible area for access by emergency and maintenance personnel.

210529 – HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

- All hangers and components shall be FM Approved and/or UL Listed for their application. Sprinkler piping shall not be supported from any electrical or mechanical equipment.
- Sleeves shall be provided where pipes penetrate any structural feature, including walls and beams.

210600 – SCHEDULES FOR FIRE SUPPRESSION

- All fire suppression piping shall be a minimum of schedule 40. No piping less than schedule 40 (including schedule 10) shall be used for any fire suppression system unless approved by the University.
- All piping less than 2 inches shall be threaded. Pipe 2 inches and larger shall be rolled or cut grooved with mechanical couplings.
- Threaded fittings and joints shall be malleable or cast iron screwed type.
- All mechanical fittings and couplings shall be of the same manufacturer.
- All dry and pre-action system piping and fittings are required to be externally and internally galvanized.

211119 – FIRE-DEPARTMENT CONNECTIONS

- All fire department connections shall be 5 inch Storz-type with tethered aluminum cap and internal mesh screen.
- All fire department connections shall be verified to be compatible with the equipment used by the responding fire department of Fairborn, OH.
- All fire department connections shall be provided with secured caps, riser sleeves and base escutcheon. Components shall be brass with exposed surfaces chrome plated.

211200 – FIRE-SUPPRESSION STANDPIPES

- Where standpipes are installed, all fire department connection points shall be located within a stairwell on intermediate landings between floors unless otherwise stated on the contract documents. Standpipes shall be Type I with 2½ inch connections only.
- Hydraulic calculations for standpipe systems shall comply with NFPA 14 and shall include hydraulic data sheets.

211300 – FIRE-SUPPRESSION SPRINKLER SYSTEMS

- All new construction on campus is required to be fully sprinklered unless otherwise specifically directed by the University.

SYSTEMS

- All systems, unless otherwise noted, shall be complete with necessary components, accessories and piping.
- Sprinkler piping shall be so located as to be protected from damage by freezing.
- All fire sprinkler systems installed on campus are required to be automatic wet pipe sprinkler systems unless the protected area cannot be maintained above 40 °F.
- Antifreeze sprinkler systems of any size shall not be permitted for use on campus.
- Sprinkler system zones will be provided for each floor level, up to the maximum square feet permitted by NFPA 13.
- A supervised control valve, flow alarm switch and inspectors test valve shall be provided for each sprinkler zone. The control valve and flow alarm switch shall be monitored by the building fire alarm system.
- Sprinkler system test and drain water will be piped for discharge to the exterior of the building.
- Wet pipe sprinkler systems are preferred for the protection of electric, communications, and data rooms.
- If a protected space requires additional insurance against accidental water discharge, a double interlock pre-action sprinkler system will be utilized. All equipment used in the preaction system must be FM Approved and/or UL Listed for such use.

SPRINKLERS

- Sprinklers, unless otherwise noted, shall be FM Approved and/or UL Listed quick-response / standard response semi-recessed frangible bulb-type having a temperature range suitable for the application and pressure rating in excess of the maximum system pressure. Concealed-type sprinklers may be used in drywall ceilings. All sprinklers and matching escutcheons and/or cover plates shall be white.
- Pendent type sprinklers shall be located in the center of square suspended ceiling tile and at the center or at quarter-points of the long axis of rectangular suspended ceiling tile. The acceptability of alternate layouts will be contingent upon obtaining the Architect's approval regarding the location of the sprinklers.
- Sprinklers located in an area subject to mechanical damage shall be provided with model-specific sprinkler guards.
- Sidewall sprinklers shall be used to protect electric, communications, or data rooms where possible.

PIPING

- Flexible sprinkler drops are acceptable for use, following code requirements. Flexible piping shall be corrugated stainless steel with woven stainless steel wire braid jacket, minimum 1 inch size I.D.
- The use of CPVC piping must be approved by the University. CPVC piping listed for use in fire sprinkler systems may be utilized only for branch lines of 3 inches or smaller. Installation and use must be per code and listing requirements. Provide CPVC fittings that are listed with the CPVC piping being utilized.
- Sprinkler system piping shall not penetrate or cross over electric, communications, or data rooms unless specifically needed to protect the immediate space.

212000 – FIRE-EXTINGUISHING SYSTEMS

- Non-water-based extinguishing systems shall be permitted in communications, electrical, and computer rooms.
 - a. Includes Carbon Dioxide, Clean Agent, Inert Gas, and Wet/Dry Chemical.
- If a non-water-based extinguishing system is specified, Architect/Engineer must submit justification to the appropriate University official for approval.

213000 – FIRE PUMPS

- Only electric-drive centrifugal-type fire pumps and accompanying assemblies shall be provided. Installation shall comply with the Ohio Building Code and NFPA 20.
- The fire pump assembly shall include a controller, automatic transfer switch, jockey pump and jockey pump controller, exterior wall mounted test connection, remote alarms, pump bypass piping, and any other additional equipment required for operation and code compliance of the pump package.
- The fire pump test connection shall be located on the building exterior for the purpose of performing acceptance and yearly testing. The test connection shall be located so that a discharge of water will not damage the surrounding environment or impact an adjacent building. Examples of approved discharge arrangements are direct discharge onto a pre-formed concrete pad or through a test connection cluster with 2½ inch valves designed to accept 150% of the fire pump water output.

Division 22

Plumbing

220100 – OPERATION AND MAINTENANCE OF PLUMBING

- On renovation projects utilizing existing under floor, in grade sanitary or storm drainage piping, the under floor, in grade piping shall be jet cleaned and video inspected prior to final design. Video inspection shall be recorded and saved to a compact disk or other electronic media. Video inspection shall be conducted in a manner that corroded, damaged or otherwise unusable piping can be located.
- Water systems shall include a sufficient number of isolation valves to allow maintenance and replacement of terminal fixtures and equipment without requiring a shutdown of the entire building or large areas of the building.

220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

- Motors shall be NEMA design for their particular application; inverter service rated for those used variable frequency drives. Service factor shall be 1.15 minimum. Motors shall be sized so as not to operate in the service factor range at any point on the curve.

220519 – METER AND GAUGES FOR PLUMBING PIPING

- Gauges shall be 4.5" diameter Bourdon tube type, with lead-free bronze ball valve and pressure snubber. Accuracy shall be 1-percent at midrange. Pressure gauges on the discharge side of pumps shall be liquid filled.
- Thermometers shall be mercury-free, 9-inch column type, red-reading organic liquid filled with adjustable angled hinge, insert stem and separable well.

220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

- Valves for domestic water systems shall be ball-type, unless specifically required by codes or standards to be another type, or if dictated by size.
- General purpose valves, 3-inch size and smaller shall be ball-type, two piece, lead-free bronze body, ball and stem.
- General purpose valves larger than 3-inch size shall be OS&Y gate-type or butterfly-type. Butterfly valves shall include a tapped lug ductile iron body, stainless steel disk and stem, manual gear operator, for bi-directional bubble-tight service.

220553 – IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

- Piping shall be identified by color bands or stenciling and flow arrows showing direction of flow. Color selection and designations shall be per the following chart.

<u>Service</u>	<u>Color</u>	<u>Designation</u>
Compressed Air	White on Blue	COMP AIR
House Vacuum	White on Blue	HOUSE VAC
Natural Gas	Black on Yellow	GAS
Hydrogen	Black on Yellow	HYD

Nitrogen	White on Blue	NIT
Oxygen	White on Blue	OXY
Dom Cold Water	White on Green	DCWS
Dom Hot Water	White on Green	DHWS
Dom Hot Water Return	White on Green	DHWR
Deionized Water	White on Green	DZDW
Distilled Water	White on Green	DSTLW
Soft Water	White on Green	SFTW

- Each valve shall be identified with a stamped tag. Valves shall be scheduled.
- Labels, tags and markers shall comply with ANSI A13.1-2007 for lettering size, colors and length of color field.

220576 – FACILITY DRAINAGE CLEANOUT

- Cleanouts located in floors shall be two-piece adjustable housing, NPT gasketed plug and round non-slip nickel-bronze cover with securing screw and accessories to accommodate finished floor material.
- Cleanouts located in walls and partitions shall be cast bronze plug and round stainless steel access cover secured by vandal-proof center screw.
- Exterior cleanouts in areas not subject to vehicular traffic shall be cast iron two-piece adjustable housing, NPT gasketed plug and round non-slip cast iron top with securing screw. Where subject to vehicular traffic, cleanout shall be NPT gasketed plug, heavy duty double flanged housing and round non-slip cast iron cover with securing screws.

220719 – PLUMBING PIPING INSULATION

- Insulation shall be provided for domestic cold water, domestic hot water, domestic hot water return piping, condensate drainage piping, the body of drains receiving cooling condensate, above grade horizontal storm drainage piping and roof drain bodies. All insulation thicknesses shall meet the referenced edition of ASHRAE 90.1.
- Insulation shall be closed-cell elastomeric insulation, tubular and sheet form, flexible pipe insulation. Insulation will be manufactured without the use of CFC's, HCFC's or HFC's. Insulation shall meet ASTM C534 and also be formaldehyde free, low VOC and resistant to mold and mildew
- Insulation shall be factory molded tubular fiberglass with "all service" jacket having an integral vapor barrier. Insulation will be GreenGuard certified for low formaldehyde and VOC emissions.

221116 – DOMESTIC WATER PIPING

- All piping and pipeline, valves, devices and appurtenances supplying drinking water for human consumption shall conform to the requirements of NSF/ANSI 61, Annex G and NSF/ANSI-372.
- Sizing the domestic cold water piping distribution system shall be established by diversified flow, based on fixture count and supply fixture units, and equipment requirements. Pipe sizing for domestic cold water shall be based on a maximum 8 feet per second (fps) water velocity and/or 3 psig/feet pressure loss. Pipe sizing for domestic hot water shall be based on a maximum 5 feet per second (fps) water velocity and/or 3 psig/feet pressure loss.
- Interior domestic cold water piping, sizes 4-inch and smaller, shall be Type "L" ASTM B88 seamless hard drawn copper with wrought copper or cast bronze solder (lead free) fittings ASTM B16.22, electro-hydraulic compression crimped fittings with EPDM seal, or mechanically formed extruded outlets (ASTM B31.9 Section 930.2) with brazed joints.

- Interior domestic water piping, larger than 4-inch size, shall be Type 316L, schedule 10 stainless steel with butt-welded fittings and joints / roll grooved mechanical coupling and EPDM gasket.
- Non-metallic piping shall not be used unless specifically pre-approved by the University.

221119 – DOMESTIC WATER PIPING SPECIALITIES

- Backflow prevention shall be provided where contamination of the potable water system is possible and in compliance with the Plumbing code and EPA requirements. Air gaps shall be utilized wherever possible. Where air gaps are not possible, ASSE listed backflow preventers shall be utilized.
- Reduced pressure zone backflow preventers shall be installed selected to minimize pressure drop at the probable peak demand flow rate of the service. Backflow preventer shall be minimum line size, where a single device is installed. Where water flow to the building or service is critical, as defined through consultation with the University, duplex backflow preventers shall be installed. Air gap fittings shall be provided at the relief valve outlet, and air gap fitting discharge shall be piped full size and air gapped over a floor drain. Floor drain capacity shall be capable of handling the full flow discharge of the backflow preventer relief valve.
- Thermal expansion tanks shall be sizes based on the design minimum and maximum system temperatures, maximum operating pressure, maximum anticipated service pressure and Boyles' law. Tanks shall be ASME labeled for 125 PSI, fitted with a NSF or FDA approved liner or bladder, stainless steel system connection and air charging valve.
- Hot water recirculating pump shall be pipe mounted type, lead-free all bronze casting and impeller or NSF 61 stainless steel, constructed for 125 lb. pressure, complete with flexible motor coupling, resilient motor mounting and flanged fitting with gaskets. Small pumps can be wet rotor design. Pumps shall be quiet operating type. Control of recirculation pumps shall be start and stop by return water temperature, or time clock through the building automation system.
- Provide wall mounted hose bib with loose key handle in all toilet rooms with more than one water closet or urinal.

221113 – DOMESTIC WATER PUMPS

- Domestic water booster pumps shall be provided where service pressure to the building is inadequate to supply plumbing fixtures and/or equipment with the proper operating pressure.
- Pump systems shall be factory packaged, factory tested and third party certified. Pump systems shall be minimum duplex design. Pumps shall utilize variable frequency drives, unless specifically approved based on the application, to be constant speed. An accumulator tank shall be provided as part of the pump package where the turndown ratio of the pump system exceeds the system minimum flows.
- Pump packages supplying critical buildings or services shall be sized such that the design demand can be satisfied with the largest pump inoperable.
- Pump packages shall be installed on a concrete equipment pad, bolted and grouted in place.

221316 – SANITARY WASTE AND VENT PIPING

- Interior above grade sanitary waste and vent piping shall be service weight centrifugally cast iron with hub and spigot ends (ASTM A74) with drainage pattern fittings and push tight gasket joints, or service weight centrifugally cast iron with hubless ends (ASTM A-888) with drainage pattern fittings and heavy duty (80 ft-lbs torque) no-hub couplings (ASTM C1540).
- Above grade pipe fittings, 5-inch size and larger, shall be restrained per CISPI standards.
- Interior sanitary waste piping, in grade below the floor slab, shall be service weight centrifugally cast iron with hub and spigot ends (ASTM A74) with drainage pattern fittings and push tight gasket joints.

- Maintain a minimum 4" backfill depth between the top of the pipe hub and bottom of the floor slab for all piping installed in grade below the floor.
- All cast iron waste and vent pipe shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- Non-metallic piping shall not be used unless specifically pre-approved by the University.

221319 – SANITARY WASTE PIPING SPECIALTIES

- In addition to code required locations and general floor drain locations to receive indirect waste from fixtures and equipment, floor drains shall be provided in each toilet room, at each emergency shower location, and in all electric rooms.
- Floor drains in finished areas and/or mechanical rooms shall be cast iron body, integral seepage pan, with clamping flange. Strainer shall be adjustable nickel bronze or stainless steel in finished areas and adjustable or fixed cast iron in mechanical rooms and other unfinished areas.
- Floor drains near water softeners, reduced pressure backflow preventers and other high discharge flow equipment shall be cast iron body, deep sump style with flat bottom strainer and half or no top grate.
- Floor drains in kitchen areas, will be stainless steel body, integral seepage pan, with clamping flange. Strainer shall be square or round, and be stainless steel.
- Drains not receiving consistent waste flow will be primed with a trap priming device.
- Chair carriers shall be provided for all wall mounted plumbing fixtures. Chair carriers, ASME A112.6, shall be concealed type, specifically design for the fixture supported. Chair carriers shall be mounted to the floor slab utilizing all available bolt holes.
- Backwater valves shall be provided for all lower level drains that are subject to backflow from surcharging of site sanitary sewers. Backwater valves shall be accessible for inspection and repair.

221323 – SANITARY WASTE INTERCEPTORS

- Garage waste interceptor shall be constructed of 5000 lb. reinforced concrete complete with vent and cleanout openings and cast iron manhole frame and cover. As an option garage waste interceptor shall be constructed of reinforced fiberglass with single-wall construction, using polyester resin suitable for underground installation.
- Kitchen waste interceptor shall be a precast basin constructed with minimum 4000 lb. strength concrete, with manhole openings, cast iron manhole frames and gas tight covers, and internal baffles. As an option, kitchen waste interceptors shall be molded, seamless high density polyethylene construction, load rated covers; flow controller and engineered inlet and outlet flow diffusers; integral air relief/anti-siphon ports; adjustable bolt-on access extension(s) as necessary for proper installation depth. The interceptor shall be certified by NSF and listed by IAPMO to ASME A112.14.3. As an additional option, kitchen waste interceptors shall be single-wall fiberglass reinforced plastic (FRP), capable of withstanding a 5-psig internal pressure test.. Access openings, extension risers and access lids shall be manufactured of FRP.
- Consult with the University to determine the need for acid waste interceptors prior to the start of plumbing systems design. Acid Waste Interceptor shall be seamless, rotationally molded and constructed of high density polyethylene or polypropylene (with reinforced fiberglass wrap if partially direct buried) and complete with gasketed and bolted cover, gas tight threaded manway, adjustable extension, and tapings for inlet, outlet and vent. Limestone fill shall be 1" to 3" diameter size with a calcium carbonate content greater than or equal to 90%.
- All interceptors shall be installed below grade, exterior to the building. Interceptors subject to traffic shall be rated for H20 loading.

221326 – SANITARY SEWERAGE PUMPS

- Sewage ejector pumps shall be submersible type, duplex design, with anti-floatation design basin and gas tight lid, pipe flanges and cord grips. Pumps shall be open volute design, rated to pass minimum 2-inch solids. Pumps shall be removable via chain, or when basin exceeds 6-feet deep a stainless steel slide rail removal system shall be provided. Pump system controls shall include lead/lag operation, alternating operation and overload protection. Pumps operation shall be controlled by mechanical float level switches. A separate high level alarm panel and associated mechanical float switch shall be provided. Alarm panel shall provide remote annunciation to the building automation system.
- Sewage ejector pumps for applications where waste flow includes solids not capable of being passed by open volute design pumps shall utilize grinder style or chopper style pumps.

221400 – FACILITY STORM DRAINAGE

- All building roof systems shall include a secondary (emergency) means of roof drainage, sized equal to the primary roof drainage system. The secondary drainage method, separately piped interior drainage system or exterior scupper drain system, will be decided through consultation with the University and the Architect, and will depend on a number of design elements, including roof design, roof structure, roof material, parapet design, aesthetics, and other factors.

221413 – FACILITY STORM DRAINAGE PIPING

- Interior above grade storm drainage piping shall be service weight centrifugally cast iron with hub and spigot ends (ASTM A74) with drainage pattern fittings and push tight gasket joints, or service weight centrifugally cast iron with hubless ends (ASTM A-888) with drainage pattern fittings and heavy duty (125 ft-lbs torque) no-hub couplings (ASTM C1540).
- Above grade pipe fittings, 5-inch size and larger shall be restrained per CISPI standards.
- Interior storm drainage piping, in grade below the floor slab, shall be service weight centrifugally cast iron with hub and spigot ends (ASTM A74) with drainage pattern fittings and push tight gasket joints.
- Maintain a minimum 4" backfill depth between the top of the pipe hub and bottom of the floor slab for all piping installed in grade below the floor.
- All cast iron waste and vent pipe shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- Non-metallic piping shall not be used unless specifically pre-approved by the University.

221426 – FACILITY STORM DRAINS

- Roof drains shall consist of cast iron bodies and cast iron dome strainers, gravel stop, under deck clamp, sump receiver, expansion joint and extension fitting to accommodate roof insulation thickness. A clamping device for attaching flashing or membrane to the seepage pan shall be provided. Strainer openings shall have a combined area equal to twice that of the drain outlet size. Drains used for secondary drainage shall include a 2-inch size standpipe inside the strainer.

221429 – SUMP PUMPS

- Elevator sump pumps shall be provided in elevator pits and shall indirectly discharge into the sanitary drainage system or to a safe point exterior of the building. A high level alarm panel with remote

annunciation capability shall be provided. Elevator sump pumps shall have a minimum capacity of 50 gallons per minute, in compliance with ASME A17.1 Safety Code for Elevators and Escalators.

- Sump pumps shall be submersible type, duplex design, with anti-floatation design basin and loose fit lid with pipe flanges and cord grips. Pumps shall be open volute design, rated to pass minimum 0.75-inch solids. Pumps shall be removable via chain, or when basin exceeds 6-feet deep a stainless steel slide rail removal system shall be provided. Pump system controls shall include lead/lag operation, alternating operation and overload protection. Pumps operation shall be controlled by mechanical float level switches. A separate high level alarm panel and associated mechanical float switch shall be provided. Alarm panel shall provide remote annunciation to the building automation system.

221513– GENERAL SERVICE COMPRESSED-AIR PIPING

- Pipe shall be Schedule 40 black steel ASTM A-53 Type E and F. Fittings shall be ASTM A234 steel welding type and/or ASTM B16.3 threaded malleable iron, consistent with joint requirements.
- Pipe shall be extruded aluminum ASTM B241. Fittings – Polyamide with fiberglass or treated aluminum push type body and nuts conforming to UL94HB, with gripping ring for sizes 1.5-inch and smaller and double clamp ring for 2.5-inch and larger. Rated system pressure shall be 185 psig at 140 degrees F. Piping and fittings are to be by same manufacturer. Pipe hangers shall be as manufactured by piping system manufacturer.
- Pipe shall be Type "L" seamless hard drawn copper tubing. Fittings shall be ASME B16.22 wrought copper or cast bronze, solder ends with soldered joints.

221516 – GENERAL SERVICE COMPRESSED-AIR VALVES

- General purpose valves, 2.5-inch size and smaller shall be ball-type, two piece, bronze & stem, chrome plated brass ball, safety vent, blowout-proof stem.
- General purpose valves 3-inch size and larger shall be butterfly-type. Butterfly valves shall be lug style manufactured in accordance with MSS SP-67 and be rated at least 200 psi non-shock cold working pressure. Body shall be cast iron or ductile iron. Valve shall have plated ductile iron or aluminum bronze alloy disc with Buna-N rubber seat and seals, stainless steel stem, lever or gear operator.

221519 – GENERAL SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

- Compressor shall be reciprocating type with high efficiency intercooler, mounted on a horizontal or vertical receiver, simplex or duplex depending on application, constructed for 200 psig, ASME labeled with pressure switch, relief valve, pressure gauges and drains. Compressors shall not to exceed a decibel level above 85 db, or shall be equipped with sound attenuation to reduce the decibel level to below 85 db.
- Scroll type?, screw type?
- Additional accessories shall include factory installed air-cooled aftercooler, belt guard, inlet air filter and sound muffler, low oil level shut-down, electronic tank drain valve, vibration isolators, UL Listed control panel.
- Dryer shall be a refrigerated, heat sink cycling type equipped with refrigerant feed and refrigeration controls to vary the load from 0 - 100% capacity. Maximum working pressure shall be 200 psig.
- Desiccant type dryers?

- Electronic drain valves shall automatically drain condensate, without compressed air loss. Units shall be provided with electronic control to perform automatic diagnostic routines.
- Pressure reducing regulators shall have brass body, reduced pressure range 2 - 125 psig adjustable, 300 psig maximum supply pressure, spring type, diaphragm operated and relieving.
- Provide oil/water separator for all drains from air compressor, receiver, dryer and filters.
- Provide the following filtration as appropriate for application.
- Moisture Separator designed to remove bulk liquids and large volumes of water, with automatic condensate drain.
- Particulate filter designed to remove solids, burnt oil and bulk liquids, with a pressure differential indicator and automatic condensate drain. Filter element shall limit carryover 5 micron, 5 ppm.
- Coalescing filter designed to remove liquid aerosols and mist, with a pressure differential indicator and automatic condensate drain. Filter element shall limit carryover to 1 micron, 0.1 ppm.
- Polishing coalescing filter designed to remove majority of liquid aerosols and mist. Filter element shall limit carryover to 0.01 micron, 0.01 ppm.
- Activated carbon filter designed to remove vapors and odors, with a pressure differential indicator. Filter element shall limit carryover to 0.003 ppm.

223100 – DOMESTIC WATER SOFTENERS

- Water softening system shall be a factory assembled, skid mounted, pre-piped, packaged, vertical pressure type system complete, ready for operation including resin tanks, multi-port control valves, brine tank(s), electronic controller and all interconnecting piping, tubing, wiring, and meters. The system shall be a simplex, duplex or triplex, and automatic alternating type or automatic parallel progressive type control as appropriate for the application.
- Tank(s) will be electrical welded pressure vessel, low carbon steel construction rated for 100.0 psig working pressure and a minimum design of 1.2 times the working pressure. As an option, tanks shall be constructed of fiberglass-reinforcement polyester with additional reinforcement from continuous fiberglass overwrap, rated for 100 psig working pressure.
- The ion exchange resin shall be “standard mesh” of sulfanated polystyrene capable of removing minimum 30,000 grains of hardness per cubic foot and manufactured to comply with the food additive regulation 21 CFR 173.25 as set forth by the USFDA.
- The main operating valve will be a fully automatic multiport diaphragm type to control all steps of regeneration of backwash, brine/rinse, fast rinse and brine tank refill. Valve shall allow hard water bypass.
- Electronic Programmable Controllers shall be provided to automatically cycle the main operating valve and be capable of receiving a signal from a flow sensor to activate regeneration on a volume basis and/or time/calendar basis. The controller shall allow for manual initiation of automatic regeneration with a button on the face of the controller.

223400 – FUEL-FIRED DOMESTIC WATER HEATERS

- Domestic water heaters shall be natural gas fired or electric depending on application. Natural gas fired instantaneous domestic water heaters may be utilized where applicable to load profile. Water supply to instantaneous domestic water heaters shall be quality tested and treated to comply with water heater manufacturer’s requirements.
- High efficiency condensing type domestic water heaters shall be used, unless water is pre-heated. Water heaters in systems with pre-heated water shall not exceed the 85% thermal efficiency.
- Gas fired heaters exceeding 75,000 BTU/HR input shall be certified to ANSI Z21.10.3. Gas fired water heaters and storage tanks with fuel inputs of 200,000 BTU/HR or higher, storage capacities of 120 gallons

or more, or storage temperatures exceeding 210 degrees F shall be ASME tested and labled for minimum working pressure of 150 PSIG, and shall bear the HLW stamp.

- Gas fired water heater controls shall comply with ASME CSD-1 safety standards.
- Water heater thermal efficiency and standby losses shall meet ASHRAE 90.1 requirements.
- Neutralizing basins shall be supplied for all condensing water heater drains.
- Flues for condensing water heaters shall be non-corrosive superferritic stainless steel alloy (AL29-4C). PVC or CPVC shall not be used. PVC or CPVC may be used for combustion air inlet pipe.

224200 – COMMERCIAL PLUMBING FIXTURES

- All plumbing fixtures, equipment and trim shall meet the dimensional and performance requirements of the ANSI, ARI, ASME, ASSE and/or CSA standards listed in the current edition of the Ohio Plumbing Code. All faucets and fittings supplying drinking water for human consumption shall conform to the requirements of NSF/ANSI 61, Annex G and NSF/ANSI-372.

224213 – COMMERCIAL WATER CLOSETS AND URINALS

- Water closets shall be white vitreous china, wall mounted, high efficiency, 1.6 / 1.28 gallon per flush, 1.5-inch inlet spud, elongated bowl, top spud, mounted with rim at 15-inches above finished floor, 17-inches above finished floor for ADA compliant units. Flush valves shall be manual operation, diaphragm type, exposed, with screwdriver check angle stop and adjustable tailpiece. Flush valve shall be ADA compliant design where installed on ADA compliant fixtures.
- Water closet Map testing score shall be minimum 800 grams of miso at the rated gallons per flush.
- Urinals shall be white vitreous china urinal, wall hung, flushing rim, siphon jet or washout design, ultra/high efficiency, 0.125 / 0.5 gallons per flush, 0.75-inch inlet top spud, mounted with rim at 24-inches above finished floor, 17-inches above finished floor for ADA compliant units. Flush valve shall be manual operation, diaphragm type, exposed with screwdriver check angle stop and adjustable tailpiece. Flush valve shall be ADA compliant design where installed on ADA compliant fixtures.
- Urinals shall be certified to the U.S. EPA's WaterSense® specification as High Efficiency Urinals.
Note: If floor mounted urinals are desired, must use sensor operated flush valve to meet ADA requirements, and 1.0 GPF to meet ANSI testing for urinal wall cleaning.

224216 – COMMERCIAL LAVATORIES AND SINKS

- Lavatories shall be white vitreous china, 21-inches X 17.625-inches oval, self-rimming with front overflow, faucet holes on 4-inch centers. Faucet shall be cast brass manually operated faucet, handle and spout style to match application.
- Lavatories shall be white vitreous china, 20.5-inches X 18.25-inches, wall hung, to comply with ADA accessibility requirements, front overflow, faucet ledge, faucet holes on 4-inch centers, support from concealed arm carrier. Faucet shall be cast brass manually operated faucet, handle and spout style to match application.
- Lavatory faucets located in public toilet rooms shall deliver maximum 0.5 gallons per minute, with vandal resistant aerator and be provided with an ASSE 1070 compliant mixing valve to limit the hot water supply to maximum 110 degrees F. Lavatory faucets located in non-public toilet rooms shall deliver maximum 1.5 gallons per minute

- Stainless steel sinks shall be 18 gauge, 304 SS, top mount, hole-punched to match selected faucet and spray, 3.5-inch drain opening(s), raised rim, coved corners, sound/condensation coating on underside.
- Sink faucets shall be manually operated cast brass, deck mounted, rigid or swivel cast brass spout, supplies on 8" centers, 1.5 gallons per minute and ceramic operating cartridge. Handle, spout style, strainer style and accessories to match application. Use laminar flow aerator or base mounted flow controllers with plain end spouts for sinks in medical treatment areas.
- Janitor mop basin sinks shall be floor set, molded plastic and stone composite, square or rectangular, with tiling flange, vinyl bumper guards, hose and wall hook, mop hanger and stainless steel wall guard. Faucet shall be cast brass, wall mounted, rough chrome plated, with pale hook spout, 0.75" male hose thread outlet, metal lever handles and elevated vacuum breaker. Provide check valves in the cold and hot water supplies. Check valves shall be accessible for repair.
- Laundry tub sinks shall be molded plastic and stone composite, floor set with metal support legs. Faucet shall be cast brass, deck mounted, chrome plated, vacuum breaker swing spout, ceramic cartridges and metal lever handles.

224223 – COMMERCIAL SHOWER

- Shower bases shall be terrazzo, acrylic or composite to match application. Shower bases shall include tiling flange, appropriate depth curb and integral drain body to accept minimum 1.5-inch waste piping. ADA compliant transfer showers shall have maximum 0.5-inch curb. ADA compliant roll-in showers shall have no curb. Non-ADA showers shall have 2-inch curb.
- Shower units shall be one piece, acrylic shower enclosure module with integral soap ledges, appropriate depth curb and integral drain body to accept minimum 1.5-inch waste piping. ADA compliant units shall include, grab bars, fold up seat, and backer plates support all mounted accessories. ADA compliant transfer showers shall have maximum 0.5-inch curb. ADA compliant roll-in showers shall have no curb. Non-ADA showers shall have 2-inch curb.
- Shower valve and trim shall be brass body and trim, thermostatic / pressure balance, 1.5 / 2.0 gallons per minute shower head, handle, integral service stops/check stops, adjustable temperature limit stop and cast brass adjustable spray head with arm and flange. Unit serving ADA compliant shower shall include 1.5 / 2.0 gallons per minute hand shower, hose quick disconnect, 30" / 48" slide bar and metal / vinyl hose. Finish trim style and accessories shall be selected in coordination with the Architect and University to meet the specific application.

224516 – EYEWASH EQUIPMENT

- Pedestal or wall mounted barrier free assembly, stainless steel bowl, 2-spray type heads with covers, stay open actuating ball valve, identification sign, ANSI Z358.1 compliant.

224526 – EYE/FACE WASH EQUIPMENT

- Pedestal or wall mounted barrier free mounted assembly, stainless steel bowl, 4-spray type heads with covers, stay open actuating ball valve, identification sign, ANSI Z358.1 compliant.

224533 – COMBINATION EMERGENCY FIXTURE UNITS

- Combination emergency eye wash and shower, stainless steel shower head and stainless steel eyewash bowl, stay open shower actuating ball valve, stay open eye wash actuating ball valve with spray heads,

schedule 40 galvanized steel piping, 1.25" supply, 1.25" drain outlet, ADA compliant, identification sign, ANSI Z358.1 compliant.

224536 – EMERGENCY FIXTURE WATER – TEMPERING EQUIPMENT

- Mixing valve: ANSI Z358.1, ASSE 1071 compliant to provide tempered water at flow rate of connected emergency fixture. Unit to include cold water bypass, inlets with integral water strainer, check valves, supply stops, outlet connection, dial thermometer on tempered water outlet. Set temperature at 80 degrees F, with limit stop set at 90 degrees F.

224713 – DRINKING FOUNTAINS

- Bi-level drinking fountain shall be wall mounted, front and side push pads, bubbler guard, vandal resistant stainless steel construction and finish. Mounted so one side meets ADA accessibility requirements.
- Provide glass filter accessory on ADA compliant side.

226200 – Vacuum Systems for Laboratory and Medical Facilities

- All vacuum systems installed in medical facilities serving patients shall be compliant with the currently enforced edition of NFPA 99, and shall be tested and verified by a certified verifier prior to final acceptance of the systems, who shall follow strictly the procedures for verification as described in currently enforced edition of NFPA 99 and who shall provide a written report and certificate.

226213 – Vacuum Piping for Laboratory and Medical Facilities

- Tubing for medical vacuum and waste anesthesia gas disposal shall be Type "L" hard-drawn copper (ASTM B-88 or B-819) or ASTM B-280 ACR copper.
- Fittings shall be wrought copper, brass or bronze designed expressly for brazed connections (ANSI B16.22 or MSS SP-73). Joints shall be brazed in compliance with ANSI / AWS A5.8. Joints shall be made using a copper-phosphorus brazing filler alloy with a melting temperature in excess of 1,000 degrees F. (BCuP-5 series) without flux
- Valves shall be full port, 3-piece, ball-type shut-off, rated for minimum 300 psig working pressure. All materials shall be compatible with oxygen service. Valves shall be specially cleaned for oxygen service in a facility equipped to clean, rinse and purge the material. Valves shall be delivered to the project site cleaned, capped and sealed.

226219 – Vacuum Equipment for Laboratory and Medical Facilities

- Vacuum producers shall be factory packaged (prewired and pre-piped,) tank or frame mounted. The medical vacuum producer unit shall be a complete plant consisting of pumps, receiver, controls and alarms. The plant will require single point field connections for electrical, intake air, discharge air and condensate drains, only.
- Vacuum producers shall be multiplex design (minimum duplex), so that the system demand can be delivered with the largest producer in the package out of service.
- Vacuum receivers shall include a 3-valve bypass assembly to permit system operation with the receiver out of service.

226300 – Gas Systems for Laboratory and Medical Facilities

- All gas systems installed in medical facilities serving patients shall be compliant with the currently enforced edition of NFPA 99, and shall be tested and verified by a certified verifier prior to final acceptance of the systems, who shall follow strictly the procedures for verification as described in currently enforced edition of NFPA 99 and who shall provide a written report and certificate.

226313 – Gas Piping for Laboratory and Medical Facilities

- Tubing for pressurized gases shall be Type "L" (Type "K" for systems with working pressure exceeding 185 PSI), hard-drawn seamless copper (ASTM B-819). All tubing and fittings shall be labeled "OXY", "MED", "OXY/MED", "OXY/ACR" or "ACR/MED".
- Fittings shall be wrought copper, brass or bronze designed expressly for brazed connections (ANSI B16.22 or MSS SP-73). Joints shall be brazed in compliance with ANSI / AWS A5.8. Joints shall be made using a copper-phosphorus brazing filler alloy with a melting temperature in excess of 1,000 degrees F. (BCuP-5) without flux.
- Tubing and fittings shall be specially cleaned for oxygen service in a facility equipped to clean, rinse and purge the material. Tubing and fittings shall be delivered to the project site cleaned and capped/bagged.
- Valves shall be full port, 3-piece, ball-type shut-off, rated for minimum 300 psig working pressure. All materials shall be compatible with oxygen service. Valves shall be specially cleaned for oxygen service in a facility equipped to clean, rinse and purge the material. Valves shall be delivered to the project site cleaned, capped and sealed.

226319 – Gas Equipment for Laboratory and Medical Facilities

- Air compressors shall be factory packaged (prewired and pre-piped), tank or frame mounted, and of an oil-less technology design. The air compressor unit shall be a complete plant consisting of compressors, receiver, controls and alarms. The plant will require single point field connections for electrical, intake air, discharge air and condensate drains, only.
- Air compressors shall be multiplex design (minimum duplex), so that the system demand can be delivered with the largest compressor in the package out of service.
- Air compressor systems filtering, air drying and multiplexing shall be designed to accommodate the application. Consult with the University prior to design.

226653 – Chemical-Waste and Vent Piping

- The extent of chemical-waste drainage shall be determined in consultation with the University based on the presence of acids and processes in the laboratories.
- Chemical- waste drainage piping above ground shall be Polypropylene S40 piping with fusion and/or mechanical joints.
- Chemical-waste drainage piping below grade shall be Polypropylene S40 piping with fusion joints.
- The University shall be consulted prior to the use of high silicon iron drainage piping, borosilicate glass drainage piping or plenum rated PVDF drainage piping for chemical-waste.

226700 – Processed Water Systems for Laboratory and Healthcare Facilities

- A water quality test shall be conducted and data of the required water quality shall be acquired prior to the design of processed water systems.
- Pure water generating systems shall be provided to meet the requirements of most routine laboratory water quality needs. Systems shall be centrally located to minimize the length of recirculation loops.

Higher quality water, where required at local units, shall be point-of-use systems fed from the centrally located pure water generating system.

- All centrally located and point-of-use pure water systems shall be provided by same manufacturer for ease of maintenance and stocking of consumables.

226713 – Processed Water Piping for Laboratory and Healthcare Facilities

- Pure water system piping, fittings, valves and supports shall be un-pigmented, Type 2, high impact virgin natural polypropylene. Piping and fittings shall be Schedule 80 socket fused type.

Division 23

Heating, Ventilating, and Air Conditioning (HVAC)

GENERAL PROVISIONS

- Design shall comply with the requirements of most recent version of the following code and/or standards:
 - a. Ohio Building Code
 - b. Ohio Mechanical Code
 - c. ASHRAE 15
 - d. ASHRAE 55
 - e. ASHRAE 62.1
 - f. ASHRAE 90.1
 - g. LEED - NC
- All designs shall use the following criteria for calculations and equipment selections:
 - a. Heating Design Temperature: 0°Fdb
 - b. Cooling Design Temperature: ASHRAE 0.4% Cooling with Mean Coincident Wet Bulb
 - c. Air cooled Refrigeration Condensing Temperature: 100°Fdb
 - d. Heating Setpoint: 68°Fdb unless otherwise specified
 - e. Cooling Setpoint: 75°Fdb unless otherwise specified
 - f. Maximum Relative Humidity: 55% RH unless otherwise specified
- All designs shall focus on building energy efficiency. The following minimum performance of the total building shall be achieved and documented using an ASHRAE 90.1 Appendix G energy model:
 - a. New Construction: 25% better than the 90.1 Appendix G baseline requirement
 - b. Renovation where 70% of floor area of the facility is affected: 20% better than the 90.1 Appendix G baseline requirement

230100 – OPERATION AND MAINTENANCE OF HVAC SYSTEMS

- Special attention shall be given during design and construction to accessibility of systems required for maintenance and code required verification of operation. All necessary service clearances to major equipment (chillers, boilers, AH units, fans, pumps, and VAV terminal units) shall be shown on the drawings and maintained clear and accessible. Access doors in both walls/ceilings and in ducts shall be provided to permit access.
- Equipment requiring maintenance or code required verification shall not be located in such locations as to make them not readily accessible. Examples of prohibited installations are: above classroom tiering, in ceilings or at levels of atriums that require large lift access, above swimming pools. If installation in these locations is required, fixed access platforms shall be incorporated into the design. OSHA required fall protection system tie-off points and related railings shall be accounted for during the design.
- Provide three (3) copies of O&M manuals for all HVAC systems and equipment as well as one (1) copy on USB flash media.
- Provide HVAC system training at the conclusion of the project. Sessions shall not exceed four (4) hours in duration, shall be focused on one specific topic, and shall be digitally recorded and turned over the University on DVD-ROM media.
- Adequate storage space for attic stock shall be incorporated into the design. Attic stock shall be provided for all consumables on each project including, but not limited to:
 - a. Filters – two full sets of all filters
 - b. Belts – one full set of belts

- Air handling equipment shall be located within the building in mechanical rooms or penthouses. Exterior roof mounted equipment is not acceptable, except in the case of exhaust fans.
 - If roof mounted equipment is approved via variance, it shall be screened with materials consistent with the building envelope construction.
- All major equipment shall be provided with a 5 year part and labor warranty, non-prorated as part of the project construction. This equipment shall include, at minimum:
 - Air Handling Units
 - Boilers
 - Pumps
 - Chillers
 - Cooling Towers
 - Chemical Treatment System Equipment
 - Heat Pump Units
- A central equipment mounted on grade or on the roof shall be screened with materials consistent with the building envelope construction.
- All Variable Frequency drive units shall be provided with a factory installed three – contactor bypass to permit removal and replacement of the VFD unit while maintaining operation at constant speed.
 - The DDC control system shall monitor the “Bypass” position of each VFD on a fan system and drive Air Terminal units to a proper position for continued operation and temperature control while the system operates in VFDE Bypass mode.

230519 – METERS AND GAGES FOR HVAC PIPING

- Each building utility shall be provided with electronic metering connected to the building DDC system. Utilities to be metered include:
 - Domestic Cold & Hot Water
 - Natural Gas
 - Electricity – via integration of Powerlogic metering into the DDC
 - Steam
 - Chilled Water
 - Heating Hot Water
- Utility meters shall be the following type:
 - Domestic Cold and Hot Water – Badger Industrial Disc with electronic instantaneous and totalized flow to DDC or similar
 - Natural Gas – Dattus FM2 with electronic instantaneous and totalized flow to DDC or similar
 - Electricity – via integration of Powerlogic metering into the DDC of Demand and Usage
 - Steam – Spirax Sarco RIM Series with electronic instantaneous and totalized flow to DDC or similar
 - Chilled Water – ONICON F-120 Turbine Meter with electronic instantaneous and totalized flow to DDC or similar and related temperature sensing for BTU calculation
 - Heating Hot Water - ONICON F-120 Turbine Meter with electronic instantaneous and totalized flow to DDC or similar and related temperature sensing for BTU calculation
 - Make up water to closed loop hydronic systems shall be equipped with a Badger Industrial Disc with electronic instantaneous and totalized flow to DDC or similar type meter.
- Gages and thermometers shall be provided on the inlet and outlet of each piece of HVAC equipment including but not limited to:
 - AH unit coils
 - Chillers
 - Boilers
 - Pumps

Additionally, analog gages / thermometers shall be provided at all DDC sensors locations in central utilities.

- Gages shall be 4" liquid filled, bourdon tube type.
- Thermometers shall be 9" color reading spirit filled column type.

230523 – GENERAL DUTY VALVES FOR HVAC PIPING

- All valves for steam service shall be rated for a minimum of 500°F and 1.5 times the system relief pressure.
- Valves for hydronic service shall be as follows:
 - a. 3" and smaller: 2 piece, ball type
 - b. 3.5" and larger: butterfly type, lug body, rated for shutoff service
- Shut-off valves shall be provided at each floor to facilitate isolation without shutdown of the entire facility.
- Shut-off valves shall be provided at each piece of equipment to permit isolation during service. One valve at each piece of equipment may be a combination device such as automatic flow controller with shut-off valve or combination manual balance and shut-off valve.
- Water flow balance devices may be manual balance valves with locking operators or automatic flow controllers, at the Associate Engineer's discretion. If manual balance valves are utilized, return systems shall be design as reverse return in their entirety. If automatic flow controllers are utilized, direct return systems may be utilized.

230548 – Vibration and Seismic Controls for HVAC

- All fans 1 HP and larger shall be installed on combination spring / rubber isolation systems.
- All base mounted pumps shall be installed on combination spring/rubber isolation systems.
- All inline pumps 5 Hp and larger shall be installed on combination spring/rubber isolation systems.
- Inertia bases shall be provided on rotating equipment not installed on grade.

230553 – Identification for HVAC Piping and Equipment

- Mark location of fan coil units, VAV terminal units, and other equipment concealed within a ceiling plenum or cavity with "buttons" to approximate the devices location. The button should be printed with the devices equipment ID.
- All major equipment shall be tagged with a specific identifier. This shall include, at minimum:
 - AH units
 - Chillers
 - Boilers
 - Pumps
 - Fans
 - VAV terminal units
 - Fan coils
 - Unit Heaters
 - Fire and Smoke Dampers
- Labeling shall be placed on all duct and piping systems at 50 ft intervals maximum. Directional arrows shall be located with each system label.
- Duct labeling shall be representative of the duct service:
 - Supply
 - Return
 - Relief
 - Exhaust

- Laboratory Exhaust
- Outside Air
- Pipe band colors and letters for HVAC Systems shall be as follows:

STEAM - BLACK	BANDS	ABBR.
High pressure steam	Black-Red	STM-HI
Medium pressure steam	Black-Yellow	STM-MED
Low pressure steam	Black-Orange	STM-LOW
High pressure return	Black-Purple	STM-HPR
Pumped condensate return	Black-Green	P.C.R.
Condensate drain	Black-White	C.D.
HEATING - YELLOW		
Hot water heating supply	Yellow-Red	H.W.H.S.
Hot water return	Yellow-Orange	H.W.H.R.
AIR CONDITIONING-GREEN		
Refrigerant piping	Green-Red	REF.
Chilled water supply	Green-White	CH.W.S.
Chilled water return	Green-Yellow	CH.W.R.
Condensate water supply	Green-Orange	C.W.S.
Condenser water return	Green-Purple	C.W.R.

230593 – Testing, Adjusting, and Balancing for HVAC

- All air systems and hydronic systems shall be balanced for appropriate operation and optimal emergency performance.
- Balance contractors shall be certified by the Associated Air Balance Commission (AABC).

230713 – DUCT INSULATION

- All ducts shall be insulated as required by ASHRAE 90.1.
- Duct insulation in exposed areas including mechanical rooms shall be rigid board type insulation with FSK jacket. Duct insulation in concealed areas shall be flexible blanket type insulation with FSK jacket.
- Fiberglass duct liner shall not be utilized. Fiber free liner may be considered for use with approval of Campus Engineering only.

230719 – HVAC PIPING INSULATION

- All piping shall be insulated as required by ASHRAE 90.1.
- Insulation on heating hot water, steam, and steam condensate systems shall be factory molded tubular fiberglass insulation with factory applied ASJ.
- Insulation on cold service piping (<60°F) shall be cellular glass type insulation with factory applied ASJ.

230923 – DIRECT-DIGITAL CONTROL SYSTEMS FOR HVAC

- The existing University DDC front end is Siemens Apogee 600. All control system components shall be fully integrated into the existing Siemens front end via proprietary Siemens protocol or native BACNet

protocol. Coordinate closely with the University the integration requirements for any project control system work.

- New Buildings and Existing Buildings without Siemens DDC: all controls shall be native BACNet type. All manufacturers must be capable of integration of all I/O functions via BACNet gateway to the existing Siemens campus front end system including but not limited to:
 - a. All schedules
 - b. All setpoints
 - c. All enable / disable functions
 - d. All analog points (I/O)
 - e. All binary points (I/O)
 - f. All building energy metering points
 - g. Global points
 - Campus outdoor lighting control on/off
 - Outside air temperature
 - Outside air humidity
- Existing buildings with Siemens DDC: all controls shall be Siemens Apogee 600 BACNet.
- All actuators (modulating and two-position) shall be electronic. Pneumatic actuation cannot be utilized.
- DDC thermostats shall be ABS plastic cover with local occupied/unoccupied override and setpoint adjustment slide or dial.
- All control systems shall be provided with trends (15 min sample time, 7 day storage for each) setup prior to turnover for the following minimum points:
 - AH Units
 - Supply Fan Speed
 - Return or Relief Fan Speed
 - Discharge Air Temperature
 - Cooling Valve Position
 - Preheat and/or Heating Valve Position
 - OA/RA Damper Position
 - Chiller Plants
 - Chiller # Discharge Water Temp
 - Chiller # Entering Water Temp
 - Chiller Load %
 - Common Chilled Water Supply Temp
 - Common Chilled Water Return Temp
 - Common system differential pressure
 - Energy Meter output
 - Correlating outdoor air temperature
 - Heating Plants
 - Boiler # Discharge Water Temp
 - Boiler # Entering Water Temp
 - Boiler # Firing Rate
 - Common Heating Hot Water Supply Temp
 - Common Heating Hot Water Return Temp
 - Common system differential pressure
 - Energy Meter output
 - Correlating outdoor air temperature
- Thermal control zones (VAV, Fan Coil, etc.) shall be tied to local occupancy control sensors for lighting to initiate occupied/unoccupied mode of that thermal zone unless approved otherwise by campus engineering.
- Control valves

- AH Unit valves shall be Belimo Energy Valve or similar by Flow Energy.
- Thermal zone valves for VAV units, Fan Coil units, etc. shall be characterized ball or globe type valves.
- All valve actuators shall be true modulating type. Floating point actuators shall not be utilized.
- All valves shall be rated for 150% close – off pressure of the maximum system service operating pressure (i.e. relief valve setting).

232113.23 – Aboveground Hydronic Piping

- Piping systems for HVAC service shall be one or more of the following system types:
 - Schedule 40 or 80 Black Steel with Screwed, Flanged, or Welded joints
 - Type L Copper Tubing with Wrought Copper fittings and soldered or brazed joints

232123 – Hydronic Pumps

- Pumps may be base mounted or inline based on design requirements.
- Inline Pumps 5 HP and larger shall be flexible coupling type. Under 5 HP may be direct couple.
- Pumps 5 HP and larger SHALL NOT be balanced by a manual balance valve. A VFD shall be provided and, if not a variable speed pump, shall be manually set for balance purposes and programmed for constant speed operation at the determined appropriate balance frequency.

232200 – Steam and Condensate Piping and Pumps

- Steam condensate pumping units shall be electric driven, duplex type with integral pump alternator.
- Pump operation, trouble, and condensate temperature shall be monitored by the building DDC system.
- Steam piping shall be Schedule 40 Black Steel with Screwed, Flanged, or Welded joints.
- Steam condensate piping shall be Schedule 80 Black Steel with Screwed, Flanged, or Welded joints or Schedule 10 Stainless Steel Type 304L with Flanged or Welded joints or Schedule 40 Stainless Steel Type 304L SS with Screwed joints..

232300 – Refrigerant Piping

- Refrigeration piping shall be hard drawn Type ACR copper tubing with wrought copper brazed joints.
- Any refrigeration piping installed within walls, chases, or in ceiling spaces above occupied spaces shall be supported within vibration isolation hangers to limits the transmission of vibration into the structure.

232513 – Water Treatment for Closed-Loop Hydronic Systems

- All make up water to closed loop hydronic systems shall be softened and filtered for solids PRIOR to the automatic water make up system due to the excessive hardness in local water on campus.
- Each closed loop system shall be provided with an automatic feed water system with meter to maintain minimum system pressure.
- Each closed loop system shall be provided with a 5 Gallon chemical bypass – filter shot feeder.

232516 – Water Treatment for Open Hydronic Systems

- All make up water to open loop hydronic systems shall be softened and filtered for solids PRIOR to the automatic water make up system due to the excessive hardness in local water on campus.
- University preference is for Non-Chemical Water treatments systems for open loop hydronic systems such as Clearwater Systems Dolphin or similar.
 - All Non-chemical systems shall be selected for proper control of solids, hardness, and biological contaminants.
 - All Non-chemical systems shall be provided with a side stream centrifugal separator system for the removal of particulates and precipitates.

- All Non-chemical systems shall be provided with a basin sweep system on the cooling tower to ensure entrainment of solids and precipitates.
- With Campus Engineering approval only, consideration will be given to the use of automatic solid injection chemical systems.

232519 – Water Treatment for Steam System Feedwater

- All make up water to steam systems shall be softened and filtered for solids PRIOR to the steam chemical treatment system due to the excessive hardness in local water on campus.
- Each steam boiler shall be equipped with surface blowdown line, automatically controlled based on water conductivity or boiler load.
- Each boiler shall be equipped with By-pass Feeders/Chemical Pot Feeders for chemical injection into the boiler.
- Each steam system (group of multiple boilers) shall be equipped with an automatic chemical monitoring and feed system with the following minimum components:
 - Metering Pumps
 - Chemical Pump Timers
 - Make-up Water and meter
 - Bleed Solenoid Valves
- All chemicals used in the steam system shall be FDA Approved for direct steam injection into HVAC airstreams
- All Chemical Feed Piping shall be stainless steel

233100 – HVAC Ducts and Casings

- All HVAC ducts shall be metallic construction (galvanized steel, aluminum, or stainless steel) and appropriate for the service. Fiberglass duct board or liner shall not be utilized.
- Flexible ductwork shall be spiral reinforced rated for positive and negative pressure and may be utilized in the following locations only:
 - Direct connection to the inlet of a VAV terminal unit. Length shall not exceed 5 feet. Any changes in direction shall match the dimensional relationship of a corresponding hard duct elbow.
 - Runouts to air devices (supply, return, and dry exhaust) with a maximum length of 4 feet. Any changes in direction shall match the dimensional relationship of a corresponding hard duct elbow.
- Louver plenums shall be 2" double wall air plenum casing with internal insulation. All bottoms of louver plenums shall be welded construction, water-tight and shall be equipped with a piped drain connection or pitched to the louver sill for drainage.

233600 – Air Terminal Units – VAV and CAV

- Air terminal units shall be single duct type with integral airflow sensing ring.
- Air terminal units shall be double wall construction only.
- Hot water reheat coils shall be copper tube, aluminum fin.
- Air terminal units shall be selected to minimize sound and air pressure drop while maintaining appropriate control characteristics.

233813 – Commercial-Kitchen Hoods

- All Type 1 commercial kitchen hoods shall be equipped with a control system which varies the airflow through the hood based on cooking load operation under the hood similar to Melink Intelli-hood.

233816 – Chemical Fume Hoods

- The university is a participant in the labs 21 program and is committed to energy efficient laboratory ventilation. All fume hoods shall be variable air volume type, low airflow, high efficiency design. 60 FPM face velocities are anticipated with these style hoods.
- All fume hoods shall be field tested prior to turnover for compliance with ANSI/ASHRAE Standard 110.

234100 – Particulate Air Filtration

- All Air Handling units shall be equipped with the following minimum filtration:
 - Prefilters: MERV 6, Cartridge Type, 2" Throw Away Media
 - Final Filters: MERV 13, Cartridge Type, 12" Throw Away Media
- Provide a minimum of two full sets of replacement filters at project close-out, in addition to the set currently installed in the unit.
- All return/exhaust air inlets shall be protected with disposable MERV 8 filter media throughout the construction phase of all projects.

235200A – Heating Boilers – Hot Water

- All heating boilers shall be design for condensing operation unless specifically accepted as Non-condensing by Campus Engineering.
- New buildings and major renovations shall be selected for heating water temperatures that permit boiler condensing operation throughout the entire year to maintain maximum boiler efficiency.
- All boilers shall be equipped for modulating burners with a minimum of 5:1 Turndown ratio.
- Electronic flame safeguard operating, sequencing and safety controls
- ASME stamped with corresponding pressure relief valve. Operating and safety pressures shall be coordinated with Campus Engineering.
- Heating hot water systems (multiple boiler installations) shall be equipped with a boiler optimization control system which stages the boilers and controls their firing rates for maximum possible efficiency. This control system shall be integrated into the building DDC system via a BACNet gateway.
- University preference is for direct vent, separated combustion systems.

235200B – Heating Boilers – Steam

- All steam boilers shall be packaged forced draft scotch marine type, wet back design with minimum 3-passes, 358 sf maximum heating surface unless approved by Campus Engineering.
- Natural gas fired powered burner, modulating, with minimum 5:1 turn down, and UL/FM gas train.
- Electronic flame safeguard operating, sequencing and safety controls
- ASME stamped with corresponding pressure relief valve. Operating and safety pressures shall be coordinated with Campus Engineering.
- 10 year refractory warranty.
- Surge load baffles.
- Connections for automatic surface blow-down (and skimming tube), and manual bottom blow-down (with slow and quick opening valves furnished with the boiler)
- Low water cutoff, pump controller, water column with try cocks, and gauge glass with ball checks and cocks, separate or in combination.
- Probe type auxiliary low water cut-off.
- High limit safety pressure control.
- Operating pressure control.

- Low-fire hold/ minimum temperature control for warm-up and stand-by mode in the sequencing of boilers.
- Modulating feedwater control and motorized valve, maximum 10 psi pressure drop.
- Factory installed sample cooler equal to Penn, complete with needle valve and bimetal thermometer on sample outlet, ball valve on cold water inlet, drain connection, and connection to boiler with shutoff globe valve.
- Factory wired control panel with main power disconnect for single point power connection, controls transformer, magnetic starters or contactors and overload protection for each motor, solid state flame safeguard controller with full sequencing and operating, checking and safety controls, damper motor positioning switch and manual-automatic selector switch, status indication lights (for power on, call for heat, pilot operation, burner operation and shutdown due to low water, pilot failure and flame failure), alarm bell and silencing switch, and other trim and accessory items, as appropriate.
- Steam systems (multiple boiler installations) shall be equipped with a boiler optimization control system which stages the boilers and controls their firing rates to maintain design system pressure. This control system shall be integrated into the building DDC system via a BACnet gateway.

236400A –Water Chillers - Air Cooled

- Chillers shall be selected for best possible kW/Ton. Ambient outdoor air temperature for capacity selection shall be ASHRAE 0.4% Cooling plus 5°F.
- Units shall have solid state starters or VFD for compressor motors.
- Unit shall have unloading capability to at least 10% of rated capacity.
- Provide liquid solenoid valve on systems using coil pump down
- Isolation valves shall be provided on all independent circuits.
- Install liquid charging port and service valve on large systems (> 50 Tons).
- Install sight glass- moisture indicator in convenient and accessible location
- All motors shall have sensors in windings for thermal protection
- The following safeties:
 - High and low pressure safety cutout
 - External overload protection
 - Low oil pressure
 - Timer to limit restart
 - Safeties shall be manually reset electrically lockout unit and a trouble light for activated device
- Gauges shall be provided on the high side, low side, and oil pressure
- Forced feed lubrication with filter, cooler, and visual inspection port in the oil reservoir shall be provided
- Capacity control:
 - Digitally operated adjustable capacity control in the machine control cabinet with a minimum adjustable range of 10 to 100 percent
 - Device shall be suitable to be reset by Remote Power Management System
- Provide crankcase heaters on a separate electrical circuit
- Provide purge units to eliminate non condensable gases if required for refrigerant used
- Provide a pump out unit and receiver large enough to hold the full refrigerant charge into the receiver, if required for refrigerant provided
- Each chiller shall be equipped with a BACNet interface to DDC to fully integrate the chiller controls. At minimum, the following information shall be ported:
 - Enable/Disable
 - CW Setpoint
 - Operating Capacity
 - CW Entering Temperature

- CW Leaving Temperature
 - Refrigeration Circuit Temperatures and Pressures
- Units shall be equipped with electric barrel heaters for freeze protection.

236400B –Water Chillers - Water Cooled

- Chillers shall be selected for best possible kW/Ton.
- Units shall have solid state starters or VFD for compressor motors.
- Unit shall have unloading capability to at least 10% of rated capacity.
- Provide liquid solenoid valve on systems using coil pump down
- Isolation valves shall be provided on all independent circuits.
- Install liquid charging port and service valve on large systems (> 50 Tons).
- Install sight glass- moisture indicator in convenient and accessible location
- All motors shall have sensors in windings for thermal protection
- The following safeties:
 - High and low pressure safety cutout
 - External overload protection
 - Low oil pressure
 - Timer to limit restart
 - Safeties shall be manually reset electrically lockout unit and a trouble light for activated device
- Gauges shall be provided on the high side, low side, and oil pressure
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- Each chiller shall be equipped with a BACNet interface to DDC to fully integrate the chiller controls. At minimum, the following information shall be ported:
 - Enable/Disable
 - CW Setpoint
 - Operating Capacity
 - CW Entering Temperature
 - CW Leaving Temperature
 - Refrigeration Circuit Temperatures and Pressures

237300 –Air-Handling Units

- Fans shall be rated to AMCA standards.
 - Selection shall be made from standard catalogued data.
 - Selection shall be made in a unit classification at a pressure at least 20 percent less than the maximum pressure listed for that particular manufacturer's classification (an excess pressure of 20 percent must be available without exceeding the construction classification of the unit furnished)
 - Drives shall be "V" belt type selected at 150 percent of the specified operating power.

- Units serving variable volume systems shall have stable fan operation (without objectionable noise or vibration) across the entire fan system curve, down to the minimum CFM listed on the drawings, and without exceeding the static pressure rating of the duct work system. Fan motors shall operate within name plate values
- Fans for low pressure construction shall be forward curve type. Fans for medium pressure construction to be air foil backwardly inclined non-overloading type or forward curved type. Fan selection shall be in a stable range of the curve and within 10 percent of the maximum efficiency of that particular fan. Fans shall be statically and dynamically balanced.
- Fan bearings shall be pillow type (not split) ball bearing, self-aligning type. For fans above 2 horsepower bearings shall be greaseable type with 200,000 hours predicted bearing life. Supply extended grease lines where bearings are inaccessible due to unit construction or location. Motor may be either internally or externally mounted. Provide slide rails with 2 adjusting nuts. Base shall be connected to the integral framework of the casing
- Moving parts shall be isolated from the casing to eliminate vibration and noise transmission. All drives, whether inside or casing or exterior to casing, shall have protection guards
- Casing shall be double wall heavy gauge steel reinforced with angles and assembled bolts and screws, fully thermally broken construction. Component parts shall be flange joints. Double wall casing components shall be lined with injected polyurethane foam insulation provide a minimum of R13 performance on the assembly. All insulation shall meet NFPA flame and smoke requirements.
- Access doors shall be provided into each separate compartment, including convenient access to any internal motor and drive. In addition, furnish 20" x 20" gasketed hinged and lock seal type inspection doors on all sections with window and service light.
- An insulated drip pan shall be incorporated under the cooling coil section.
- Heating and cooling coil sections, minimum 14" deep in direction of air flow, and removable and with gasketed seals to prevent air bypass.
- Filters shall be side access, slide rail mounting, cartridge type.
- Furnish where shown, mixing boxes for return and fresh air, complete with provisions for multi-leaf dampers. Dampers shall be extruded aluminum blade and frame with integral edge seals and blade seals, low leakage type. Dampers on outside air and relief air shall be insulated thermally broken construction.

238123 – COMPUTER-ROOM AIR-CONDITIONERS

- Each Communication Closet, MDF Room, IDF Room, Elevator Machine Room, or similar shall be provided with a dedicated air cooled, DX split system to provide proper conditioning.
- Exterior condensing units shall be equipped for cooling operation during low ambient temperatures as low as 0°F.
- Humidification of these spaces is not required.
- Each system shall be monitored by the building DDC system for the following criteria:
 - a. Space Temperature
 - b. System Trouble

238413 – Humidifiers

- All humidification shall be via direct injection of steam from a central boiler system. The use of local steam generation equipment is not acceptable.
- Steam dispersion tubes shall be selected for rapid absorption of steam into the air stream.
- University preference is for humidifier dispersion locations to be within AH units in a mechanical room. In areas which this is not possible, the duct section 24" upstream and 24" past the point of 100% absorption shall be stainless steel.

Division 26

Electrical

GENERAL PROVISIONS

- Each electrical design shall include the submittal of the following design calculations:
 - a. Lighting calculations showing required and designed foot-candles.
 - b. Estimated panel board loading (including 25% extra as a projection of future building loads)
 - c. A projection/summation of the panel board loads to justify the sizing of the building transformers
 - d. An economic analysis to justify the selection of either 120V/208V or 277Y/480V on the secondary side of the building transformers
 - e. An analysis, for the 277Y/480 V choice, as to whether the step down transformer(s) shall be large central units or smaller units placed throughout the building
 - f. A short-circuit analysis to determine the AIC rating of the system components.
 - g. A coordination study to determine the circuit breaker settings and system coordination
- Whenever possible, selection of products should be based on Standards Energy Star Rating and/or LEED (Leadership in Energy and Environmental Design).

260513 – MEDIUM-VOLTAGE CABLES

- WSU has standardized on Ethylene Propylene Rubber (EPR) insulated cable and on 500 thousand circular mils (KCMIL) as the preferred size for the 15 kV cable.
- The system voltage is a nominal 12.5 kV.
- The EPR cable shall be 15 kV single copper conductor, shielded at 105 degrees C and rated with a 133% insulation level.
- The strand screen shall be extruded semi-conducting EPR meeting or exceeding the electrical and physical requirements of ICEA S-68-516, AEIC CS6, and UL 1072.
- The shield shall be 5 mil thick bare copper tape helically applied with a 12- 1/2% overlap.
- The jacket shall be a polyvinyl chloride (PVC) jacket. The cable shall be UL listed as Type MV-105 in accordance with UL 1072.
- Each feeder shall consist of three single-conductor cables, plus a ground wire as described hereinafter, or a three-conductor cable with an integral ground. Where EPR cable is installed, it shall have a copper ground conductor installed with the phase conductors. The ground conductor shall be No. 1/0 AWG minimum in accordance with NEC Article 250-51 and Table 250-94.
- All splices shall be custom made at each location by an experienced cable splicer using customized splicing kits from a reputable cable manufacturer. All splices shall be started and carried through to completion without interruption, usually taking about 8 hours.

260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- Wire insulation shall be color coded. Branch-circuit conductors shall have colored insulation. Larger conductors shall be taped with the appropriate color tape for a minimum 6 in. starting from the termination. Each conductor of multi-conductor cable shall be color coded the same as single conductors. Color coding shall be as shown below for power conductors in the given voltage systems:

<u>PHASE</u>	<u>208/120 V</u>	<u>480/277 V</u>	<u>12,500 V</u>
Phase A	Black	Brown	Brown
Phase B	Red	Orange	Orange
Phase C	Blue	Yellow	Yellow
Neutral	White	Gray	
Ground	Green	Green	
Isolated Ground	Green with Yellow Tracer		

260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- Solid-grounding electrode system shall be provided to ground the service entrance equipment.
- Where an exterior pad-mounted transformer is utilized, a ground ring of #4/0 AWG bare copper conductors shall be provided around the transformer pad. Ground rods shall be placed approximately 3 ft. outside each corner of the pad. Two #4/0 AWG conductors shall be brought up into the transformer enclosure for equipment grounding. The transformer neutral shall only be grounded inside the service entrance (SE) equipment in the building.
- A #4/0 AWG ground conductor shall extend from the outdoor ground ring underground to the main electric room ground bus.
- Ground conductors shall be connected to a wall mounted ground bus. The ground bus shall be 2 in. x 0.25 in. x 24 in. copper. The ground bus shall be mounted 18 in. above finished floor (AFF). Grounding conductors leading to the ground ring shall be exothermically welded to the ground bus; all others shall be bolted.
- Equipment and grounding electrode conductors (all bolted conductors) shall be labeled. Labeling shall utilize embossed brass metal tags with nylon tie wraps.
- Ground conductors brought through the floor or walls shall be in PVC conduit sleeves.
- Ground conductors shall not be located in traffic areas or where subject to damage.
- Feeders and branch circuits shall contain equipment ground conductors sized in accordance with the NEC.
- Panel boards serving isolated ground receptacles shall have an isolated ground bus in addition to the equipment ground bus. The isolated ground bus shall not be bonded to the panel board enclosure or equipment ground bus.
- Isolated ground receptacles are typically required in laboratories and offices. The buses shall be clearly labeled.
- An isolated ground conductor shall be sized to match the phase conductor. The isolated ground conductor shall be isolated to the separately derived power source.

260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

- Conduit shall be metallic to provide a redundant ground path. PVC or aluminum conduit is not acceptable except as noted below.
- PVC conduit may be used in underground applications and shall be used in concrete duct banks.
- All conduits shall be clearly shown on the contract drawings.
- Homerun arrows with panel designation and circuit numbers are acceptable. All switch legs and circuit continuations shall be indicated on the contract drawings.
- Conduits shall be clearly indicated on drawings where they are to be installed exposed and where they are to be installed concealed. All conduits run in walls shall be run vertically. No horizontal runs of conduit shall be allowed in any walls.
- The couplings used on electrical metallic tubing (EMT) shall be rain tight compression type. Set screw couplings shall not be allowed.

- The minimum conduit size shall be 0.75 inches.
- Surface mounted conduit in wash down areas and where exposed outside shall be PVC coated RGS with threaded couplings.
- Flexible metal conduit (Greenfield) shall be used for lighting fixture connections (whips) only. Liquid-tight, flexible metal conduit shall be used for connections to equipment subject to vibration, noise transmission, or movement.
- Lighting fixture connections shall be made with minimum 4 ft. and maximum 6 ft. lengths of flexible metal conduit in accordance with NEC.
- Surface metal raceway shall be metallic; plastic is not acceptable. The standard is Wiremold 4000 series. All other series must be approved by the university electrical engineer. Emergency circuits shall be wired in separate channels from normal circuits. Power and communications shall be in separate channels.
- All raceways shall follow the color scheme listed below. All existing conduits that are reused shall have their boxes, couplings, and fittings hand painted by brush to match the color scheme below using the PPG number shown.

<u>SYSTEM</u>	<u>RACEWAY COLOR/ (PPG #)</u>	<u>DEVICE & PLATE COLOR</u>
Fire Alarm	Red/ (70075)	Red
Voice/Data/video/security	Blue/ (12809)	N/A
Normal Power	Unpainted	White
Emergency/Life Safety	Orange/ (71346)	Red
Stand-By	White/ (4185)	Gray
Lighting	Black/ (4337)	N/A
Dedicated Grounding	Green/ (46180)	N/A
Wireless Way-finding	Yellow/ (80453)	N/A

- Busway shall have all solid copper bus. Ventilated busway shall be installed in dry locations not subject to moisture. Non ventilated bus way may be installed in wet or dry locations.

260536 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

- Cable tray shall be made of aluminum and of the ladder type for all power and communication cables. Cable trays shall consist of factory manufactured units that bolt together in the field.
- The minimum cable tray size for communications cable shall be 12 in. x 4 in. nominal. Fabrication in the field, other than the shortening of a single straight section per each straight run to meet field conditions, will not be permitted. Corners, intersections, and tee units shall be standard manufactured units for this purpose; modification of straight sections to meet these needs will not be permitted. Where vertical space permits, and as approved by the Project Manager, tees and intersections can be in the form of two separate, straight tray sections at differing elevations; minimum spacing between these sections in the vertical direction shall be 6 in.
- Ventilated tray bottoms, in lieu of ladder rungs, will not be acceptable.
- Cable trays are to be routed near the side of the utility or pedestrian corridor wherever possible. Cable-tray locations shall be coordinated with adjacent utilities so that the tray will be accessible for adding or removing cables in the future. Routing shall also be adjusted so as not to obstruct access to other utility items that would routinely require access for maintenance or adjustment.
- The cable trays shall be supported directly from the building structure above and side walls wherever possible. Bridging of other utilities with a trapeze arrangement is acceptable. The spacing of the support

points shall be as recommended by the cable tray manufacturer. Supporting cable tray from suspended ceiling construction shall not be permitted.

- Where cable tray would penetrate wall (4) 4" Hilti speed sleeves shall be used to allow cables to pass through wall.

260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

- All electrical equipment shall have nameplates identifying the name of the piece of equipment or the name of the equipment served (disconnects, starters, etc.) the nominal voltage, phase, and where it is fed from.
- Nameplates shall be laminated phenolic legend plates with black letters on white surround for normal power, white letters on a red surround for emergency power and red letters on a white surround for stand-by power.
- Nameplates shall have minimum 0.25 in. high letters for small equipment and disconnects, 0.5 in. high for medium-sized wall mounted equipment such as panel boards and individual Size 2 starters and above, and 2 in. high for freestanding equipment such as large panel boards, switchgear, and transformers.
- The nameplates shall be attached with stainless steel screws.
- All devices, switches, and receptacles shall be labeled with panel and circuit number that serves them. Labels shall be made from clear label tape with 1/8" high black text. Label shall be adhered to the front face of the device plate.

260620 – SCHEDULES FOR LOW-VOLTAGE ELECTRICAL DISTRIBUTION

- The information to be supplied on the panel board schedules is all data necessary to order the equipment and all data needed to completely identify the attached loads. Information to be clearly shown shall include the following:
 - Panel name
 - Number and size of spare breakers
 - Number of bused spaces and the maximum ampere ratings
 - Total number of breaker positions in the panel
 - Top feed or bottom feed
 - Main circuit breaker (MCB) or main lugs only (MLO)
 - Surface or recessed mounting
 - Trip rating, frame rating, and number of poles of each breaker
 - The AIC rating of the panel; series rating is not acceptable
 - The identification of the load and the room name
 - The estimated connected load in watts
 - The estimated connected load in volt amperes (or KVA) per circuit
 - Panel total connected KVA and Amps
 - Panel total demand KVA and Amps

260650.13 – LIGHTING PANEL BOARD SCHEDULE

- The information to be supplied on the panel board schedules is all data necessary to order the equipment and all data needed to completely identify the attached loads. Information to be clearly shown shall include the following:

- Panel name
- Number and size of spare breakers
- Number of bused spaces and the maximum ampere ratings
- Total number of breaker positions in the panel
- Top feed or bottom feed
- Main circuit breaker (MCB) or main lugs only (MLO)
- Surface or recessed mounting
- Trip rating, frame rating, and number of poles of each breaker
- The AIC rating of the panel; series rating is not acceptable
- The identification of the load and the room name
- The estimated connected load in watts
- The estimated connected load in volt amperes (or KVA) per circuit
- Panel total connected KVA and Amps
- Panel total demand KVA and Amps

260913 – ELECTRICAL POWER MONITORING

- All metering shall be as manufactured by Square D to interface with existing Square D Power Server equipment. Every new unit substation shall have a Square D PowerLogic PM8000 series or greater metering package installed with LAN cable connected to campus network. This meter shall be housed within a dedicated metering cubicle within each substation.

260923 – LIGHT CONTROL DEVICES

- Occupancy sensors shall be provided in conference rooms, bathrooms, and single-person offices. An ultrasonic type sensor shall be utilized in enclosed rooms such as bathrooms and conference rooms. A passive infrared-type sensor shall be utilized in single offices. The ceiling-mounted, ultrasonic and switch replacement, passive infrared units shall be specified depending on the room configuration. Dual technology should be used in lieu of a single technology for all installations unless this would lead to misapplication of a technology. The designer shall check with the manufacturer for recommendations.
- Sensors shall be as manufactured by Sensor Switch only.
- Dimming of fluorescent lighting fixtures shall be prohibited. Multiple levels of light shall be obtained with multi-level switching.
- Localized switching shall be provided in lieu of large-area switching. Labs shall be switched in 12 foot width groups within multi-modules.
- The use of relays to control lighting circuits or sub circuits with lighting contactors is encouraged from an energy conservation standpoint and have the ability to measure usage and control i.e. shut off, go to 50% on "breaks"/long weekends.. The system must be flexible and easy to use. Corridors are a good application for PLC and PLC must be able to accept input from Siemens.
- Spaces within buildings with large amounts of exterior glass or skylights shall utilize photocell control of electric lighting. Lobbies as well as exterior offices are good examples of day lighting opportunities. Adjustable photocells must be the overriding control to allow for cloud cover and twilight. Zoning the lighting in rows of fixtures parallel to the exterior wall is preferred. Multi-level ballast switching of fluorescent fixtures in response to a photocell is also a way of saving energy.
- Dual switching shall be provided where appropriate with three lamp fluorescent light fixtures. The fixtures shall have two ballasts, one for the inner lamp and one for the outer lamps. One switch controls each ballast, providing the flexibility of one, two, or three lamps to be lighted.

261100 – SUBSTATIONS

- The building substations shall be located indoors in a 2 hour rated electrical vault and shall be unitized. The vault shall be a minimum of 30 foot long by 25 foot wide with a 6 foot wide door in the middle of the 25ft width. The room shall be a minimum of 12 foot high measured from floor to the bottom side of the floor structure above. All main vaults shall be on the basement level for easy access to the tunnel system.
- The size of building transformers and the requirements for power reliability at WSU require that there be an exit route specified for these large, heavy items of electrical equipment. The designer of the building must provide for a permanent exit route to remove these large items and bring in new units. Note that the faulty unit must be removed while the other unit substation remains in place and in operation.

261116 – SECONDARY UNIT SUBSTATION

- The typical building service shall consist of two unit substations one 120/208V and one 277/480V. Each transformer shall be sized for 125% of the total building load including any spare or future capacity.
- Building substations shall consist of a 15 kV primary HVL switch, a dry type transformer, a dedicated metering cubicle, a secondary main electronic trip circuit breaker, and a fusible switch distribution.
- The 15 kV primary switch shall be an HVL load break switch. The fusing shall be sized accordingly. The switch shall be bused to the transformer as an integral part of the unit substation.
- The unit substation will contain an electronic trip circuit breaker with adjustable trip settings as the secondary main on the load side of the transformer. This switch shall be an integral part of the unit substation.
- Low-voltage (below 600 V) switchboard is defined as a metal enclosure containing fusible switches in individual grounded metal compartments. The internal switchboard busing shall be copper and shall be insulated with PVC or other tough insulating material, except at split connections and where cable connectors are located. At these locations removable boots shall be provided for inspection of connection points.
- Square D PowerLogic metering shall be provided on the line side of the secondary main overcurrent device within a dedicated metering cubicle. The following minimum metering is required:
 - a. Volts (phase to phase and phase to neutral)
 - b. Frequency
 - c. Ampere demand (per phase and average three-phase)
 - d. Kilowatt hours (resettable)
 - e. Kilowatt demand (three-phase)
 - f. KVA demand (three-phase)
 - g. Harmonic load content (percent THD)
 - h. Power factor
 - i. Disturbance and waveform capture
- Spaces in switchboards shall be fully bused. Spaces shall have insulated covers over bus stabs and ready for fusible switch installation. Bus shall be fully rated and shall have factory provisions for extension of main bus.
- Switchboards shall be located in electrical rooms dedicated to such use. No piping, ducts, or equipment foreign to the electrical equipment shall be permitted to be installed in, enter, or pass through electrical rooms in accordance with NEC requirements. Switchboards shall have the joints in the top (between sections) caulked with silicone after installation. Likewise, any conduit connections that are not inherently watertight shall be caulked.
- Electrical equipment that requires specialized tools for installation, maintenance, calibration, or testing shall have such tools supplied with the associated equipment and turned over to WSU at the end of the construction project. These tools can be as simple as a special screwdriver for vandal-proof lighting

fixtures or the very complex test and calibration equipment needed to maintain solid-state circuit breakers. The argument that says tools are proprietary is not acceptable, and withholding the tools shall be cause for non-acceptance of the respective equipment that needs to be maintained.

- The transformer manufacturer shall coordinate and be responsible for the entire unit substation (switch, transformer, and secondary main and distribution).
- If Integrated Facility System Switchboard (IFSS) equipment is being considered for a project, the WSU Electrical Facility Engineer must approve prior to start of design.

261316 – MEDIUM VOLTAGE INTERRUPTER SWITCHGEAR

- All building electrical services shall originate from a new medium voltage freestanding SF-6 insulated switch with load interrupting switch ways. This switch shall be located within the same room as the new substation. The switch shall consist of manually operated load interrupting, SF-6 insulated, 630A, rotary puffer switches rated at 40,000 AIC and as manufactured by G&W model #VGRAM. The switch shall always have minimum of 5 switch ways. The switch shall come with a fill port, quick disconnecting pressure gauge and a dry contact for low pressure warning. The switchgear shall be labeled phase A, B, C from front to back.

262116 – ELECTRICAL SERVICE ENTRANCE

- WSU Electrical Engineer will determine the location of the service connection to the campus electrical distribution infrastructure grid for all new buildings or additions.

262416 – PANEL BOARDS

- Circuit breakers shall be bolt-on type. Plug-in-type breakers are not acceptable. The breaker shall have a published ampere interrupting rating at 125/250 V DC. This latter requirement is sometimes referred to as requiring an E-Frame breaker. (A DC rating for the one-pole and two-pole breaker shall be assumed by WSU to extend to the three-pole device as well, for purposes of this requirement.) The specified minimum DC rating is 5,000 A at 125/250 V DC. Note that some manufacturers do not publish this data, as it is an expensive procedure to have UL do the necessary tests to obtain the DC rating. Breakers without the DC rating or listing shall be approved by the University facilities electrical engineer.
- Every panel board shall have a main breaker in the same enclosure. The main breaker can be likened to a local disconnect and must be readily accessible should the panel board need to be de-energized in an emergency situation.
- Single-pole breakers shall not be ganged to form multi-pole breakers. Series rated equipment is not acceptable.
- The panel board directories shall be typed and shall reference the actual room numbers for the circuits. This shall be specified as part of the Contractor's responsibility regardless of room numbers used on the drawings. The directory shall list the panel board name and the name of panel it is fed from.
- New panel boards shall contain 25% spare circuit breakers. The spare breakers shall be left in the OFF position, and the panel board directory card shall list the word SPARE for these breakers.
- New panel boards shall contain space for future circuits that amount to at least 25% of those required in the initial design.
- Panel boards shall be located in electrical rooms or closets with code-required clearances and 3 in. minimum separation. Bathrooms, labs, or other rooms requiring floor drains or plumbing in the floor shall not be located above electrical rooms or closets. No pipes, ducts, or equipment foreign to the electrical

equipment shall be installed in, enter, or pass through electrical rooms or closets in accordance with NEC requirements.

- Branch circuits shall not be served from panel boards located in an adjacent building, area, wing, or located on a different floor.
- Panel boards shall be labeled with name and feeder source panel or riser source location. The nameplate shall be a phenolic laminate with engraved black letters on a white surround. Emergency panels shall be white letters on red surround. The panel name shall have 0.5 in. high letters. The words FED FROM PANEL XX OR SWGR XX shall be 0.35 in. high on a line below the panel name.
- Panel boards shall have a 100% neutral bus, a ground bus, and all buses shall be copper. Panels serving high harmonic load content (50% nonlinear load) shall have a 200% neutral bus.
- All panel board breaker busing (extension fingers) including spaces shall be rated for 100 amperes minimum.
- Distribution panels shall be defined as those panels serving branch circuit panel boards and other three phase loads. Distribution panels shall be labeled DP-1, 2, 3, etc. below shall be used in sizing distribution panels for future space allocation.

<u>Maximum Active Poles</u>	<u>Minimum Spare Poles</u>	<u>Total Poles</u>
12	5	18
24	8	30
36	11	42

- Branch circuit panel boards shall have a maximum of 42 poles.
- Branch circuit panel boards shall be three-phase, four wire, with ground bus and all copper busing.
- All panel boards shall be provided with a hinged trim feature with a full-height piano style hinge. The trim shall hinge open with the removal of a few screws. The panel door shall give access to the circuit breakers only and shall have a flush tumbler lock.
- All panel board doors shall be keyed alike.

262726 – WIRING DEVICES

- The standard color for receptacles and cover plates in all finished areas shall be white and in all unfinished areas shall be brown unless otherwise noted or approved. All emergency/life safety powered devices shall be red in color and all stand by powered devices shall be gray in color.
- All receptacles shall be installed such that the ground prong is mounted in the down position.
- All receptacles shall be extra heavy duty specification grade equal to Hubbell HBL5362W.
- General purpose receptacles shall have a design load of 180 VA each in accordance with the NEC.
- For circuiting purposes a maximum of six receptacles shall be connected to a circuit. This allows a future expansion of two receptacles per circuit.
- Offices shall have minimum one general (white) receptacle per wall.
- Personal computers (PCs) shall be limited to four per 20 Amp circuit.
- Printers shall be limited to two per 20 Amp circuit.
- A 20 A duplex receptacle shall be mounted within 25 ft. of and on the same level as any electrically operated equipment on rooftops, in attics, and in crawl spaces. The receptacle must be on a separate circuit than that serving the equipment.
- Receptacles mounted outdoors shall be GFCI type with metal in use covers.
- Tamperproof safety-type receptacles are required in child care areas.

- All tamperproof receptacles shall operate with a 2 or 3 prong plug.
- Special duplex or single receptacles to serve specific equipment or loads shall be indicated by NEMA configuration.
- All cast in place floor boxes shall be FSR FL-600P with maximum depth as floor slab will allow.
- All raised floor boxes shall be FSR FL-640P with maximum depth as raised floor will allow.
- All flush floor poke through's shall be Wiremold 8AT Evolution series.
- All toggle switches shall extra heavy duty industrial series equal to Hubbell HBL 1221W.
- All device cover plates shall be standard size, smooth and nylon with matching device color cover plate unless otherwise directed by WSU or as noted elsewhere in this document.
- All exterior receptacles shall be weather resistant, GFCI type with metal in-use covers.

262913 – ENCLOSED CONTROLLERS

- Motors shall be operated on the system voltage noted below. Motors with ratings other than those listed shall not be connected. Thermal manual motor starters (TMMS's) shall be of the non-automatic resetting type and shall be lockable in the off position.

<u>Motor Rating (V)</u>	<u>System Voltage (V)</u>
115	120
200/208	208
460	480

- Three-phase motor starters shall be sized by the NEMA rating. Motors 37,300 W and larger shall have reduced-voltage starters.
- Motor starters shall be combination type with a fused disconnect switch.
- Three-phase motor starters shall have integral single phase protection against loss of any phase voltage. Solid-state overload relays provide this function inherently. Pilot devices to be included in three-phase motor starters are:
 - Red running LED pilot light
 - Green power available LED pilot light
 - Hand-off-automatic (HOA) switch
 - Control power transformer (CPT) with two primary and one secondary fuse; secondary voltage shall be 120 V.
 - 2 N.O. and 2 N.C. auxiliary contacts with the capability of adding more
 - Mechanical override to open the starter enclosure while energized.
- Motor control centers (MCCs) shall be provided where six or more motors are located in an area and need to be interlocked. MCCs shall have copper bus and plug-in starters with no hard wiring directly to the starter. All control wiring (in or out) shall be extended to terminal strips in a central location in the MCC in accordance with NEMA Standard ICS 2-322, Type C wiring. Motor starters shall conform to IEC 947-4-1 Type 2 component protection in the event of a short circuit. Ladder diagrams and sequences of operations shall be provided for all control functions. This applies to heating, ventilating, and air conditioning (HVAC), automatic temperature controls (ATC) (pneumatic or electric), plumbing, fire protection, security, programmable lighting control, etc.
- Motor starter enclosures shall be NEMA Type 1 indoors, NEMA Type 4 outdoors, and NEMA 4X in corrosive environments.

- High-efficiency motors shall have the overcurrent protection sized in accordance with the manufacturer's recommendations.
- Power factor correction capacitors shall be applied to motors 7.5 kW and larger. The capacitors shall be wired directly to the motor terminals.

262923 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

- Variable-frequency (speed) drives (VFDs) shall be as specified by the mechanical engineer, to yield better coordination between the motor, the drive, and the driven piece of equipment.

63213– DIESEL-ENGINE-DRIVEN GENERATOR SETS

- The following is the preference for WSU on generator selection. Approval must be given by WSU for any option rather than the first preference.
 1. First preference is outdoor and diesel driven.
 2. Second preference is outdoor gas driven
 3. Third preference is indoor gas driven
 4. Fourth preference is indoor diesel driven.
- The preferred generator location is outdoors in a sound-attenuated enclosure with adequate working space around the generator. Consideration shall be given to diesel exhaust, feeder length, aesthetics, space requirements, ease of removal, air intakes, etc. when locating the generator on the site. The sound attenuated enclosure shall provide 70 to 79 dB maximum noise level 20 ft. from the enclosure at rated output regardless of the generator size.
- The generator location shall have lighting on both sides of the generator(s) connected to emergency power.
- The generator exhaust silencer, or muffler, shall be critical grade rated or quieter to achieve the required sound rating. The location and direction of the engine exhaust shall not adversely affect the air intake for the building. The preferred direction of the exhaust is up, from a sound rating standpoint. A hinged rain cap shall be provided on vertical discharge exhaust pipes.
- An on-site minimum fuel storage capacity of 96 hours run time at 100% load shall be provided.
- Fuel-tank leak detection shall be provided.
- The battery charger shall be connected to emergency power. The jacket water heaters shall be connected to normal power. Where an oil circulation pump is provided to circulate oil through the engine top end, it shall be connected to normal power. A battery warmer of the wrap around blanket type shall be provided and shall be on emergency power.
- The diesel distribution system is defined as the system delivering power from the generator to the emergency terminals of the automatic transfer switch (ATS). Diesel power is normally dead until the generator is on line. Normal power is delivered to the normal terminals of the ATS. Emergency power starts at the load terminals of any ATS.
- Diesel power is distinguished from normal power which is live normally, and emergency power which is live all the time except during the brief engine start-up period (5-10 sec.). Where two or more ATS's will be installed, an emergency diesel distribution panel EDDP shall provide for future addition of ATS's with minimal interruption to the diesel power system.
- The lifting of the generator neutral to ground bond shall comply with NEC requirements for three-pole, solid neutral transfer switches. New construction or complete renovation projects shall utilize four-pole switches on three-phase, four-wire systems. The generator neutral shall be grounded when using four-pole switches in accordance with NEC requirements.

- If site constraints are such that the generator must be located indoors, the following design requirements apply.
 - Provide sound attenuated room to suit the generator being installed and the surrounding occupancies. The design for the volume of air delivered to the interior space where a generator is located must include the combustion air that exits out the exhaust stack and the cooling air that flows through the radiator. Note that the air that flows through the engine radiator is heated, and this expanded air, if used for combustion, will reduce the engine efficiency.
 - The cost of conditioning the air to be used for the needs of the generator dictates that outside air be used wherever possible. This requirement has no impact upon combustion air, but cooling with outside air will require that the coolant in the generator contain a chemical antifreeze ingredient. The outside air intake for combustion air shall be coordinated so that there is little chance that the building exhaust (which might contain smoke in a fire situation) will be drawn in for combustion air. The ventilation air intake shall be coordinated such that it does not draw in engine exhaust.
 - Where the engine exhaust from the indoor generator exits the building through a wall, or penetrates interior floor slabs or the roof, an insulating thimble must be used to protect adjacent materials from the excessive heat that would be created by full load operation.
 - The design that places a generator within a new building must also provide a suitable exit route for removal of this equipment should replacement be necessary in the future. This route shall be clearly delineated on the drawings.
 - The air for either cooling or combustion purposes shall be primary filtered as it enters the building from outside. The engine filter shall be considered a second and final filter for indoor units

263623 – AUTOMATIC TRANSFER SWITCHES

- The number of switched poles (three or four) in a transfer switch shall match the existing where replacement or upgrade is occurring.
- ATSs shall have override switches to cause them to transfer to the other source only if it is a good source. A "good source" is defined as one with line voltage + 10% available and frequency of 60 Hz + 1/2%.
- ATSs shall have external manual operators (EMOs) to mechanically operate the ATS under load without opening the enclosure door. Pushbuttons shall not be used as EMOs. The EMO shall transfer the switch to any position regardless of the condition of the source. ATSs without center off time delay shall have an in phase band monitor. ATSs shall have center off time delay when serving motors.
- ATSs shall be located indoors. If a waiver is granted for an outdoor location, the ATS shall have door-in-door NEMA Type 4X construction with strip heaters inside the enclosure. The strip heaters shall be connected to emergency power.
- The transfer switch shall be UL listed in accordance with UL 1008.
- The ATS shall be provided with a complete Square D Powerlogic metering package supplied on the load side of the device. These meters shall monitor the load whether the source is normal or diesel power. Metering shall consist, as a minimum, of voltmeter (phase to phase and phase to neutral), ammeter (per phase and average three-phase), frequency meter, and kW demand meter, plus associated switching devices.
- The operating mechanism of the transfer switch shall be electrically operated, mechanically held.
- ATS's shall not be manufactured utilizing two circuit breakers with the trip handles physically connected. The cable connection points for the two inputs and load shall have a phase to-phase spacing of at least 2.75 in.
- Bypass transfer switches shall be used where the load cannot be taken out of service or the scheduling of an outage is extremely difficult. Transfer switches shall be maintained once a year. The bypass switch shall

be make before break. The user shall be made aware of the added cost of a bypass transfer switch so as to make an educated decision. The size of a transfer switch will also increase with the addition of the bypass function. The bypass switch shall be capable of manual operation to either source, under load, regardless of the condition of the source or transfer switch position. The manual operator shall be readily and permanently accessible without opening the enclosure door.

264313 – TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

- Surge Suppression Systems
 - Provide a UL 1449 2nd Edition “Master Plan” transient voltage surge suppressor (TVSS) and filter system for the protection of AC electrical circuits and equipment from the effects of lightning induced currents, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching and other electronic equipment.
 - The surge suppression system shall be comprised of distribution class arresters at the utility equipment, an ANSI/IEEE C62.41 Category "C" TVSS at the building service entrance, ANSI/IEEE C62.41 Category "B" TVSS's at critical distribution panels within the building, and ANSI/IEEE C62.41 Category "A" TVSS receptacles in telecommunications MDF and IDF rooms and in areas as directed by engineering.
- Transient Voltage Surge Suppressors (TVSS)
- Distribution Class Arresters.
 - Equipment shall comply with ANSI/IEEE C62.11, metal oxide varistor distribution surge arrester requirements.
 - Equipment shall employ metal oxide varistor technology, mounted in ceramic housing. Equipment shall be rated 3 kV on 4,160 V distribution system, 9 kV on 12,470 V distribution system, and 10 kV on 13,800 V distribution system. Equipment shall provide line-to-ground protection. Like Cooper Power Systems VariSTAR.
 - Equipment for pad mounted applications shall employ metal oxide varistor technology mounted in pre-molded rubber elbows. Equipment shall be rated 3 kV on 4,160 V distribution system, 9 kV on 12,470 V distribution system, and 10 kV on 13,800 V distribution system. Equipment shall provide line-to-ground protection. Like Cooper Power Systems M.O.V.E. Elbow.
 - Preferred manufacturers are Cooper Power Systems, General Electric, and McGraw-Edison.
- Category "C" TVSS
 - All service entrance equipment, unit substations and switchgear shall have integral category “C” TVSS.
 - Equipment shall comply with ANSI/IEEE C62.41 (IEEE 587), Category "C" requirements, tested to ANSI C62.45, listed to UL 1449 Second Edition, and bear the UL label.
 - Equipment shall operate bi-directionally and treat both positive and negative impulses, yielding line control and short flicker ride-through, and with per mode power handling capacity exceeding 200,000 AMPS L-L and L-N, 150,000 AMPS L-G and N-G, 350,000 AMPS per phase for repeated strikes. Equipment shall be capable of passing the entire UL duty/cycle and life test for a minimum of 10 times with less than 1 percent degradation. Equipment shall have UL 1449 Second Edition certified listing suppression level, after duty/cycle and life tests, of peak voltage phase-to-neutral ratings of 400 volts or less for units on 120/208 volt systems and 800 volts or less for units protecting 277/480 volt systems. Equipment shall protect against line-to-line, line-to-neutral, line-to-ground, and neutral-to-ground voltage transients. Equipment shall provide high frequency noise filtering of up to 50 decibel attenuation (MIL-STD-220A), both in normal and common modes, at frequencies of 100 KHz to 100 MHZ. Equipment shall actively track the AC sine wave to further remove low level surges, sharp wave fronts and eliminate error producing high frequency noise bursts. Like Current Technology Model MP.

- Preferred manufacturers are Current Technology, Cutler-Hammer, General Electric, Innovative Technology, LEA International, Leviton and Leibert.
- Category "B" TVSS
 - Category "B" Transient voltage surge suppression (TVSS) shall be provided integral on all 120/208V panels.
 - Equipment shall comply with ANSI/IEEE C62.41 (IEEE 587), Category "B" requirements, tested to ANSI C62.45, listed to UL 1449 Second Edition, and bear the UL label.
 - Equipment shall operate bi-directionally and treat both positive and negative impulses, yielding line control and short flicker ride-through, and in conjunction with the service entrance TVSS, power handling capacity exceeding 135,000 transient amps per phase for repeated strikes.
 - Equipment shall be capable of passing the entire UL duty/cycle and life test for a minimum of 10 times with less than 1 percent degradation. Equipment shall, in conjunction with service entrance TVSS, perform as follows for disturbances injected at the source and measured at this unit:

Injected Signal:	Typical measured output of signal at the same time:
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1) IEEE 587 'A' Ring Wave (6000 volts, 200 amps)	3 volts
2) IEEE 587 'B' Ring Wave (6000 volts, 200 amps)	4 volts
3) IEEE 587 'B' Unipolar UL1449 (6000 volts, 3000 amps)	120 volts
4) Attenuation (100 hertz)	66 decibels

- Equipment shall protect against line-to-line, line-to-neutral, line-to-ground, and neutral-to-ground voltage transients. Equipment shall provide high frequency noise filtering of up to 60 decibel attenuation (MIL-STD-220A), both in normal and common modes, at frequencies of 100 KHz to 100 MHZ. Equipment shall actively track the AC sine wave to further remove low level surges, sharp wave fronts and eliminate error producing high frequency noise bursts. Like Current Technology Model MPA.
- Preferred manufacturers are Square D, Current Technology, Cutler-Hammer, General Electric, Innovative Technology, L.E.A. Dynatech, and Leibert.
- Category "A" TVSS
 - Equipment shall comply with ANSI/IEEE C62.41 (IEEE 587), Category "A" requirements, tested to ANSI C62.45, listed to UL 1449 Second Edition, and bear the UL label.
 - Equipment shall be duplex type receptacle, NEMA 5-20R, and shall protect against line-to-line, line-to-neutral, line-to-ground, and neutral-to-ground voltage transients. Receptacles shall have a minimum of two, 130V, 20mm metal oxide varistors (MOV), visible and audible surge status indicators, thermoplastic base, and ivory face. Devices shall not be used to provide "down-stream" protection of other receptacles.
 - Preferred manufacturers are General Electric, Hubbell, Pass and Seymour, and Leviton.

265000 – LIGHTING

- Lighting requirements shall follow the IESNA Handbook unless otherwise noted.
- All luminaires shall have a UL listing.

- The lighting fixture schedule shall list at least three manufacturers and model numbers.
- Pendant or cable mount 4' direct/indirect linear luminaires can be utilized. Luminaires require 25 watt T8 lamping, electronic ballasting, 20 gauge steel or cast aluminum components, end caps and a minimum 20% down light component. Suspended luminaire shall not be placed closer than 16" from the ceiling plain or as recommended by the manufacturer.
- Another acceptable light fixture on WSU campus is the recessed 24 in. x 24 in and 24 in x 48 in. fluorescent recessed indirect or volumetric troffers. All fluorescent recessed indirect or volumetric troffers shall meet the criteria below:
 - 24 in x 48 in., 24 in x 24 in, and 12 in. x 48 in.
 - Depth: 6 in.
 - Body Metal Thickness: 22 gauge
 - Endplate Metal Thickness: 20 gauge
 - Door Material: Aluminum with mitered corners
 - Door Latches: Cam type
 - Paint Reflectance 90%, pre- or post-painted 2x4 Coefficient of Utilization (CU): .89 minimum at room cavity ratio (RCR) of 1.0 and ceiling/wall/floor reflectances of 80%/50%/20%.
 - 2x2 Coefficient of Utilization (CU): .83 minimum at RCR of 1.0 and ceiling/wall/floor reflectances of 80%/50%/20%.
 - 1x4 Coefficient of Utilization (CU): .79 minimum at RCR of 1.0 and ceiling/wall/floor reflectances of 80%/50%/20%.
 - Lens: .125 in. thick pattern 12 100% acrylic with flat prism surfaces or Reflector: One piece vacuum formed volumetric lens system: direct indirect basket system.
 - Lamps: (3) F25T835 W (3) PL-L 40W/35/RS, (2) F25T835
 - Total minimum luminaire efficiency: 80% lensed troffers, 80 % volumetric lensed troffers, 65% direct/indirect basket type troffers.

265100 – INTERIOR LIGHTING

- The office average maintained light level using a maintenance factor of 75% shall be 35 to 45 ft.-candles for the space. Task lighting shall be provided to maintain 50 FC at the work surface. All interior lighting levels must meet or exceed the current energy code (ASHRAE 90.1). For values in other types of spaces confer with the Electrical engineer at WSU.
- Circuit connections to lighting fixtures shall be made with minimum 0.5 in. flexible metal conduit, maximum 6 ft. in length.
- Lighting fixture pendants shall be minimum 0.5 in. diameter stems with swivel mounts or aircraft wire.
- Light fixtures in mechanical/electrical spaces and any other back of house space without a lay-in ceiling shall be chain mounted acrylic lens wrap around vapor tight style fixture.
- Shelf-mounted, open-strip light fixtures shall also have plastic sleeves over the lamps or lens.
- All circuiting must be shown on the contract drawings, the use of switch labels (a, b, c) and corresponding labels (a, b, c) at each fixture shall not be acceptable. It shall not be the Contractor's responsibility to lay out the room wiring diagram (i.e., perform the design function) in order to determine the number of conductors needed between fixtures or between fixtures and switch locations.

265113 – INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

- Electronic ballasts shall be used in all fluorescent lighting fixtures.

- Where fluorescent lighting fixtures are controlled by occupancy sensors, they shall have program rapid start electronic ballasts.
- Ballast shall be solid-state electronic type consisting of rectifier, high-frequency inverter, and power control and regulation circuitry. Ballast shall be UL listed, Class P thermal rating, and Class A sound rating, per UL935-84 and certified as follows by lighting Electronic Testing Laboratory (ETL) or UL and labeled by Certified Ballast Manufacturers Association (CBM). Ballast shall be rated for the actual number of lamps served, and the voltage shall match the connecting circuit voltage.
- Ballast shall have an operating frequency of 20 kHz or greater. Ballast shall contain no polychlorinated biphenyls (PCBs). Light regulation shall be plus or minus 10% with nominal plus or minus 10% voltage variation.
- Ballast shall be designed to withstand transients described in IEEE Standard 587, Category A. Ballast temperature rise shall not exceed 25°C above 40°C ambient.
- Ballast shall meet Federal Communications Commission (FCC) regulations, Part 18.
- Ballasts shall have a minimum 5-year warranty.
- Fluorescent lighting fixtures 24 in x 24 in, 24 in x 48 in shall use T8 (1 in diameter) lamps. The ballast/lamp combination shall have an efficacy in excess of 75 lumens per watt (LPW).
- Fluorescent 4 ft. lamps shall be 25W, T8, 3,500 K color temperature with a CRI of 86 or higher and rated average life of 46,000 hours.
- LED/LED modules shall be manufactured by Nichia, Cree, Achriche, Phillips, Osram/Sylvania or approved equal. LED/LED modules shall be rated for 50,000 hours of life at 70% output (L70), shall have been tested in accordance with IENSA LM-79, LM-80 and TM-21 and have a minimum 5 year warranty.
- LED/LED modules shall be rated for efficacy of 80 lumens per watt and color consistency of NEMA SSL-3.
- LED/LED modules shall have one of the following designated CCTs (Color Corrected Temperature) per ANSI C78.377-2008 and all within the 7-step chromaticity quadrangles of: 2700K, 3000K, 3500K, 4100K, and 5000K.
- LED driver shall have 50,000 hours rated life with minimum efficiency of 85% at full load conditions.
- LED driver shall be UL 8750 approved, meet UL class 2, FCC 47CFR Part 15, and Class A minimum compliant.
- LED driver shall Class A sound rating, power factor of 0.9 or higher and have a minimum of 5 year warranty.
- Fluorescent lamps are recommended in all but the most critical color rendering applications. In those few specific applications, incandescent lamps may be utilized. The PAR halogen infrared (HIR) lamps are recommended for their lumen output and rated lamp life. Standard incandescent A, PAR and R lamps shall not be specified. Halogen versions of the PAR and R lamps shall be specified where compact fluorescent lamps cannot be used.
- Specialty light fixtures where fluorescent lamps are not possible, shall utilize LED lamp source. If LED is not an option, permission must be granted by WSU to utilize another lamp source.
- LED lamp sources shall be used for recessed and surface mounted can lights when applicable.
- LED lamps sources shall be utilized for all decorative lighting.
- Recessed fluorescent lighting fixtures shall be supported from the building structure on all four corners independent of the ceiling construction. Steel wire shall be minimum 0.125 in diameter

265300 – EXIT SIGNS

- Light emitting diode type exit signs shall be used at WSU. Exit Signs shall have a minimum 10 year warranty. Fixtures shall either be edge glow style in finished spaces and white polycarbonate in unfinished spaces. Both shall have red letters.

- All exit signs shall be connected to building emergency power unless there is no building emergency power available, then battery backup powered AC exit signs shall be used.

265600 – EXTERIOR LIGHTING

- All exterior lighting shall utilize either an induction lamp source or LED lamp source.
- Lighting designers shall minimize light pollution, or the intrusion of WSU light on bordering neighbors. The use of "house side shields" on fixtures, or light fixtures with good "cut-off" optics for glare control shall be utilized on WSU property. Light trespass levels shall meet or exceed requirements for site light over flow of 0.10 horizontal/vertical foot-candles at the property line, 0.01 foot-candles at a distance of 10' beyond the property/project line.
- The maximum circuit breaker size protecting site lighting circuits shall be 30 A
- All exterior lighting circuits are to be controlled at their point of origin by a lighting contactor. The lighting contactor shall have a 24VAC coil and a hand/off/auto switch with red and green LED pilot lights. This is so the circuit can be energized during the day for trouble-shooting purposes.
- Site lighting circuits shall use minimum #6 AWG wire in minimum 2.5 in. PVC schedule 80 conduit. The plastic conduit is placed at least 24 in below finished grade with a 6 in. wide plastic warning tape with a metallic tracer strip placed above it at 6 in. below finished grade.
- Outdoor lighting circuits shall not have underground splices or tee splices. If splices are necessary, they shall only occur in accessible locations in light pole bases.
- All exterior lighting shall be of the glare control type with a flat lens rather than the drop-lens type. Up lighting shall not exceed more than 2% from the luminaire at an angle of 90 degrees or greater.
- A lighting fixture schedule shall list at least three manufacturers and model numbers. A note indicating "or approved equal" shall be included at the bottom.
- Site lighting circuit voltages of existing circuits may be obtained from WSU.
- Animal loading docks and food service loading docks shall be induction or LED lighting.
- Loading docks shall be provided with 120V source(s) for bug "zapper" fixtures.
- The electrical lighting plan drawings shall contain enough information so that the number of wires in each conduit run is easily discernible.

265613 – LIGHTING POLES AND STANDARDS

- Site lighting poles shall have a 3 in. x 1 in. aluminum tag riveted to the pole. The tag shall clearly identify the building, panel, and circuit number where the service is derived.
- Street lighting shall be mounted 30 ft. above the pavement. Where poles are placed immediately at the edge of a parking lot or other areas where automobile bumpers may come in contact, the pole shall be mounted on a 3 ft. high concrete base for protection. The pole shall be shortened accordingly to maintain the 30 ft. mounting height.
- The placement of lighting poles near the property line shall be avoided and will be scrutinized by WSU.
- When a new street lighting pole is installed, it is required to have a 10 ft. long, 0.75 in. diameter, copper-clad ground rod placed in the foundation, and all metallic components shall be grounded to the rod, such as the metal standard, the ground wire pulled in with the power circuit, and an equipment ground wire to the luminaire.
- Walkway lighting fixtures are typically mounted on 14 ft. poles.
- Provide TVSS surge protection behind the hand hole at each new pole location.

265616 – PARKING LIGHTING

- Street lighting shall utilize a shoe box fixture mounted 30 ft. above the pavement with induction or LED lamps.
- LED shoe box shall contain die cast aluminum heat sink.
- UL iIP65 and or UL1598 wet location listing.
- CCT: 5000K
- LED Drivers shall have a 90% power factor and less than 10% THD
- LED assembly shall have a minimum 60,000 hour (L90at 40C)
- Off grid solar LED pole lighting is acceptable with WSU approval. Pole shall contain solar panel (maximum size 41" x 42"), Pole mounted battery enclosure, and LED luminaire. Pole and entire assembly must be rated for manufactures EPA rating and wind loading charts.

265633 – WALKWAY LIGHTING

- Walkway lighting fixtures are typically mounted on 14 ft. poles with LED lamps. Walkway lighting shall be shoe box fixtures and match the fixtures in the area.
- LED shoe box shall contain die cast aluminum heat sink.
- UL iIP65 and UL1598 wet location listing.
- CCT: 5000K
- LED Drivers shall have a 90% power factor and less than 10% THD
- LED assembly shall have a minimum 60,000 hour (L90at 40C)
- Off grid solar LED pole lighting is acceptable with WSU approval. Pole shall contain solar panel (maximum size 41" x 42"), Pole mounted battery enclosure, and LED luminaire. Pole and entire assembly must be rated for manufactures EPA rating and wind loading charts.

Division 27

Communications

GENERAL PROVISIONS

- At this time, WSU CaTS installs all of the Structured Cabling (Voice/Data/CATV), Phone System (Headend & Handsets), Network Electronics, WLAN (Headend and AP's) & Audio/Visual Equipment. The Contractor should only install Infrastructure (Box, Conduit & Power) to support the Owner Furnished Equipment.
- The Infrastructure (Box, Conduit & Power) must be designed by a RCDD (Registered Communications Distribution Designer).
- The Engineer of Record (RCDD) must have meetings early in the Design Process with the FPD & EC to discuss TRB & TR Locations as well as a general strategy for infrastructure for the project.
- This is a Wright State University, CaTS Telecommunications Design Guideline Specification Document.
- The purpose of this document is to describe and specify the standards and practices as they pertain to the design and installation of communications and networking requirements at Wright State University. This document is based on standards including ANSI/TIA/EIA 568B, 569A, 570, 606A and guidelines including BICSI Telecommunications Design Manual 11th Edition, see these references for further detail. This document does not replace any national or local standards, regulations or codes, but enhances them. If the standards and practices of Wright State University exceed national or local standards, regulations or codes, Wright State University's practices shall take precedent.
- The scope of this document includes the design and installation methods of communication Main Building Telecommunications Rooms (MBTR), Telecommunication Rooms (TRs), cabling distributions systems, work area outlet locations, cable specifications, testing, documentation and administration. This document shall be the minimum standard of reference for all phases of communications and networking for all new design and upgrades at Wright State University. This document is subject to change in form and technical content as warranted by advancements in building construction techniques and telecommunications technology. As such, Wright State University specifically reserves the right to add to and revise, the information contained herein.
- This document does not address the actual cable, electronic equipment or their designs and installation which will be used in conjunction with the conduit, pathways and other infrastructure as specified in this document. The University will design, install, or employ other means to procure the cable plant, equipment and technical expertise to be used in conjunction with the pathways being depicted in this document.
- The scope of this document includes the design and installation methods of Equipment Rooms, Telecommunications Rooms, cabling distributions systems, work area outlet locations, cable specifications, testing, documentation and administration. This document shall be the minimum standard of reference for all phases of communications and networking for all new design and upgrades at Wright State University.

The following codes and standards contain provisions that, through reference in this text, constitute provisions of Document. At the time of publication, the editions indicated were valid. All codes and standards are subject to

revision; parties to agreements based on this Document shall apply the most recent editions of the codes standards indicated. All Personnel involved with the design or installation of communication and networking at Wright State University must have access to the following documents. All equipment, construction practices, design principles and installations must conform to the latest version of any or all of the following standards and codes, published by the following organizations, where applicable;

- Federal Communications Commission (FCC)
- Institute of Electrical and Electronics Engineers, Inc (IEEE)
- National Fire Protection Association (NFPA)
- National Electrical Safety Code (NESC)
- American National Standards Institute (ANSI)
- Telecommunications Industry Association (TIA)
- Electronic Industries Alliance (EIA)
- Building Industry Consulting Service International (BICSI)

DEFINITION OF TERMS, ACRONYMS AND ABBREVIATIONS

General

This section contains definitions of terms, acronyms, and abbreviations that have a special meaning or that are unique to the technical content of this document. The terms that are used in only one clause may be defined within, and at the beginning of, that clause.

Definition of terms

Equipment Room (ER): An ER Room is a special purpose room designed to serve as a campus point of demarcation. An ER Room may service multiple MBTR's in a campus design. In large campuses multiply ERs may be required and interconnected. Equipment Rooms can contain equipment to support all of the following: entrance protection, access provider terminations, cable infrastructure pathway, voice MDF, wireless, data communications' paging, CATV and video conferencing.

Main Building Telecommunications Room (MBTR): A MBTR is a special purpose room designed to serve a single building with multiple TRs. The MBTR may also contain the necessary equipment to function as a TR for the floor it is located on. A MBTR can contain equipment to support all of the following: entrance protection, cable infrastructure pathway, data communications, voice BDF and IDF, wireless, paging, CATV and video conferencing.

Telecommunication Room: A TR is a special purpose room designed to serve a single floor. In buildings with multiple floors, TRs shall be vertically stacked to form a backbone pathway. The TR is the point in the Data and Voice infrastructure that the backbone and horizontal distribution systems are connected to each other. A TR can contain equipment to support all of the following: cable infrastructure pathway, data communications, voice IDF, wireless, paging, CATV and video conferencing.

Acronyms

AFF Above the Finished Floor

BICSI	Building Industry Consultants Service International
CAT	Category
CATV	Community Antenna Television (cable television)
HH	Handhole
MH	Maintenance (Man) Hole
PBX	Private Branch Exchange (Phone Switch)
TR	Telecommunication Room
MBTR	Main Building Telecommunications Room
TGB	Telecommunications Grounding Busbar
TMGB	Telecommunications Main Grounding Busbar
TDMM	Telecommunications Distribution Methods Manual (BICSI Publication)
UTP	Unshielded Twisted Pair

Also see "References" for additional codes and standards Acronyms.

270528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

- All room sizes and dimensions must be approved in writing by Wright State University and CaTS prior to design.
- All sizes indicated below are inside room dimensions.

Space name	Acronym	Minimum Recommended space size	Functions /equipment
Equipment Room	ER	Case-by-case	<ul style="list-style-type: none"> - entrance protection - transition for access provider cables - distribution point to other ER/TRBs - cable infrastructure pathway - voice MDF/PBX location - wireless - paging - backbone data communications - CATV - video conferencing

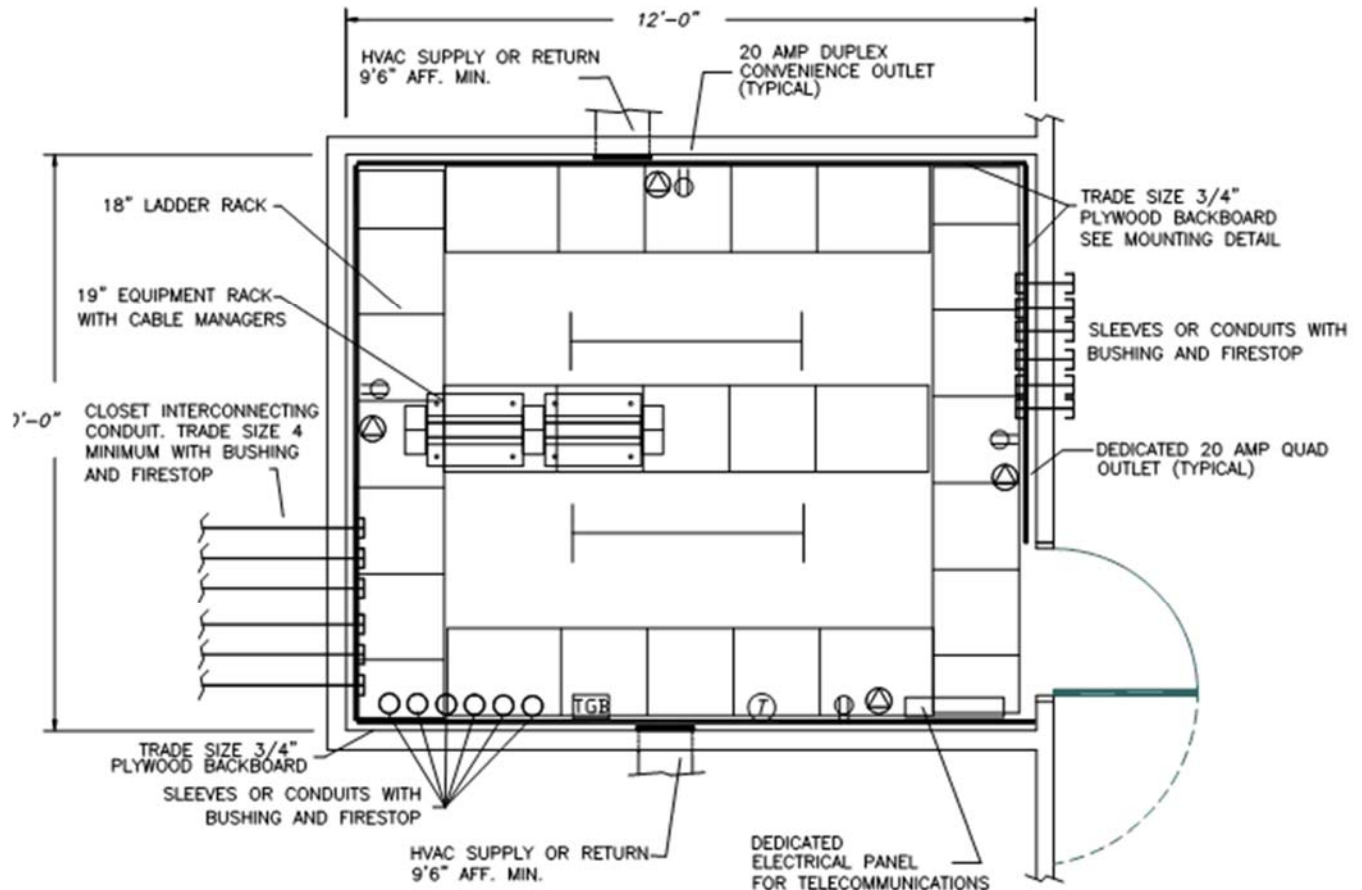
Main Building Telecommunications Room	MBTR	12 ft x 10 ft	<ul style="list-style-type: none"> - entrance protection for cables PBXR - distribution point to other building (TRBs) - cable infrastructure pathway - data communications - voice BDF and IDF - wireless - paging - CATV - video conferencing
Telecommunication Room	TR	10 ft x 10 ft	<ul style="list-style-type: none"> - cable infrastructure pathway - data communications - voice IDF - wireless - paging - CATV - video conferencing

Main Building Telecommunications Rooms and Telecommunications rooms

General

The following section will outline the location, design and pathway requirements for Main Building Equipment Rooms (MBTR) and Telecommunication Rooms (TR). The design for both MBTR's and TR's shall follow all BICSI TDMM design recommendations. Wright State University must approve all final design in writing. A detailed T3 drawing will be required for Telecommunication Plans, for more information on drawing detail see BICSI TDMM 12th Edition.

Figure 1 - Example of a Main Building Telecommunications Room



Location

MBTRs and TRs locations must meet the following requirements

- Location should be selected so that the room may be expanded.
- Shall be located as close as practicable to the center core of the building to minimize horizontal cable distances (Maximum cable length is 295' (90m) from TR to drop location)
- Shall be accessible through common-use corridors that will allow the delivery of large cable reels and equipment and access for repairs 24x7.
- In multiple floor applications, MBTRs and TRs shall have all 4 walls vertically stacked.

MBTRs and TRs may not be inside of or be part of an Electrical equipment room, Mechanical space, Equipment room, Washroom, Storage area, Janitor closet, etc. All room locations must be approved in writing by Wright State University prior to design.

Electromagnetic interference

Rooms shall be located away from sources of electromagnetic interference. Special attention shall be given to electrical power supply transformers, motors and generators, x-ray equipment, elevator equipment, and induction devices.

Access

Access to the Rooms shall be 24 hours-per-day, 365 days-per-year basis (24x7). Access shall be through common use corridors and not accessed by way of any other room.

Design

Architectural

Size

ER and TR Rooms shall have a minimum inside dimension of 10ft. x 10ft. MBTR's shall have a minimum inside dimension of 10ft. x 12ft. If these rooms require additional square footage based on additional requirements, the size shall be determined on a case-by-case basis. Wright State University must approve all room dimensions in writing.

Walls

All four (4) walls shall be floor to deck and have a 2-hour fire rating.

Plywood backboards

All four (4) walls shall be covered with $\frac{3}{4}$ " in. fire resistance backboard as manufactured by U-Teck model number UT-501082M. To reduce warping, fire-rated plywood shall be kiln-dried to maximum moisture content of 15%. Plywood shall be painted on all 6 sides with a gray fire retardant paint. Start and Mount plywood 12" AFF.

Ceiling height

Ceilings will not be installed in these rooms. Where an existing room is renovated and may require a ceiling, consult WSU CaTS prior to design.

Treatment

Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting. Floor covering shall be a vinyl anti-static material. Color shall be determined on a case-by-case basis.

False ceiling (lay-in ceiling)

Room shall not have a false ceiling to permit maximum use of cable pathways both vertically and horizontally. In such cases where fire-proofing may be sprayed onto the exposed ceiling, the fire-proofing shall be treated to mitigate airborne dust.

Door

Doors shall be a minimum of 0.9 m (36 in) wide and 2 m (80 in) high, without doorsill, hinged to open outward (code permitting) or slide side-to-side, or be removable. Consideration could be given to using double doors with a removable center-post. The door(s) shall be fitted with a lock which is keyed for a Telecom Closet key. The door frame shall be prepped for an electric strike for a Card Access system. Refer to Standard Detail Drawing. All doors shall have a sill at the bottom to protect against dust.

Floor loading

The MBTR's shall be located on floor areas designed with a minimum floor loading of 4.8 kPa (100 lbf/ft²). The TRs shall be located on floor areas designed with a minimum floor loading of 2.4 kPa (50 lbf/ft²). The project structural engineer shall verify that concentrations of proposed equipment do not exceed the floor-loading limit.

Signage

Signage, shall consist solely of a room number sign; matching style and type of remaining building room number signs. No other signage shall be installed or used.

Contaminants

The rooms shall be protected from contaminants and pollutants that could affect operation and material integrity of the installed equipment.

Heating, Ventilation and Air Conditioning (HVAC)

Continuous operation

HVAC shall be available on a 24 hours-per-day, 365 days-per-year basis. A stand-alone unit shall be installed for Telecommunication Rooms. The MBTR shall have a minimum of 24,000 BTU of cooling and the TR shall have a minimum of 12,000 BTU of cooling.

Standby operation

The HVAC system serving both the MBTR's and the TR's shall be powered by stand-by power source.

Operational parameters

The temperature and humidity shall be controlled to provide continuous operating ranges of 18 °C (64 °F) to 24 °C (75 °F) with 30% to 55% relative humidity. The ambient temperature and humidity shall be measured at a distance of 1.5 m (5 ft.) above the floor level, after the equipment is in operation, at any point along an equipment aisle centerline.

Positive pressure

A positive pressure differential with respect to surrounding spaces shall be provided with a minimum of one air change per hour.

Vibration

Mechanical vibration coupled to equipment or the cabling infrastructure can lead to service failures over time. A common example of this type of failure would be loosened connections. If there is a potential for vibration within the building that will be conveyed to the TR via the building structure, the project structural engineer should design in safeguards against excessive TR vibration.

Other mechanical fixtures

Mechanical fixtures, control systems, or other building systems (e.g., piping, ductwork, pneumatic tubing, electrical conduits) not related to the support of MBTR or TR shall not be installed in, pass through, under or enter the MBTR or TR. In addition, the area adjacent to the exterior of the MBTR or TR walls shall remain clear for cable pathways entering the MBTR or TR.

Electrical

Lighting

Lighting shall be a minimum of 500 lx (50 foot candles) measured at the finished floor. Light fixtures shall be mounted 8.5 ft minimum above the finished floor. Light fixtures must be independently supported from the building structure. Light fixtures shall not be mounted to, or supported by the cable tray. All Lighting fixtures within the MBTR or TR shall be powered by the buildings emergency lighting circuits. Dimmer switches or occupancy sensors shall not be used

Power

General

Each MBTR shall contain a dedicated electrical panel for the MBTR and all of the TRs that will be fed from that MBTR. TRs shall be fed from the dedicated panel in the MBTR so that all outlets in all TRs are on standby power.

Panel

The electrical panel shall be dedicated to serve only the MBTR and TR's. The panel shall be fed from the building stand-by electrical power system. The panel shall be sized to accommodate the MBTR and all the TRs that will be served by it. Confirm panel location during review and design with WSU CaTS staff and WSU Electrical Engineer. The panel shall have a laser printed directory to indicate rooms and loads served by each breaker.

Telecommunication Equipment 110v Outlets

MBTR's and TR's shall be equipped with a minimum of three (3) dedicated 110V, 20A circuits. Outlets shall be NEMA 5-20R. Outlets shall be installed 18" from finished floor to center. All outlets shall have a laser printed circuit identifier affixed to it indicating the panel ID and circuit number. Wright State University may specify additional outlets on a case-by-case basis.

Convenience 110v Outlets

All MBTR's and TR's shall be equipped with (1) dedicated 20A convenience outlet for uses other than network equipment (i.e. power tools, testing equipment). This outlet shall and be gang mounted with the room light switch. All outlets shall have a laser printed circuit identifier affixed to it indicating the panel ID and circuit number. Wright State University may specify additional outlets on a case-by-case basis.

Location of power conditioning systems

Where applicable for MBTR or TR room specific use, dedicated power conditioning systems and/or UPS's shall be permitted to be installed within the room. Large units should be located in a separate room. This must be approved in writing by Wright State University prior to design.

Bonding and grounding

MBTR's shall have a TMGB installed within the room to which all TGBs in TR's, equipment, conduit, cable shields, cable trays, sleeves, etc. shall be bonded. The TMGB shall be connected to the main electrical service ground of the building reference TIA 607B for appropriate sizing of the conductors. TR's shall have a TGB installed to which all equipment, conduits, cable shields, cable trays, sleeves, etc. shall be bonded. The TGB shall be connected to the TMGB located in the MBTR. The conductor shall be continuous from the TMGB to the TGB. Reference TIA 607B for appropriate sizing of the conductor. A separately derived ground or isolated ground system shall not be permitted.

Miscellaneous Requirements

Fire protection

Fire protection of the Telecommunications Rooms, if required, shall be provided as per applicable code. If sprinklers are required within the spaces, the heads shall be provided with wire cages to prevent accidental operation. Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room. For some applications, consideration should be given to the installation of alternate fire-suppression systems, confirm applications with Wright State University.

Water infiltration

The MBTR' and TR's shall not be located below water level unless preventive measures against water infiltration are employed. The room shall be free of water or drain pipes not directly required in support of the equipment within the room. A floor drain shall be provided within the room if risk of water ingress exists. No piping or drainage piping shall be allowed in the MBTR or TR room walls. Including roof drains, water supply, sanitary drains, etc.

Cable Pathways

General

Conduits and sleeves shall extend 4- 6" into the MBTR and/or TR. If the conduits or sleeves are subject to water intrusion they must drain away from the room and be watertight. All conduits and sleeves must have the ends plugged upon installation to keep debris from entering the conduits and sleeves. Conduits and sleeves must have bushings installed at all ends and at all pull boxes. All conduits shall have a pull line installed with foot markings. Wright State University must approve all pathway designs in writing.

Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements. Telecommunications conduits shall have not more than 180 degrees of cumulative bends between pull points.

Sleeves/Conduits

Backbone Pathways

In a multi-story building where TR's are stacked to form a riser, a minimum of four (4) -4" sleeves shall be installed between the stacked TR's. All sleeves shall have applicable fire stopping applied.

Backbone Pathways Intra-building

Backbone pathways in the form of four (4)-4" conduits shall be installed between the MBTR of each building and the nearest designated maintenance man/hand hole servicing that building. Cable tray shall be used for Intra-building Backbone distribution where applicable.

Backbone Pathways Inter-building

If the TR's are not vertically stacked on top of the MBTR, backbone pathways in the form of three (4)-4" conduits shall be installed between the MBTR of the building and each TR. A pull rope with footage markers shall be installed in all conduits including each innerduct and cable pathways. In a multi-story building where TRs are stacked to form a riser, a minimum of four (4)-4" conduits shall be installed between the MBTR and the first TR in the stack.

Interior Communications Pathways

General

The Interior Communications Pathways will provide a distribution system for all system cabling that will be served by the building TRs. The pathways for a building may include all or some of the following, cable tray, conduit systems and sleeves. All pathways must be approved in writing by Wright State University prior to design completion. Interior pathway design shall follow all BICSI TDMM design recommendations and TIA568-C and TIA569-C standards.

Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements. Telecommunications conduits shall have not more than 180 degrees of cumulative bends between pull points.

Interior Pathways

Cable Tray

A continuous aluminum cable tray system shall be installed on each floor. Minimum tray size shall be 12" wide by

4" deep with 1" rungs spaced every 9". When making turns and elevation changes the appropriate tray accessories, having the proper bend radius, shall be used. For access to, and installation of, cables in the cable tray, the following clearances are required around the cable tray. The cable tray system shall have 6" min. unobstructed clearance above the cable tray measured from the top most surface of the tray. The cable tray shall have a 12" min unobstructed clearance along the side of the cable tray along its entire length. Access to the cable tray from below shall be unobstructed along its entire length. There shall be no other equipment, ductwork, lights, conduits, fixtures etc. attached to, mounted on, running through or on the cable trays that is extraneous to the support of the cable tray system. Cable tray shall not run through walls.

Conduit:

General

Sizes indicated for conduits are trade sizes in all cases.

- Conduits shall have an insulated bushings installed prior to the installation of telecommunications cabling.
- Conduit needs to run in the most direct route possible, but shall be parallel and perpendicular with building lines.
- Conduit runs shall contain no continuous sections longer than 100 feet. If runs total more than 100 feet, pull points or pull boxes need to be inserted.
- Conduit shall have not more than 180 degrees of cumulative bends between pull points and not more than 90 degrees of bends at any one point. Pull boxes shall be installed allowing a straight through installation of the cable plant only. Pull boxes shall not be installed to be used as a ninety degree turn.
- Electrical Metallic Tubing shall be electro-galvanized steel.
- Conduit must terminate on the floor where it originates allowing for the cable plant to be installed and terminated on the same floor. This would include floor boxes.
- Reference Wright State University Construction Electrical specifications for **Color identification** of all conduits.
- Reference Wright State University Construction Electrical specifications for **surface mounted raceway** specifications.

Outlet / Conduit location

New construction wall outlet

Conduit from the cable tray to a typical wall outlet should be a minimum of 1-1/4". Each 1-1/4" conduit will service only **one** wall outlet location. The conduit will be terminated in a 5" X 5" x 2.75" deep box with a pull string. The box shall be fitted with a double gang mud ring. Outlets are typically located at the following heights to center:

- Desks 18" AFF
- Wall Phones 48" AFF
- Pay Phones 48" AFF

Conduits run to the cable tray should end approximately 4"- 6" inches away from the top or bottom edge of the cable tray to maintain a proper bend radius.

Flexible conduit shall not be permitted unless prior approval has been given by WSU CaTS personnel.

New construction floor outlet

Conduit from the cable tray to a typical floor outlet should be a minimum of 1-1/4". Each conduit will service only **one** floor outlet location. Conduit must terminate on the floor where it originates allowing for the cable plant to be installed and terminated on the same floor. Confirm all floor outlets meet Fire Code and will accommodate

manufacturers jacks and outlets. **Reference** Wright State University Construction Electrical specifications for floor outlet requirements.

Renovations

For areas being renovated, the minimum requirement for horizontal wiring shall be the same as new construction. If walls cannot be accessed the university has a number of options that can be used. These will be determined on case by case basis and approved by Wright State University.

Sleeves

- Sizes indicated for sleeves are trade sizes in all cases.
- Sleeves shall have an insulated bushing installed prior to the installation of telecommunications cabling.
- Sleeves used at wall transition points for cable tray systems shall be a min. of 4". Capacity of the sleeves shall exceed the capacity of the cable tray.
- All sleeves that penetrate a smoke or fire barrier shall be Hilti Speed Sleeves.
- Bonding and grounding - All metallic conduits, cable trays, sleeves, etc. shall be bonded back to the TGB in the TR that serves cabling in that area.

270543 – UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

The Exterior Communications Pathways will provide a campus distribution system for all system cabling that will be served by the MBTR's. The pathways for a campus distribution system may include all or some of the following, maintenance man/hand holes, innerduct for both in conduits and direct buried, conduit, multi-cell conduits, All pathways must be approved in writing by Wright State University prior to design completion. Exterior pathway design shall follow all BICSI TDMM and BICSI Customer Owned Outside Plant Design Manual design recommendations and TIA568-C and 569-C standards. Wright State University must approve all final design in writing.

Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements. Telecommunications conduits shall have not more than 180 degrees of cumulative bends between pull points.

Exterior Pathways

General

Sizes indicated for conduits and Innerducts are trade sizes in all cases.

Conduit

All primary distribution conduits will be 4" trade size or larger. Conduits must have the ends plugged with a manufactured designed removable plug upon installation to keep debris from entering them. All conduit runs shall contain no continuous sections longer than 300 feet. If runs total more than 300 feet, pull points such as "Hand holes or Man holes" need to be inserted. Conduit shall not have more than 180 degrees of cumulative bends between pull points and not more than 90 degrees of bends at any one point.

All bends must be long, sweeping bends with a radius not less than six times the internal diameter of conduits 50 mm (2 in) or smaller, or ten times the internal diameter of conduits larger than 50 mm (2 in). All conduits must be cleared and free of obstructions prior to turning over to the university. All ends of conduit must be reamed and have a bell type bushing installed. All conduits entering a building must be pitched to drain away from the building to avert water intrusion. To prevent conduit shearing, conduits that enter through walls shall be metal and extend

to undisturbed earth, particularly where such backfill is susceptible to load bearing tension. Pull ropes with footage markers shall be installed in all conduits. Rigid Galvanized Steel Conduit shall be PVC coated. Reference Wright State University Construction Electrical specifications for Rigid Galvanized Steel Conduit specifications.

Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial use shall be used whenever conduit is not encased in concrete.

Heavy wall conduit: Schedule 40, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and concrete encasement shall only be used when encased in concrete.

Conduit Depth Requirements and Encasement

Top of conduit if direct buried or top of duct bank if concrete encased shall be a minimum of 36 inches below finished grade. All underground conduits where installed below vehicular traffic shall be concrete encased. Concrete shall encase the conduit 360 degrees by a minimum of 4 inches. Manufactured conduit spacers and chairs shall be used for all conduits in the duct bank whether encased or not so conduits maintain the same orientation at all points of access.

Separation From Other Utilities

Power up to 1KVA:

- 12 in. of well- packed earth
- 4 in. of masonry
- 4 in. of concrete

Gas, Oil, Water, etc.:

- 12 in. when parallel
- 6 in. when crossing

Innerducts Within Conduits

- If required will be installed by the University.

Maintenance Man Holes (MH)

General

Joint Use Maintenance Man Holes (MHs) shall not permitted. All Maintenance Man Holes (MH) shall be dedicated to the communications distribution system.

Conduit Entry Points

Conduits entering the MH are to be placed at opposite ends of a MH for a straight through pull.

Covers

- Covers shall always be round and centrally located on single- cover maintenance man holes.
- All MH frames and covers shall be rated to withstand vehicular traffic.
- For MH over 3.7 m (12 ft) long, follow these guidelines:
 - Between 3.7 m (12 ft) and 6 m (20 ft) use two covers.
 - Over 6 m (20 ft), use three covers.

Interior Hardware

All hardware in MHs must be galvanized.

MHs shall be equipped with the following:

- Bonding inserts and struts for racking.
- Pulling eyes at least 22 mm (7/ 8 in) in diameter.

- A sump of at least 200 mm (8 in) in diameter.
- An entry ladder (where feasible).

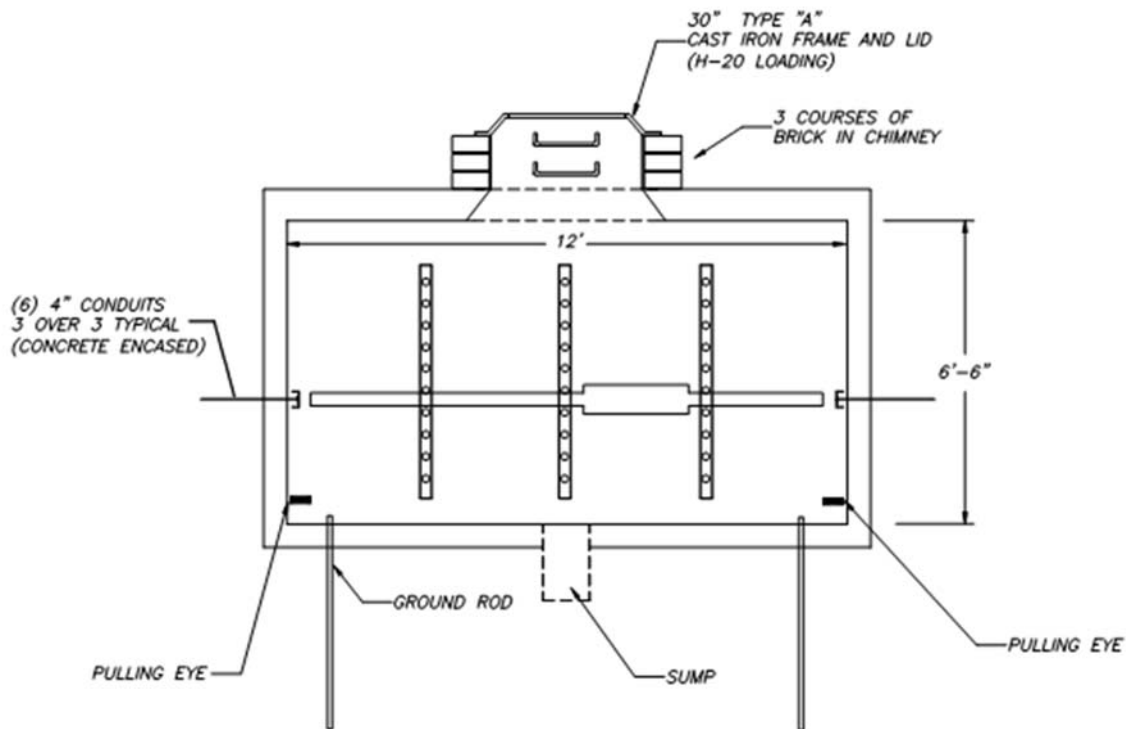
Identifying Covers

All covers shall have TELECOMMUNICATIONS pre-marked on the cover for easy identification.

Concrete Strength

The strength of concrete used for MHs shall be a minimum of 24,000 kPa (3500 psi). Stronger concrete may be stipulated in certain installations.

Figure 2 - Example of a Maintenance Man Hole



Handholes (HH)

General

Handholes (HH's) are smaller than maintenance man holes (MH's), but the covers provide full access to the entire space inside the hole. Hand holes (HH) shall be used as pull-through points only. All Hand holes (HH) shall not be used as splice points, unless specified by the project manager. All Hand holes shall not be used in conduit runs that have more than four (4) 4in conduits.

- All HH frames and covers all be rated to withstand vehicular traffic.
- Joint use HH are not permitted. All HH's shall be dedicated to the communications distribution system.
- All HH's shall have a minimum size of 24"X36". Specific applications may dictate the HH's be larger. Consult with WSU CaTS on the appropriate size for the application.

Conduit Entry Points

Conduits entering the HH are to be aligned on opposite walls of the HH at the same elevation so as to provide a straight through pull.

Identifying Covers

All covers shall have TELECOMMUNICATIONS pre-marked on the cover for easy identification.

271300 – COMMUNICATIONS BACKBONE CABLING

Backbone cabling is the media over which Voice, Video, Data, Audio, Community antenna television (CATV) signals will be transmitted to the TR's. The media used for the transmission of the signals will be copper, fiber and coax.

Backbone cables are broken into two types, inter-building and intra-building. Intra-building cabling has very strict requirements when entering a building. Cable insulation type, lightning protection and termination methods are important considerations when designing outside plant (OSP) cabling.

Sizing of backbone cabling for support of a building is directly related to the building's functions both during initial occupancy and future use. There is no generic backbone installation that will fit all applications. Design of the building's backbone cabling will be on a case-by-case basis. Generally, Optical Fiber, High Pair Count Copper and Coaxial cable will be installed for backbone applications.

Backbone cable design shall follow all BICSI TDM design recommendations and TIA568C standards. Wright State University shall approve all backbone infrastructure designs in writing prior to design completion.

A transition point will be required when outside cable plant enters a building. This location will need to be accessible to future access and construction activities. Refer to TIA568C and confirm the location and needs of this access point with the University.

271500 – COMMUNICATIONS HORIZONTAL CABLING

The following will describe the **minimum** work area outlet requirements for areas such as, a standard 8'x10' office, classroom and conference room, special locations and residents halls. The exact placement and quantities of outlets and pathways shall be approved in writing by Wright State University prior to design completion. Any deviation from this shall require written approval from the University.

Horizontal cable design shall follow all BICSI TDM design recommendations, TIA568C and TIA569C standards. Wright State University shall approve all final designs in writing.

In general, install one work station drop on each wall measuring 12'-0" in linear length. Provide additional work area outlets as required so that no "point" along the liner wall space is more than 12'-0" from a network outlet. This rule is intended to keep the network station cord from exceeding the maximum length of 10'-0" from the wall outlet to the network device.

A minimum of one duplex electrical outlet shall be installed within 16", but not closer than 8", of every work station location.

Standard office

Each office shall have a minimum of two (2) work station locations, one on each wall perpendicular to the wall that has the door in it. The work station locations should be three (3) feet from the back wall (the wall opposite from the wall with the door in it).

Classroom

Each classroom designed will vary on a case by case basis.

As a typical installation requirement. Refer to the audio visual requirements and add these notes;

- Conduits for data cabling to be 1-1/4".
- Wall phone location 48" AFF with 4" square box 2 1/8" deep with a single-gang mud ring and 1-1/4" conduit to cable tray.
- Preferred floor box is FSR FL-2000 series. Contractor shall coordinate divider & conduit layout into floor box with WSU prior to installation.

Conference room

Each conference room shall have a minimum of two (2) work area outlets. Location shall be determined on a case-by-case basis. Confer with the university for conferencing, or overhead projector applications.

Special locations

Computer rooms, labs, auditoriums, shared workspaces, and other such areas must be reviewed on an individual basis for the quantity and types of work area outlets required.

Wireless Access Point (WAP)

All wireless access point (WAP) locations shall be determined by Wright State University CaTS department and shall be done so on a case by case basis for every project. At a minimum a 1-1/4" conduit shall be installed from the cable tray to the prescribed WAP location where a 5" X 5" box shall be installed with a 2 gang mud ring flush with the ceiling.

All equipment that requires WSU network or telephone connectivity such as **Siemens automation panels, Square D power meters, Elevator control panels, Generator ATS's, etc.** shall have a 1" conduit run from the device to the nearest cable tray.

Conduits can be terminated at or in the device if there is no exposure to electrical hazards otherwise a 4" square 2 1/8' deep box will be installed inline within 4' of the devices where cabling can be terminated & accessed safely for maintenance & testing purposes.

274116.51A – INTEGRATED AUDIO-VISUAL SYSTEMS AND EQUIPMENT FOR CLASSROOMS (STANDARD LEARNING)

- A ceiling mounted video projector with a minimum output of 4500 ANSI lumens, and minimum resolution of 1280x800.
- The projection screen size is room specific.
- A teacher's station with rack rail for mounting equipment. Must have a lockable rear access door.
- A system switcher, and control system, capable of controlling the input source, volume, and video projector. This system also provides, lamp failure notifications, and can be controlled remotely via the network. Switcher will be connected to the projector via HDMI cabling.
- A Blu-Ray disc player connected via HDMI.

- Four ceiling mounted speakers with audio amplification.
- A MAC Mini computer with SSD drive, 4GB ram, running both MAC OS and Windows OS. Unit shall have HDMI output.
- Powered USB hub for external drives.
- A Smart Technologies Sympodium, or LCD monitor.
- A document camera with simultaneous USB and VGA/HDMI outputs.
- Provisions for additional laptop connection, with network.
- All Audio Visual equipment to be provided and installed by WSU-CaTS.
- All associated cabling provided by WSU-CaTS.
- Minimum of three network connections inside of the teacher's station. Please note this could require as many as five connections depending on the control equipment.
- Room shall have Tegrity lecture capture capability. The faculty shall be responsible for checking out mics and webcams.
- Install one floor box at the teacher's station location. Refer to WSU Standard Details.
- Provide and install video projector mounting pipe. Refer to WSU Standard Details.
- Install a one-inch conduit from the teacher's station floor box to a double gang box, located in the center of the rear wall. This box should be at a height of seven feet above the finished floor.

274116.51B – INTEGRATED AUDIO-VISUAL SYSTEMS AND EQUIPMENT FOR CLASSROOMS (ACTIVE LEARNING)

- Teacher's station with rack rail and lockable rear access doors.
- A system switcher, and control system, capable of controlling the input source, volume, and video projectors. This system also provides, lamp failure notifications, and can be controlled remotely via the network. Switcher will be connected to the projector via HDMI cabling.
- A Blu-Ray disc player connected via HDMI.
- A MAC Mini computer with SSD drive, 4GB ram, running both MAC OS and Windows OS. Unit will have HDMI output.
- Available external connections at the teacher's station will be: HDMI, VGA with audio, Network, and USB.
- Powered USB hub for external drives.
- A Smart Technologies Sympodium, or LCD monitor.
- A document camera with simultaneous USB and VGA/HDMI outputs
- Provisions for additional laptop connection, with network.
- All Audio Visual equipment to be provided and installed by WSU-CaTS.
- All associated cabling provided by WSU-CaTS.
- Minimum of three network connections inside of the teacher's station. Please note this could require as many as five connections depending on the control equipment.
- Distributed sound system with 70volt amplification, and appropriate type and number of ceiling speakers. System will include both wired and wireless lavalier microphones.
- A ceiling mounted video projector with a minimum of 4500ANSI lumens and a minimum native resolution of 1280 x 800 will be installed for approximately every twenty-five students. This applies in normal conditions, however physical room layout may require additional units
- Room will have Tegrity lecture capture capability. The faculty are responsible for checking out mics and webcams.
- This room will have group collaboration software, which allows the instructor to control, view, or share any of the student computers.

- Provide an AV closet within the auditorium space. This closet shall have a lockable thirty-six inch wide standard height door, which opens out. The minimum size of this room shall be four feet deep by six feet wide. This space will be used to house a Middle Atlantic WR series rack or similar.
<http://www.middleatlantic.com/enclosure/roll/wr.htm>. This closet shall have switched lighting inside. No dimming or occupancy switches shall be allowed.
- Install one floor box at the teacher's station location. The floor box should contain a dedicated 20 amp electrical circuit.
- Install (2) two-inch conduits from the teacher's station floor box to the AV rack inside the AV/ closet.
- Install (1) one and one-quarter inch conduit from the teacher's station floor box to the Telecom cable tray or closet.
- Install (1) one and one quarter-inch conduit from the AV closet rack to the Telecom cable tray or closet.
- Install two dedicated 20 amp electrical circuits in the rack inside of the AV closet.
- Install (2) one-inch conduits from the rack inside of the AV closet to above the ceiling. These conduits are to be used for a 70 volt speaker system. The conduit runs will go from speaker location to speaker location (speakers will be daisy chained). The type and number of speakers is TBD by WSU CaTS department.
- Install the necessary conduit for a wall-mounted telephone to be located on the screen wall near the teacher's station.
- Provide and install video projector mounting pipe for each video projector location. Refer to WSU Standard Details.
- Install (1) two-inch conduit from the rack inside the AV closet to each of the video projector locations.
- Provide (1) motorized projection screen (72.5" x 116"), and all required electrical connections for each video projector. The controls for these screens should be wall mounted on the screen wall near the teacher's station location.

274116.52 – INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT FOR AUDITORIUMS

- Three video projectors with a minimum of 7500ANSI lumens and a minimum native resolution of 1280x800.
- Teacher's station with rack rail and lockable rear access doors.
- A matrix switcher, and control system, capable of controlling the input source, volume, and video projector. Will have the ability to display a separate image on each screen. This system also provides, lamp failure notifications, and can be controlled remotely via the network. Switcher will be connected to the projector via HDMI cabling.
- A Blu-Ray disc player connected via HDMI.
- AA MAC mini computer with SSD drive, 4GB ram, running both MAC OS and Windows OS. Unit will have HDMI output.
- Available external connections at the teacher's station will be: HDMI, VGA with audio, Network, and USB.
- Powered USB hub for external drives.
- A Smart Technologies Sympodium, or LCD monitor.
- A document camera with simultaneous USB and VGA/HDMI outputs
- Provisions for additional laptop connection, with network.
- All Audio Visual equipment to be provided and installed by WSU-CaTS.
- All associated cabling provided by WSU-CaTS.
- Minimum of three network connections inside of the teacher's station. Please note this could require as many as five connections depending on the control equipment.
- Distributed sound system with 70 volt amplification, and appropriate type and number of ceiling speakers. System will include both wired and wireless lavalier microphones.
- Room will have Tegrity lecture capture capability. The faculty are responsible for checking out mics and webcams.
- Install two floor boxes at the teacher's station location. Each floor box should contain a dedicated 20 amp electrical circuit. These floor boxes should be located next to each other, and should be contained within the footprint of the teacher's station.
- Provide an AV closet within the auditorium space. This closet shall have a lockable thirty-six inch wide standard height door, which opens out. The minimum size of this room shall be four feet deep by six feet wide. This space will be used to house a Middle Atlantic WR series rack or similar.
<http://www.middleatlantic.com/enclosure/roll/wr.htm>
- Install (1) two-inch conduit from the floor box at the teacher's station location to each of the **three** video projector locations. These (3) conduits shall pass through an accessible box in our AV/closet.
- Install (3) two-inch conduits from the teacher's station floor box to the AV rack inside the AV/ closet.
- Install (1) one and one-quarter inch conduit from the teacher's station floor box to the Telecom cable tray or closet.
- Install (4) one-inch conduits from the rack inside of the AV closet to above the ceiling. These conduits are to be used for a 70 volt speaker system. The conduit runs will go from speaker location to speaker location (speakers will be daisy chained). The type and number of speakers is TBD by WSU CaTS department.
- Install (1) one and one quarter-inch conduit from the AV closet rack to the Telecom cable tray or closet.
- Install (2) dedicated 20 amp electrical circuits in the rack inside of the AV closet.
- Provide and install (3) motorized projector lifts that will travel from the ceiling height down to within three feet above the finished floor. Provide all required electrical connections for the lifts and the projectors. The controls for these lifts shall be located on the wall inside of the AV closet. The preferred lifts shall be as manufactured by SVS Lifts. <http://www.svslifts.com/FULLDOWN.html>
- Install the necessary conduit for a wall-mounted telephone to be located on the screen wall near the teacher's station.

- Provide and install (3) motorized projections screens (screens will be sized based on room size), and all required electrical connections. The controls for these screens should be wall mounted on the screen wall near the teacher's station location.
- The first row of lights parallel to the screen should be independently switched from the front of the room near the teacher's station.
- Install switched lighting inside of the AV closet. Dimming and occupancy sensor switches shall not be allowed.
- Install (1) one-inch conduit from the rack inside the AV closet to the center of the rear auditorium wall. The conduit should terminate into a double gang wall box on the rear wall seven feet above the finished floor.

Division 28

Electronic Safety & Security

GENERAL PROVISIONS

- At this time, WSU CaTS installs all of the Structured Cabling (Voice/Data/CATV), Phone System (Headend & Handsets), Network Electronics, WLAN (Headend and AP's) & Audio/Visual Equipment. The Contractor should only install Infrastructure (Box, Conduit & Power) to support the Owner Furnished Equipment as well as the complete Fire Alarm System.
- The Infrastructure (Box, Conduit & Power) must be designed by a RCDD (Registered Communications Distribution Designer).
- The Engineer of Record (RCDD) must have meetings early in the Design Process with the WSU PM & CaTS to discuss TRB & TR Locations as well as a general strategy for infrastructure for the project.
- This is a Wright State University, CaTS Telecommunications Design Guideline Specification Document.
- The conduit feeding the card reader location shall terminate in a 4" square box 2 1/8" deep with a single-gang mud ring 42" AFF.

280528 PATHWAYS FOR ELECTRONIC SAFETY & SECURITY

- **Enhanced security door locations**
 - a. Shall have in addition to the standard door access location a second card reader location on the interior of the door location with a separate ¾" conduit with 4" square box 2 1/8" deep with a single-gang mud ring 42" AFF.
 - b. A ¾" conduit with 4" square box 2 1/8" deep with a single-gang mud ring above the door on the exterior side for a siren.
- **(Individual Addressable Module)**
 - a. Install an IAM "Simplex fire alarm system" in the communication closet near the access control hardware for every alarm point that needs to report to WSU Police Dispatch.
- **Building Entrance**
 - a. Doors that require access control shall have at minimum the standard door access configuration, but may require additional infrastructure if the location is equipped with automatic door openers or if custom door hardware is used.
 - b. Doors that require access control will have ANSI Grade 1 electrified door hardware and operate at 24Volts DC and electrified exit devices shall have motor driven latch retraction.

Security Cameras

- **Interior**
 - a. CCTV locations shall have a bushed 1" conduit installed above accessible ceiling at the camera location to the nearest cable tray.
- **Exterior**
 - a. CCTV locations shall have a flush mounted 4" square box 2 1/8" deep at the camera location with a 1" conduit to the nearest cable tray. Final CCTV locations to be determined by WSU.
 - b. All panic buttons shall be hardwired to the Simplex fire alarm system, refer to electrical specifications.

283100 – FIRE DETECTION AND ALARM

- Within any single building, design a complete system that integrates the existing and new systems into a single system at one common location. For integration with existing systems, Contractor and Engineer must coordinate with the University Electrical Engineer. This includes connecting new equipment or systems into the Graphics Control Console (GCC) in Allyn Hall.
- All new systems shall be UL Listed and compliant with the most current editions of the Ohio Building Code, NFPA 72, and NFPA 70. Initiating devices for ventilation systems shall be compliant with NFPA 90A.
- All new systems must be demonstrated in the presence of the local Authority Having Jurisdiction, the State Fire Marshall, safety and Casualty Fire Prevention, the project manager, the University Electrical Engineer, and their designated representatives. System will not be accepted until all components and functions are in full operation and accepted by all representatives
- All fire alarm system junction boxes and terminal cabinet covers shall have 2 inch x 2.5 inch labels with red background and white letters, stating the following:

THIS BOX CONTAINS
FIRE ALARM WIRING
AUTHORIZED PERSONNEL ONLY

283111 – ADDRESSABLE FIRE-ALARM SYSTEMS

- All electronic fire alarm signaling and monitoring systems shall be manufactured or provided by Simplex.
- Every new fire panel should be Simplex 4100ES or newer equivalent. Each building shall have its own Simplex 4100ES Fire Alarm Control Panel (FACP).
- Each FACP shall contain all campus standard pre-recorded messages.
- Each FACP shall connect to the GCC in Allyn Hall via fiber optic loop. Loop shall be enclosed in red conduit.
- All alterations to the GCC shall be made with new programming and shall include new or updated floor plans.
- All devices, including detectors, initiating devices, and occupant alerting devices, must be addressable and compatible with the Fire Alarm Control Panel.
- All fire suppression system tamper and flow switches shall be addressable or made addressable with separate modules. Switches shall be tied into and monitored by the building FACP.

283143 – FIRE DETECTION SENSORS

- All fire detection sensors must be analog, addressable, and shall permit the University to adjust address, sensitivity, set point, and pre-alarm levels.
- Heat detectors shall be field-restorable, and can be either fixed temperature or rate-of-rise as required by design and code.

283146 – SMOKE DETECTION SENSORS

- All smoke detection sensors must be analog, addressable, and shall permit the University to adjust address and sensitivity.
- All smoke detectors shall be of the photoelectric type, unless specific location has a danger of rapidly-developing flaming fires.

283153 – FIRE ALARM INITIATING DEVICES

- Fire alarm initiating devices shall include, but are not limited to:
 - a. Manual pull-stations
 - b. Automatic smoke detectors
 - c. Automatic aspirating smoke detection
 - d. Automatic fixed heat detectors
 - e. Automatic rate-of-rise heat detectors
 - f. Automatic flow switches
- Pull stations shall be used as manual fire alarm initiating devices.
- All manual pull stations shall be single action with a key reset, and shall not utilize a glass rod.
- All manual pull stations shall be addressable by the Fire Alarm system. The boxes shall be colored red with a white handle.
- Within any single building, new stations shall be keyed alike, such that a single key will function for both existing and new stations
- Initiation circuits shall be zoned and separated as follows:
 - a. Manual devices (pull stations) shall report independently from automatic initiation devices
 - b. Sprinkler system flows shall report independently from all other devices
 - c. All other devices shall be zoned as required per codes and application

283163 – FIRE ALARM INTEGRATED AUDIO VISUAL EVACUATION SYSTEMS

- Audible and visual notification appliances shall be addressable, continuous alarms, horns and strobes located so that the operation of such devices will be heard and/or seen clearly in all areas regardless of the ambient level.
- Notification devices shall include, but are not limited to:
 - a. Horns
 - b. Strobes
 - c. Door releases
 - d. Fan shutdown relays
- All visual strobe devices shall be equipped with synchronized light flashes. All strobes shall be 110cd regardless of location unless otherwise required by code.
- Audible notification devices (horns) shall be speakers with multiple taps, and shall be set at the highest tap at the time of installation. All speakers shall be installed at intervals suitable to meet the NFPA intelligibility requirements.
- Temporal patterns for all audible alarms must be coordinated with the University.
- All door hold opens shall be 24 VDC.

283900 – MASS NOTIFICATION SYSTEMS

- All installed fire alarm system/FACPs must be mass notification capable.
- All components and function of the mass notification system must be listed for mass notification use and for compatibility with the FACP
- All mass notification systems must interface through and be controlled by the local Simplex 4100ES panel within each building. Each local panel must accept and transmit mass notification signals from the central FACP panel in the GCC area.
- Mass notification shall be initiated by the main microphone station/FACP within the GCC area in Allyn Hall or at a remotely controlled microphone.
- Mass notification activation shall initiate the following actions:

- a. Display action initiated on mass notification panel
 - b. Initiate the appropriate alert tone and pre-recorded or live message for the respective alert switch activated
 - c. Activate fire alarm/mass notification strobes throughout the building.
 - d. Mass notification shall have alert priority over fire alarm system. If the fire alarm is also in an active state, the fire alarm audible alarms shall stop during the mass notification messages. Fire alarm strobes may continue to flash and shall be synchronized with any mass notification strobes within building.
 - e. Mass notification signals shall not be displayed as alarm conditions. Text descriptions shall clearly indicate appropriate conditions.
 - f. Transmit the signal to the central GCC monitoring station.
- Audio amplifiers shall be installed throughout the system as required.
 - Specific mass notification/communications panel equipment to be coordinated with the University.
 - All components must be addressable and monitored by the local FACP.
 - Activation of the mass notification system shall release all magnetic hold opens within the building. Such release shall not be by zone as a chemical release cannot be detected by zoned detection devices.

Division 31

Earthwork

GENERAL PROVISIONS

- Earthwork to be completed with minimal area disturbed. All areas to be restored to original conditions.
- Refer to Ohio Environmental Protection Agency NPDES General Permit for Storm Water Discharges Associated with Construction Activity.

311000 – SITE CLEARING

- Controlled burning is not permitted, unless specifically approved by University Engineer.
- WSU will determine whether trees can be moved and replanted successfully. If feasible, that is preferred plan. Any trees that cannot be replanted on campus will have all stumps, trunks, limbs, branches, brush or other debris removed from construction area.
- Remove topsoil from the effected site prior to construction activities to reduce the potential for soil compaction and contamination. Topsoil shall be stockpiled in areas approved by the University for later use during final grading and site restoration.
- Tree protection is required around the drip line of all trees to remain within the limits of construction.

312000 – EARTH MOVING

- Utility trenches and other excavations shall be designed to limit settlement. Areas to receive pavement or other surface structures shall include engineered fill properly placed and compacted. Landscaped areas shall be dressed with approved topsoil and mulch.
- Imported fill shall be tested by certified third party testing lab for any hazardous materials.

313116 – TERMITE CONTROL

- Use only EPA approved products and methods.

Division 32

Exterior Improvements

GENERAL PROVISIONS

- All campus spaces should be designed to the same standards of full accessibility as are the University's buildings.
- Whenever possible specify pervious and semi-pervious hard surfaces to mitigate runoff.
- Graded slopes exceeding 30 degrees are not permitted.
- Areas open to unrestricted vehicular traffic should separate pedestrian and vehicular traffic to the greatest extent possible. While service routes typically used on a daily basis by University vehicles should be combined with main pedestrian paths where possible.
- Standard walkway width shall be 8 feet.
- Parking:
 - Parking lots should always be designed and treated as campus spaces, designed to collegiate standards, not suburban.
 - All parking lots shall have curb cuts every 200 feet min. around perimeter.
 - Provide curb cuts to all islands requiring mowing.
- Traffic control signage shall meet OMUTCD (Ohio Manual of Uniform Traffic Control Devices) standards.
- Curb cuts shall be 72 inches minimum.
- Light poles shall have 24" high concrete base.
- Athletic Fields:
 - All athletic field contractors will have athletic field installation experience of 3 or more years and provide 3 recent project references.
 - Provide permanent electric and water sources for all fields.
 - Assure adequate on site storage space for small and large equipment, tools, etc.
 - Provide automatic underground irrigation system.
 - Approved athletic field drainage system required for all new athletic fields.

321216 – ASPHALT PAVING

- Reference ODOT 400 – Flexible Pavement
- Asphalt access roads and cross walks are not permitted.
- Areas of ODOT Heavy duty and ODOT Light duty pavement will be coordinated with WSU.

321313 – CONCRETE PAVING

- Reference ODOT 450 – Rigid Pavement
- Locations that are expected to be used only by pedestrians, snow removal equipment and occasional police or ambulance vehicles shall be designed of Portland cement concrete as follows:
 - 4000 psi minimum comprehensive strength
 - Air entrained
 - 5" min. thickness
 - 6x6 10/10 welded wire fabric
 - 5" min. compacted granular materials base

321400 – UNIT PAVING

- Use off-the-shelf items, 2 inch thick minimum, standard stock and available locally.
- Provide concrete under pavers at locations where vehicle traffic may occur.
- Provide gravel/sand bed under pavers for pedestrian use only.
- Minimize exposure to construction trucks and equipment. If necessary, use ¾" plywood for protection.

321443 – POROUS UNIT PAVING

- Whenever possible specify pervious and semi-pervious unit paving to mitigate runoff. Careful analysis needs to be done prior to specifying porous unit paving due to clay substrate throughout campus grounds.

321713 – PARKING BUMPERS

- Not permitted

321723 – PAVEMENT MARKINGS

- Reference ODOT 640 – Pavement Marking
- All pavement marking to be hot tape or poured in place thermoplastic
- Standard parking stall size shall be 9' x 18'
- White color for student area markings
- Blue color for ADA area markings
- Yellow color for all other area markings

323113 – CHAIN LINK FENCES AND GATES

- Black vinyl coated is standard.
- Standard height 6'-0"
- Gates shall be 36" minimum wide.

329113 – SOIL PREPARATION

- Specify 6 inches of topsoil for lawn areas and 12 inches for planting areas.
- Topsoil to be provided at all areas receiving sod or planting.
- Areas to be seeded/sodded shall be cultivated to the depth of 6 inches.
- Areas that have been compacted during construction shall be cultivated 4-6 inches prior to topsoil being applied.
- All rocks, gravel, dirt and turf clods shall be removed prior to seeding.

329200 – TURF AND GRASSES

- University's standard seed mixture:
 - 40% SR 8300 Tall Fescue
 - 40% SR 8200 Tall Fescue
 - 20% Titan Fescue
- Preferred sod is Green Velvet "Sports Mix" by Green Velvet Farms, Bellbrook, Ohio. Preparation and installation shall be in accordance with ODOT item 660 material specification.
- Sod and turf to be planted within 24 hours of delivery.
- Seeding is not permitted, unless approved by the University.
- No irrigation/watering will be provided to plantings beyond first year.

- Grades shall not exceed 15 degrees.

329300 – PLANTS

- All plant materials shall be approved by University prior to installation.
- No irrigation/watering will be provided to plantings beyond first year.
- Priority shall be given to native drought-resistant species.
- Specify trees with 2" min. trunk.
- Provide 20' min. clearance between large trees and light poles.
- Provide 10' min. clearance between large trees and sidewalks.
- Follow ANSI Standards A300, Parts 3, 5 and 6 for tree care practices standards.
- Any plants found on the Invasive plant list from Ohio Department of Natural Resources (<http://ohiodnr.com/tabid/2005/Default.aspx>) are prohibited from campus.
- Open, grassy areas of the campus should be planted in a park like manner with 80% high canopy shade trees and 20% in evergreen and ornamental trees.
- At least 80% of the tree plantings in the core campus should be composed of "best" campus trees. The best campus trees for WSU include:
 - White Oak
 - Red Oak
 - Dogwood
 - Red Bud
 - White Ash
 - Tulip Poplar
 - American Beech
 - Kentucky Coffee Tree
- At least 80% of the deciduous shrubs in the core campus should be composed of the following:
 - Shrub Roses
 - Beauty Berry
 - Viburnum
 - Spirea
 - Hypericum
- At least 60% of the Evergreen shrubs in the core campus should be composed of a following groups:
 - Blue Holly – for edges
 - Littleleaf Boxwood – for edges
 - Juniper - for slopes only
- Develop flowers in association with permanent planting areas and strictly limit to important arrival or gathering areas for visitors and students.

329500 – VEGETATED ROOF ASSEMBLIES

- Extensive Green Roof – existing structures.
- Intensive Green Roof – new structures.
- Provide leak detection system.
- Consider rain water collection for irrigation.

Division 33

Utilities

331116 Site Water Utility Distribution Piping

- Underground water piping distribution system shall be designed in conformance with the most current edition of the City of Fairborn construction and material specifications, except as noted in this section.
- Piping 3"-size and smaller shall be Type K copper, ASTM B88, with silver brazed joints. Joints shall be held to a minimum.
- Piping 4"-size and larger shall be genuine ductile iron conforming to ANSI/AWWA C151/A21.51, Class 53. Fittings shall be 250 lb. pattern ductile iron, ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Pipe and fittings shall be bitumastic cement lined, ANSI/AWWA C104/A21.4. Pipe and fitting connections shall be mechanical joint or "push-on" compression type joint with rubber ring gasket, ANSI/AWWA C111/A21.11.
- Piping 4" and larger may, at the contractors' option, be PVC (polyvinyl chloride) pressure pipe with bell and spigot joints utilizing a double seal locked in gasket. Class 305, DR14, meeting AWWA C900 and NSF 61.
- Valves, fittings and Joints shall be restrained with wedge-action, self-actuating mechanical joint restraint fittings, concrete trust blocks, or a combination restrained joints and thrust blocking.

331119 Fire Suppression Utility Water Distribution Piping

- See 33 11 16.

331216 Water Utility Distribution Valves

- Underground service valves 2"-size and smaller shall be UNS/CDA No. C89833 alloy construction, AWWA C800 (ASTM B-62 and ASTM B-584), approved to ANSI/NSF Standard 61, Annex G (372), non-directional and is watertight with flow in either direction, 300 PSI working pressure.
- Underground service valves 4"-size and larger shall be resilient seat gate type, AWWA Standard C-509, non-rising stem, with cast iron body, bonnet and wedge, 175 lb. working pressure, coated interior and exterior with fusion bonded epoxy (AWWA C550 and NSF 61), opening by turning left. Right hand opening valves are expressly forbidden.
- Valves shall have a square or tee head for wrench operation. Valve rotation, direction and size of head shall conform to Water Department and responding Fire Department standards.

- A three-piece cast iron screw type valve box with cover marked with the valve number (provided by University) shall be provided with each underground valve. Valve box shall be installed with top raised 8" above finished grade, with 1 cubic foot of concrete formed round and poured around curb box.
- Post indicator valves shall include a free standing vertical indicator with adjustable two-piece stem housing section, glassed-in position indicator, removable wrench and locking device, finished bright red.

331219 Water Utility Distribution Fire Hydrants

- Fire hydrants shall conform to AWWA C502, with nozzles and threads conforming to Fairborn Fire Department standards UL listed and FM approved, traffic model breakaway type . Each nozzle shall have a chain-secured threaded brass cap. Furnish a hydrant wrench for each hydrant. Basis of design is American Flow Control, "American-Darling".
- Fire hydrants shall be installed with a service valve and valve box. Pipe and fitting at the base of the hydrant shall be mechanical joint anchoring type so as to not require a concrete thrust block.
- The "drain-to-ground" opening in the fire hydrant barrel shall be plugged to prevent entrance of ground water.

331300 Disinfecting of Water Utility Distribution

- Thoroughly flush the system prior to disinfection. Disinfection shall be performed by qualified personnel in accordance with the Local Authorities prescribed method, or when a Local Authority prescribed method is not available, in accordance with AWWA C651 Standards. Disinfection shall be by means of a chlorine solution injected into the water system. Each outlet shall be tested to prove presence of minimum chlorine concentration. Document that adequate levels of chlorine are present in each pipe section. Following the appropriate retention period, flush out the system with clean water until the residual free chlorine content is equal to the level approved by the Health Department.
- Perform a bacteriological analysis of the water system. Provide certification stating the name of the lab performing the testing, the job name, the date of the sample and results of the testing. Copies of the lab reports shall be given to the University.

333313 Utility Area Drains

- Materials: Catch basin lids and frames shall be cast iron construction, heavy duty, with removable lid.
- Trench and inlet grating, catch basins and curb inlets shall be Americans with Disabilities Act (ADA) compliant and bicycle safe.
- Trench and inlet grating, catch basins and curb inlets shall be selected and designed with attention to how the Americans with Disabilities Act (ADA), vehicle loading, pedestrian traffic and bicycle traffic affect the placement of products. The ADA, as it relates to grating, requires that grates in walking surfaces have slot

openings 0.5" or less in one direction. Grates with elongated opening shall be placed with long dimension perpendicular to the dominant direction of travel.

- The above considerations shall not affect the ability of a grate to intercept storm water or its hydraulic efficiency.

335113 Natural Gas Piping

- Underground steel pipe shall be Schedule 40, A120/A53, ASTM A-120, Type F, or ASTM A-53, Type F for 4"-size and smaller. For 5"-size and larger,, ASTM A53, Type E, Grade B, Schedule 40. All pipe shall be black steel with factory applied plastic coating. Joints shall be welded and wrapped with asphaltum type tape. Provide isolation fittings and cathodic protection for each underground piping system.
- Cathodic protection shall include minimum of 2 test station, maximum 300 feet apart, in plastic curb box and grade.
- Plastic Pipe shall be high density heavy wall plastic piping with two No. 12 TW single strand, single conductor, copper tracer and lead wires together with plastic curb boxes and terminal blocks. Joints and fittings shall be fusion welded.
- Above ground piping shall be Schedule 40, A120/A53, ASTM A-120, Type F, or ASTM A53, Type F, Grade B black steel pipe. Joints in 1-1/2 inch and smaller pipe may be screwed. Fittings, class 150 lb. banded, malleable iron, black. Use of bushings is prohibited. Weld joints in pipe 2 inch and larger.
- Underground valves shall be plastic ball valve, 125 psi, molded polyethylene body with butt or socket fusion ends and square operating head, or lubricated plug valve, Iron body, 200 psi, threaded or flanged ends, lubrication fitting shall be designed and placed for easy access thru the valve box.
- Valve box to grade with wrench extension and cover marked "GAS" shall be provided with each underground valve. Valve box shall be installed with top raised 8" above finished grade, with 1 cubic foot of concrete formed square and poured around curb box.
- Above ground valves shall be lubricated plug type, ball type, consistent with service size and listing. All above grade valves shall include a locking feature.
- Qualification Program: Any contractor performing natural gas installation, modification or repair work on the WSU campus must be qualified to work on natural gas piping and show proof of such qualification before performing any work. Qualifications shall be in accordance with all current rules and regulations outlined in 49 CFR 192.

335133 Natural Gas Metering

- Gas supply to buildings shall be metered for new buildings and major additions and renovations. Meters shall be temperature and pressure compensated when installed upstream of the building pressure regulator and subject to varying supply pressure. Pressure compensating devices shall maintain meter accuracy.
- Meters shall conform to the requirements and policies of the utility system providing the gas and AGA. Meter shall be located outside of the building. Meter installations inside the building shall not be

permitted unless specifically pre-approved by the University. Venting pipes shall be vented to the outside of the building.

- Remote registers shall be provided when the meter location prevents direct reading of the meter register from a standing position on grade or finished floor. Remote registers shall be installed at 4' to 5' above grade or finished floor. Remote registers shall be compatible with the installed meter, shall be from the same manufacturer, and shall have a straight reading odometer type display.
- Meter shall provide one set of dry contacts that give a pulse output for every 10 cubic feet of usage recorded by the meter. No batter powered registers, including remote registers, are permitted.
- Easy access shall be provided to meters for maintenance, repairs, and meters shall be flanged and valved to permit convenient replacement of metering.



DESIGN STANDARDS VARIANCE REQUEST FORM

(Please Type or Print)

Submittal Date:	Project Name:
Prepared By <i>(firm)</i> :	Project Number:
Address:	
Contact:	Project Manager:
Telephone:	Telephone:
Email:	Email:

Design Standards Reference:

(List specific item(s) section, division and paragraph from the Design Standards. Limit one issue per Request.)

Variance Request:

Basis for Variance Request:

(Explain rationale, constraints, alternatives and why variance will not compromise the project's quality. Evaluate the impact on the life of the affected building components. Document and discuss impact on the project's initial constructability and cost, long-term effects and continuous building operations costs. Attach additional information on separate pages as needed.)

Documentation of Need:

(Attach supporting information, drawings/sketches to illustrate key issues, background data, photographs or catalog sheets that substantiate the need for this variance.)

Submit to: Project Manager - Wright State University