Ohio School Facilities Commission

Design Manual Update

2013

OHIO FACILITIES CONSTRUCTION COMMISSION

April 8, 2013

Ohio School Facilities Commission
2013 Design Manual Update
On behalf of OSFC staff

Dear Commission:
The Ohio Schools Design Manual continues to be changed to accommodate current needs, new products, changes in the construction industry, and changes in teaching methods. In preparation for these changes, input from designers, agencies, OSFC staff, construction managers, and vendors has been collected, discussed, and considered. You will find here a summary of the changes made for the 2013 addition of the manual.

Planning:

1. Added an emerging trend in educational program delivery known as Blended Learning. In 2012, Governor Kasich signed into law the Blended Learning Model Section 3301.79(J)(I) and 3302.41 of the Ohio Revised Code. The Student Centered Learning Environments section of the Design Manual was renamed "High Performance Learning Environments" and modified to include definitions, processes, planning tools for traditional, student centered, and blended learning environments.
2. Added to the Teacher Prep Area a flexible Teacher Collaboration Space to encourage teachers to interact with their colleagues and to free up classroom space for other programs. When a Teacher Collaboration Space is selected, the Teacher's Desk is also removed from instructional areas.
3. Reviewed the Program of Requirements and made minor updates.

Materials and Systems:

1. The necessity of air barriers and a thorough approach to eliminating air infiltration/exfiltration is improved and language added to systems diagrams requiring proper sealing of all openings and penetrations.
2. The relationship between air barriers and vapor retarders is clarified. Numerous systems diagrams are clarified to emphasize these points.
3. The need for a minimum of two offset layers of roof insulation is strengthened.
4. Foil faced rigid insulation is added to the materials for insulation and sheathing, and sealing of insulation joints with tape or foam strengthened.
5. Cellulosic Fiber was eliminated as an insulating material.
6. Vented nail base insulation for high slope shingle and metal roof systems is eliminated after thorough research.

7. Some complete envelope systems are eliminated:
   a. metal panel on metal framing (walls).
   b. high-slope shingle roofed systems incorporating un-insulated attics (roofs).
   c. metal roof systems where attics are un-insulated.
   d. metal roof systems with batt insulation.
8. Flexibility in choice of structural systems is encouraged as a way to better accommodate changes in planning brought about by student centered learning spaces.
9. Concrete curing and moisture testing are clarified and improved to help eliminate problems with low VOC adhesives for floor finishes.
10. In-situ probe testing for concrete slab relative humidity is added.
11. Sections regarding the masonry wall mock-up are changed to require penetrations by all trades.

HVAC:

1. Exception to the requirement for air-side economizer has been expanded from only Water Source Heat Pumps to any system that utilizes Dedicated Outside Air Units.
2. Requirement for airside energy recovery has been generalized to be considered for any system that provides more than 30% outside air rather than indicating any system serving educational spaces. This allows for additional strategies such as Demand Control Ventilation without also requiring energy recovery.
3. The use of electric resistance heating is discouraged for heating hot water, especially when natural gas is available. OFCC Review Team has encountered numerous instances where heating water is available and nearby, but electric heating is provided.
4. Flow capacity of heating water pumps has been relaxed to allow the Design Professional more flexibility in the selection and optimization of the system. Requirement previously required operating/standby pumps for any system below 300 gpm and lead/lag pumps at 50% flow each for any system above 300 gpm.
5. Central Cooling Plant description has been revised to provide more flexibility on chiller selections while seeking optimized performance.
6. Quantity, selection, and flow capacity of heating water pumps has been revised to allow multiple chilled water pumps without requiring Locally Funded Initiative (LFI). Requirements are similar to heating water pumps.
7. Commercial kitchen Type I and Type II hood systems larger than 5,000 cfm shall have variable-speed control for exhaust and makeup air fans to reduce hood airflow rates at least 50 percent during those times when cooking is not occurring and the cooking appliances are up to temperature in a standby, ready to cook mode.
8. Central Heat Rejection System for Water Source Heat Pumps has been revised to recognize either cooling tower/fluid cooler or Hybrid Geothermal Bore Field. Hybrid systems are recommended in order to minimize the quantity of bores to that of the lesser dominant load; supplemental equipment shall be provided for the difference in capacity of the borefield and the dominant load.
9. Heating Water Plan for Water Source Heat Pumps has been revised to Central Heat Absorption System in order to recognize either boiler or Hybrid Geothermal Bore Field. Hybrid systems are recommended in order to minimize the quantity of bores to that of the lesser dominant load;

supplemental equipment shall be provided for the difference in capacity of the borefield and the dominant load.

10. Recommendation to include recirculation/return dampers in Dedicated Outside Air Units so that units can be utilized during morning warm-up/ morning cool-down.
11. Approval for Dual Duct Variable Air Volume System has been added back into the Design Manual.
12. Chilled Beam and Variable Refrigerant Volume Systems are recognized and described in the Design Manual. However, because OFCC is still evaluating operations of these systems in completed schools, these systems will still require Variance Requests.
13. Air handler filter minimum MERV ratings have been revised to a range for the final filter. Not all projects seek Indoor Environmental Quality Credit 5 – Indoor Chemical and Pollutant Source Control, which requires a minimum MERV-13.

Electrical:

1. Incandescent lighting options have been removed from the manual. Options have been changed to fluorescent and/or LED.
2. Parabolic lens type fixtures have been removed from the Design Manual for Computer Classrooms.
3. Color temperature has been revised to all fluorescent and LED lighting to provide a range rather than a minimum.

Technology:

1. Revised LAN data cabling standard to be Category 6, to support higher bandwidth and upgraded POE+ ports on network switches.
2. Revised the Wireless Local Area Network (WLAN) to emphasize the need for high density, ubiquitous coverage, throughout educational spaces. This is a continuation from 2012 WLAN revisions, recognizing the requirements for a high performing wireless system throughout the school for today's exploding 1:1 and BYOD environment.
    a. Requirement added to prepare the WLAN for the pending 802.11ac standard.
    b. Requirements added for Mobile Device Management and App Management.
    c. Predictive Analysis Modeling during design to include 2.4 Ghz and 5.0 Ghz.
    d. Remaining educational spaces (computer labs) revised to be totally wireless.
3. Highlighted the need for the Technology Design Professional to coordinate the design with the District's unique requirements for on-line testing. This is in light of the State wide on-line testing, which Districts need to have proper infrastructure support.
4. Requirement added to Telephone Systems for E-911 location down to the room level.
5. Digital Signage parameters clarified as an Optional technology for limited use within the building.
6. Highlighted the need for the Technology Design Professional to analyze requirements to provide an Emergency Responder Radio Coverage System.
7. CCTV Surveillance System migration to all IP based completed, with removal of any CCTV analog systems.
8. Increased all Technology System Warranties to 3 years. This acknowledges the District's need to have longer term of support for the extensive amount of technology being provided through-out all school buildings.

9. Increased Training requirements of major technology systems to include more hours with guidelines on training activities and schedule. This acknowledges common feedback from Districts regarding lack of well-defined and timely training for pertinent staff.

Career-Technical:

1. Reviewed and revised the Career Technical Education section, Program of Requirements, and space plates to apply program name changes and identifying code updates.

Costs:

1. OSFC developed a list of suggested OSDM changes to the review for potential cost impact analysis. The list was pared down from 83 potential suggested changes for this year.
2. There were 6 suggested changes that were identified as "optional" and 10 suggested changes identified as "required" in which a cost impact analysis was performed for 2013.
3. Five of the suggested changes did have a cost impact. Based on the current market conditions and applied inflation factor, the overall cost per square foot for new construction has been adjusted for these line items for the 2013 OSDM.
4. The Regional Cost Factors for the 2013 OSDM have been adjusted due to current market trends in different regions of the stat based on labor and material cost data.
5. The Non-Construction Cost percentages for the 2013 OSDM have not been adjusted overall, but have been redistributed across the categories to better reflect actual values by individual category.
6. There were 17 cost updates to the Assessment Cost Guidelines for 2013.
7. Allowances for Swing Space and Reprogramming were reevaluated for the 2013 OSDM. Cost changes were minimal based on current market pricing.
8. An annual inflation factor of 2.47% has been applied to the new square foot costs indicated in the 2013 OSDM.

A. OSFC and BLENDED LEARNING ENVIRONMENTS (BLE)

This section titled **"BLENDED LEARNING ENVIRONMENTS (BLE)"** is intended to be used in conjunction with the Ohio School Design Manual to provide guidance for the development of a Blended Learning Environment. These planning concepts **may** be implemented by the district to assure that the instructional mission, vision, goals, and objectives of the district will be met today and into the future. The following section is intended to be an **optional** choice for Ohio school districts in the development of their physical facilities as a response to Blended Learning Environments. A district desiring pursuance of an OSFC co-funded BLE facility will be **required** to follow and complete each step in the Planning Process section. As with all sections in the Ohio School Design Manual, this section will continue to be developed over time, respond to educational trends, and be updated annually.

In September 2012, section 3301.079(J)(1) and 3302.41 of the Ohio Revised Code (ORC) became effective. Section 3301.079 defines "Blended Learning as the delivery of instruction in a combination of time in a supervised physical location away from home AND online delivery whereby the student has some element of control over time, place, path, or pace of learning." Section 3302.41 stipulates the use of a blended learning model. In response to the law changes and the Ohio Department of Education's requirement to revise operating standards on Blended Learning Environments, The Ohio School Facilities Commission examined concepts associated with building Blended Learning Environments and the physical space implications. The following BLE model definition and physical characteristics are in response to the law changes to provide a clear definition of a Blended Learning Environment's physical characteristics and the development of an educational specification to achieve the building of Blended Learning Environments.

B. BLENDED LEARNING ENVIRONMENT MODELS

Blended learning is defined as any time a student learns at least in part at a supervised brick and-mortar location away from home and at least in part through online delivery with some element of student control over time, place, path, and/or pace. Concepts within a Blended Learning model can include removal of a traditional grade level system to emphasis of subject mastery, changing student teacher ratios to a maximum of 1:125, reducing traditional school day durations, reduction in minimum school year.

While Blended Learning is still in its infancy, six distinct delivery models have evolved. As delivery models vary, so does each school district and their distinct solution and adaptation of a Blended Learning Environment. The delivery models below are merely examples of models that should be studied, redeveloped, and redefined, so that each district specific Blended Learning Model delivery accommodates their needs.

1. Face-to-Face Model
   - Instructors deliver most of their curriculum face-to-face. Online learning is used on a case-by-case basis to supplement or remediate content, often in the brick and mortar facility.
2. Rotation Model
   - Within a given course, learners rotate on a fixed schedule between learning online in a one-to-one, self-paced environment and sitting in a classroom with a traditional face-to-face instructor. Within a Rotation Model there are 4 distinct models defined as;
     - o Station-rotation model
       Within a given course or subject students rotate on a fixed schedule among learning modalities in a learning area. The rotation includes at least one station for online learning.
     - o Lab-rotation model
       Within a given course or subject students rotate on a fixed schedule among locations on the traditional campus. At least one of these spaces is a learning lab for predominantly online learning, while other areas house other learning modalities.
     - o Flipped-classroom model
       Within a given course or subject students rotate on a fixed schedule between face-to-face teacher-guided practice on campus during the standard school day and online delivery of content and instruction of the same subject from a remote location after school.
     - o Individual-rotation model
       Within a given course or subject students rotate on an individually customized, fixed schedule among learning modalities, at least one of which is online learning.

3. Flex Model
   - An online platform delivers most of the curriculum. Instructors provide on-site support on an as-needed basis through in-person tutoring sessions and small group sessions.
4. On-line Lab Model
   - An online platform delivers the entire course in a brick-and-mortar facility. These programs usually provide online instructors. Often learners that participate in an online-lab model also take courses in a traditional facility.
5. Self-blend Model
   - Learners choose to take one or more courses online to supplement their traditional facility curriculum. The online learning is always remote, but the traditional learning is in a brick-and-mortar facility.
6. On-line Model
   - Involves an on-line platform and instructor that delivers the entire curriculum. Students work remotely for the most part with occasional face-to-face check-ins. Extracurricular activities can be offered in a brick-and mortar facility.

C. CHARACTERISTICS OF EDUCATIONAL INSTRUCTION IN BLENDED LEARNING ENVIRONMENTS

Blended Learning represents a shift in instructional strategy. Just as on-line learning represents a fundamental shift in the delivery and instructional model of distance learning, blended learning offers increased levels of integration with computer mediated instructional elements into the traditional facility learning and face to face learning environments.

Blended Learning Environments should:

- support self-directed learning
- provide for individual and small group instruction
- encourage problem-solving for individuals and teams
- promote socializing among participants
- encourage learner discovery
- allow instructor's guiding learning
- provide ubiquitous technology and media access in ALL forms
- support on-line learning and discovery
- allow for continuous assessment of learners knowledge and mastery level

BLE's share the same requirements of spaces as SCLE's and should contain a variety of spaces such as:

- collaborative large group spaces
- project spaces
- niche spaces for individuals and small groups
- individual study spaces and work stations with storage
- science / discovery areas
- break-out spaces
- reconfigurable labs for science, art, and project activities
- learner display / formal - informal presentation spaces
- combined music, art, performance and dance labs or studios
- wellness and physical education beyond traditional contest basketball only gymnasium spaces
- outdoor learning spaces
- varied food service and dining areas throughout the entire facility
- common spaces serving as multi-purpose and multi-function spaces
- welcoming entries
- indoor and outdoor connectivity
- facilitator spaces
- school and community connectivity and shared spaces

HIGH PERFORMNNCE LEARNING ENVIRONMENTS
BLENDED LEARNING ENVIRONMENTS (BLE)

CHECKLIST

A. INTRODUCTION

This section provides information and checklists for the development of a BLE. It is to be used in conjunction with the planning process and planning concepts section.

As a result of BLE's having both "on-site" and "off-site" learning, the traditional Program of Requirements (POR) requires modification to aid in the planning and reviews of BLE's. With the Ohio Revised Code implementation of blended learning models, it is possible to reduce the actual physical facility size while continuing to provide required instruction to the same number of students as a traditional learning environment. It is also possible to reduce the school day duration while learners are "off-site" in a rotation model.

BLE project budgets are developed in the same manner as traditional facilities. The number of students served (based upon enrollment projections) times square foot/student (based upon grade configuration and number of students) times cost per square foot (based upon regional cost tables). BLE project costs must be no greater than traditional facilities, serving the same number of students.

The maximum size of gymnasiums will be based upon total students served and any reduction in academic, administrative, student dining, food service, or building services area cannot be used to increase the size of gymnasiums.

With the variety of spaces within a blended learning facility, and the potential reduction in face-to-face time using blended learning concepts, it is possible to develop a learning environment with less square footage than what is required by a traditional facility. The OSFC will entertain flexibility between square footage and cost per square foot provided the traditionally calculated budget is not exceeded. Request for a reduction in square feet will be reviewed on a case-by-case basis.

The BLE should be planned, developed, designed, and implemented with the learner as the focus of all decisions, direction, and planning initiatives. It should be understood that no "one size fits all" solution exists. Solutions should be flexible, encourage the ability for lifelong learning, and support group, individual, team, and collaborative activities. While every effort should be made to encourage educational facility planning, design, and direction to support the BLE, the facilities will be required to address the guidelines included in the following checklist section. The Educational Specifications along with each phase of the design document diagrams, formal notice to the department of education, as stipulated in the revised Ohio Revised Code, including addressing checklist items, will be the basis for all phases of CM and OSFC review and approval.

B. CHECKLIST

The following items should be addressed, and included, as a part of the educational facility planning process. Additionally, the following checklist may be used as an outline for educational planning and becomes a part of the deliverable documents including the districts specific responses, comments, or direction associated with each item. A POR should be developed after determination of square footage required as a result of identifying impact of each item contained on the following checklist;

- LEARNERS
  - Requirements for advancement
  - Requirements for graduation
  - Ubiquitous access to technology
  - Access to guidance / counseling
  - Number of learners housed by grade level
  - Number of learners "off-site" and duration of time "off-site" each day/school year
  - School day duration
  - School year duration

- SPECIAL EDUCATION
  - Services
  - Space

- OHIO DEPARTMENT OF EDUCATION
  - Adherence to published standards
  - State testing requirements
  - Time frame for implementation
  - Long range plans

- STUDENT / TEACHER RATIOS
  - 1:125 maximum
  - Space / square footage implications

- TECHNOLOGY
  - Plan for student access to devices
    - District supplied
    - Student supplied
  - Available bandwidth and electrical power
  - On-line content
  - Ubiquitous access to technology

- OFF-SITE OPPORTUNITIES and POLICIES
  - Internships
    - Grade level(s)
    - Number of students
  - Post secondary option
    - Students travel / professors travel
    - Grade level(s)
    - Number of students
  - Early graduation
    - Grade level(s)
    - Number of students
  - Student travel / transportation policies

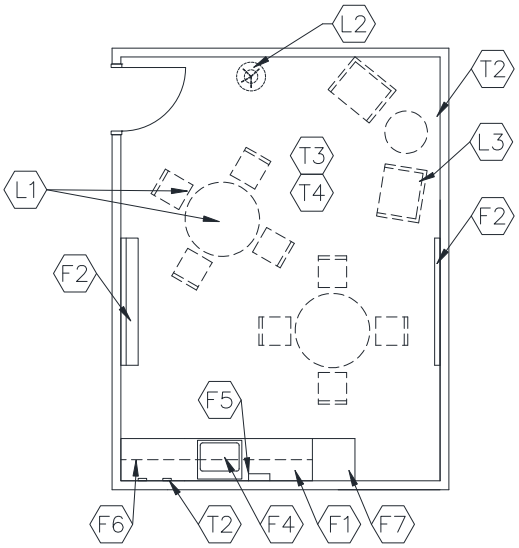
- CURRICULUM
  - Core competencies
  - Grade level model
  - Delivery model selected
  - Competency and skills based model
  - Credit based model
  - Instruction materials and equipment
  - Scheduling

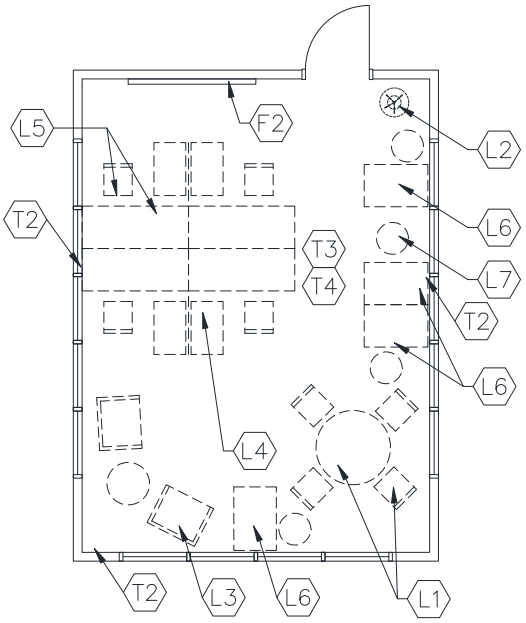
- SCHOOL DAY
  - Additional content / day
  - Length of school day

- SCHOOL CALENDAR YEAR
  - Minimum school day exemption

- STAFF
  - Teacher licensing and certification
  - Administrator training
  - Other professional personnel
  - Supervision

- SCHOOL POLICIES
  - Written
  - Admission of pupils
  - Transportation





CAPACITY: ***4 - 8 teachers***
SIZE: ***150-300 SF***

PROGRAM ACTIVITIES:

- Teachers and other staff members hold team meetings and prepare for class
- Professional interaction should be encouraged to improve communication, professional development, and team building.
- ***Collaboration of grade level grouped or subject grouped instructors.***
- ***Collaboration spaces should support the exchange of ideas, remain instantly flexible, and provide an area for both individual study and group collaboration.***

SPATIAL RELATIONSHIPS:

- Near academic core classrooms
- Near individual restroom
- Near instructional material storage

ENVIRONMENTAL CONSIDERATIONS:

- Environmental sound control -
  wall minimum STC 45
  ceiling minimum CAC 35, NRC 0.70
- ***Transparent walls or windows to adjacent rooms***

Collaboration Note:

- ***Collaboration is the vehicle by which individuals communicate their vision, desires, opinions, thoughts, and insight to their fellow colleagues. It is the means to address all aspects of the educational process, themes of focus, professional and personal relationships, and to build the camaraderie and teamwork to meet the ever changing educational needs of students of all ages.***

NOTES:

1. Loose furnishings shown represent one of many possible arrangements.
2. Depending upon the educational program of the district, a tall wardrobe may be located in this teacher prep area/workroom or could be placed in a classroom.

FINISHES[1]:	Spec. Ref.#
Flooring:	
Carpet, carpet tile, ET, linoleum, sheet vinyl, or rubber	096816 096500 096516 096813
Base:	
Resilient base	096500
Ceiling:	
Suspended, acoustical	095113
Walls:	
Paint	099100

LOOSE FURNISHINGS:

L1 Tables and chairs
L2 Coat Rack
L3 Soft Seating
L4 Teacher computer trucks
L5 Teacher workstation furniture and chair
L6 42" high teacher cabinet with work surface top
L7 Stools
Wastebasket

Miscellaneous:

Copier by school district

E1 Reserved

FEATURES[1]:		Spec. Ref.#
Fixed Items:		
F1	About 6' of base cabinets	123550
F2	***50-75 s.f.*** combination marker board, tack board and tackable wall surface	101100
F3	Reserved	
F4	3' sink base cabinet	123550
F5	Towel dispenser (optional)	102813
F6	About 9' of wall cabinets	123550
F7	Tall Wardrobe	123550
Fire Suppression:		
	Fire suppression system	211000
Plumbing:		
	Sink	224000
	Plumbing connections	224000/221116/221119
HVAC:		
	Supply/return air system	Div. 23
	Independent temperature control	230923
Electrical:		
	Single-level switching	262726
	Fluorescent lighting	265100
	Illumination level: See Table 8600-5	
	3 duplex receptacles	262726
	Double duplex receptacle adjacent to each data and video port	262726
	Duplex receptacles for office equipment	262726
	Receptacle for copier (if applicable)	262726
Communications:		
T1	***Reserved***	
T2	***voice ports with phones***	271513/273123
T3	***Wireless access point cable above ceiling***	***271513***
T4	***Wireless access point (WAP) as determined by design – refer to note 3***	***271533***
	Central sound system	275123
	Clock	275313
Electronic Safety and Security:		
	Life safety devices per code	283111

NOTES:

1. Finishes/Features: Refer to Chapter 9 for specification references.
2. When collaboration area is selected, teacher computer trucks are provided in lieu of teacher desks in classrooms.
3. Baseline includes WAP cable. WAP device quantity/placement per 272133 requirements.

A. APPLICATION

1. All wall to roof conditions

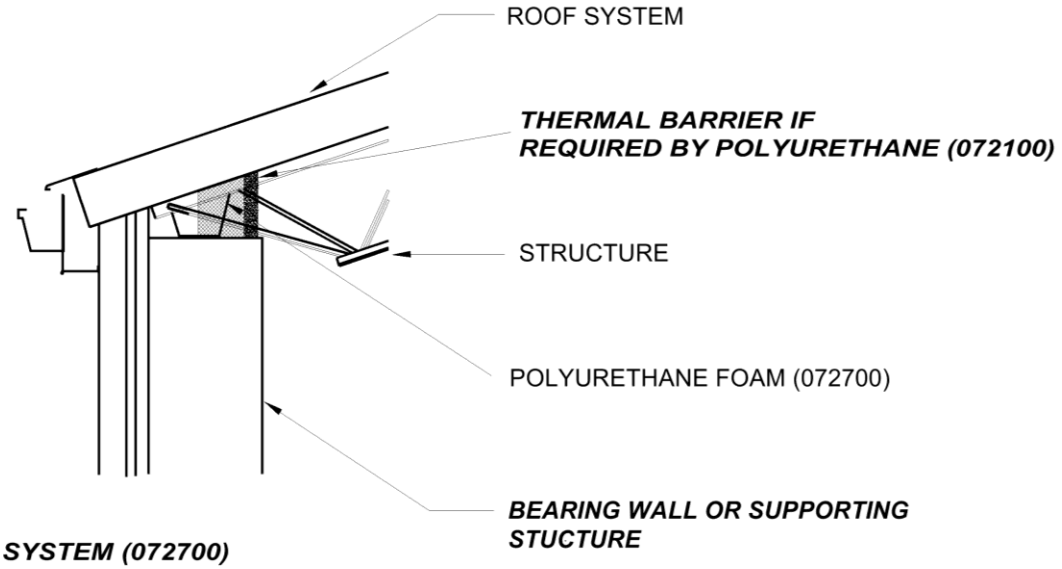
B. COMPONENTS

1. Roof and Wall Systems – selected by Design Professional
2. Structural System – selected by Design Professional
3. Sprayed-On Insulation
4. Thermal Barrier ***if required by insulation***
5. ***Air Barrier System***

C. PERFORMANCE

1. Foam seal all roof/wall intersections (low wall, high wall, rake wall) and all openings and penetrations, ridges and valleys to provide a continuous air barrier. Provides a continuous seal against infiltration.

Provide continuous air barrier system to seal juncture of walls and roofs



Recommended Exterior Wall/Roof Closure
Figure A-1

A. APPLICATION

1. Steep Roofing
2. Slope - Minimum 4:12
3. Hip roofs require special consideration

B. COMPONENTS

1. Roof Membrane
   a. Shingles
   b. Underlayment
   c. Nailable sheathing

2. Roof Insulation
   a. Rigid insulation

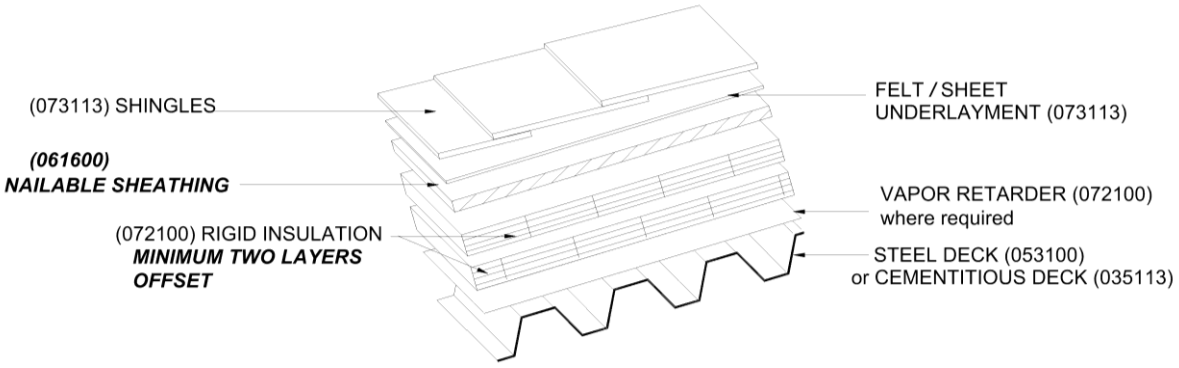
3. Vapor Retarder
   a. Where required. Refer to Chapter 9.

4. Structural Support
   a. Steel deck or cementitious deck

5. Air Barrier System Required

C. PERFORMANCE

1. Features
   a. Detail roof/wall and roof plane intersection and all openings and penetrations to provide a continuous air barrier system.



Shingle Roof System
Figure A-1

1.6 EXAMINATION

A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by ***flooring and adhesive*** manufacturer***(s)***. ***Conduct two tests for every 1000 sq. ft. of concrete slab: one for moisture transmission from the surface of the concrete and one for internal relative humidity of the concrete slab.***

a. ***Test concrete slabs*** according to ASTM F 1869, Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subflooring Using Anhydrous Calcium Chloride. 3 pounds of water/1000 sq.ft. of slab in a 24-hour period is generally accepted in the linoleum floor covering industry as a safe maximum moisture emission level***, but must be verified against the flooring and/or adhesive manufacturer's specific requirements for the product to be used.***

b. Test concrete slabs according to ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes. 75% - 85% internal relative humidity is generally regarded as acceptable, but must be verified against the flooring and/or adhesive manufacturer's specific requirements for the product to be used.

LESSONS LEARNED

2.1 Manufacturers caution against using excessive amounts of liquid during maintenance procedures. Maintenance solutions that are abrasive or that measure more than 10 pH may damage linoleum.

2.2 Products generally have a factory-applied finish that provides temporary protection during installation. After installation, manufacturers typically recommend an initial application of two or three coats of liquid polish to seal the surface. Verify the recommendations of manufacturers for the products selected. Liquid floor polish is generally used for linoleum floor covering applications instead of paste wax.

2.3 Review concrete curing methods specified to confirm that liquid curing compound is dissipating type.

2.4 In renovations require removal of all residual adhesives to clean bare concrete by shot blasting concrete slabs to receive linoleum flooring.

2.5 A below-slab vapor retarder and conditioning the space to its design level for temperature and humidity with the permanent mechanical system prior to moisture testing and flooring installation will provide the best conditions for a successful installation.

END OF SECTION

1.03 CENTRAL PLANT VARIABLE AIR VOLUME SYSTEM WITH FAN-POWERED REHEAT TERMINALS (cont'd)

8. Dry-Bulb controlled economizer for the building shall be controlled globally from the main temperature control computer. As the dry-bulb temperature of the building return air rises above the dry-bulb temperature of the outside air, the entire building shall be placed into economizer mode. Return air temperature sensors shall be included for each air handling unit. Provide an outside air enthalpy high limit to end the economizer cycle if the outside air enthalpy exceeds the limit set point.

9. Graphic screens shall be included for each air handling unit, boiler plant, cooling plant, VAV terminal unit, and floor plan.

10. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals" for additional temperature control requirements.

1.04 WATER-SOURCE HEAT PUMP SYSTEM

A. Central Heat Rejection

1. Cooling Tower or Fluid Cooler: Induced draft (cross-flow) or Forced draft (counter-flow)

a. Cooling towers shall be located at the rear of the building or on the roof. If roof mounting is selected, vibration isolation methods must be utilized. Coordinate final location of cooling tower with any outside air intake louvers. Tower shall be no closer than 30 feet from the nearest intake louver.

b. Cooling towers shall be sized to maintain heat pump condenser water temperatures during a design day with ambient wet-bulb temperatures equal to the 2 1/2 percent design wet-bulb value. This value is different than the Mean Coincident wet-bulb value.

c. Cooling tower water temperatures shall be selected with the heat pump condenser water temperature to obtain maximum efficiency.

d. Capacity reduction methods for cooling towers, such as multiple fans, 2-speed fans, variable frequency drives, inlet dampers, mixing valves, or dump valves, shall be used to maintain tower water temperature during partial load conditions. If a variable frequency drive is used on the cooling tower fan, an interlock wire between the remote disconnect and the VFD shall be installed to shut down the drive if the disconnect is turned off.

e. A remote tank capable of holding the water for the cooling tower system shall be provided below the cooling tower level within a tempered space. If a remote tank is not possible, heat tracing must be provided for all piping exposed to freezing weather and the sump of the cooling tower.

f. The cooling tower water circulation pumps shall be sized to maintain the design water flow through the cooling tower system. All pump components shall be suitable for cooling tower systems.

g. The cooling tower water treatment system shall include a makeup water connection through a back-flow preventer and shall be automatic to prevent scaling, corrosion, and bacterial growth.

h. The cooling tower water system shall be separated from the heat pump condenser water system by a plate and frame heat exchanger.

2. Hybrid Closed-loop Geo-thermal borefield

a. A life cycle cost analysis shall be submitted for approval by the Ohio School Facilities Commission. The life cycle cost analysis shall include any extra site acquisition costs and a site variance request (if applicable). Life cycle cost shall be compared with AHSRAE 90.1 (most recent as adopted by OBC or USGBC), appendix G for the various systems.

b. Borefield shall be a hybrid design, sized to handle the less-dominant load between heating and cooling. Supplemental heating (boiler) or cooling (tower or fluid cooler) shall be included to handle peak loads above the capability of the borefield. It is not the intent for the system to include both supplemental heating and cooling.

c. Design Professional shall utilize computer simulation sizing software to determine the quantity of bores.

d. Design Professional shall make adequate provisions for freeze protection based on design water temperatures. Propylene glycol should be considered for heating design values below 40°F.

e. Refer to 1.04, Paragraph K for additional guidelines.

B. Central Heat Absorption

1. Heating Water Boilers

a. A minimum of 2 heating water boilers shall be provided.

1) Gas-fired, forced draft boiler

2) Gas-fired, atmospheric boiler

3) Fuel oil boiler

4) Dual-fuel (fuel oil and gas) boiler

5) Electric boiler

6) Gas-fired, high efficient, forced draft boiler

b. A combustion air system for each boiler shall be installed to meet the intent of the code. The HVAC Design Professional must provide a means for preheating the incoming air or maintaining a minimum of 55 degrees Fahrenheit within the boiler room area.

Control of the dampers shall be through the direct digital control system and will include dampers and control for the water heater system.

2. Hybrid Closed-loop Geo-thermal borefield

a. A life cycle cost analysis shall be submitted for approval by the Ohio School Facilities Commission. The life cycle cost analysis shall include any extra site acquisition costs and a site variance request (if applicable). Life cycle cost shall be compared with AHSRAE 90.1 (most recent as adopted by OBC or USGBC), appendix G for the various systems.

b. Borefield shall be sized to handle the less-dominant load between heating and cooling. Supplemental heating (boiler) or cooling (tower or fluid cooler) shall be included to handle peak loads above the capability of the borefield.

c. Design Professional shall utilize computer simulation sizing software to determine the quantity of bores.

d. Design Professional shall make adequate provisions for freeze protection based on design water temperatures. Propylene glycol should be considered for heating design values below 40°F.

e. Refer to 1.04, Paragraph K for additional guidelines.

3. Total heating capacity shall be approximately 130 percent of the building design load minus the total heat pump heat of compression plus the heat loss of the exterior closed loop fluid cooler (where applicable).

C. Heat Pump Condenser Water Circulation System

1. Temperature of the heat pump condenser water loop shall range between 60 degrees Fahrenheit and 90 degrees Fahrenheit. An exception to this noted range would be loop temperatures as low as 35 degrees Fahrenheit for ground-source water systems. Below 40 degrees Fahrenheit design water temperature, a glycol solution shall be specified to protect the equipment. Design professional must verify that equipment is designed to and rated for the condenser water loop temperature.

2. Heat shall be introduced to the heat pump condenser water loop using a three-way temperature control valve connection to the supplementary heating loop.

3. The heat pump condenser water distribution system shall make use of a reverse return or direct return piping arrangement. Direct return systems shall use automatic flow controllers for water balancing.

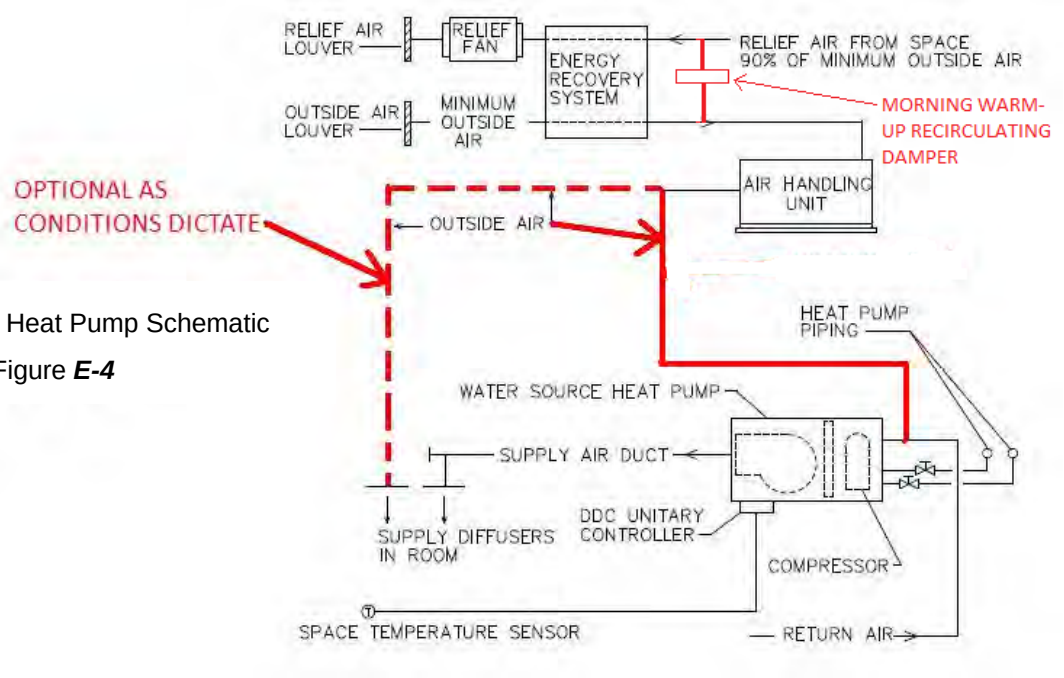
4. A minimum of 2 pumps shall be used for water circulation to the building heat pump condensers. It is recommended to use 2 pumps, each sized ***between 50-75*** percent of the total system flow ***at 100 percent design*** pressure.

1.04 WATER-SOURCE HEAT PUMP SYSTEM (cont'd)

e. An outdoor, air-cooled condensing unit piped to a refrigeration coil in each air handling unit will be provided with the equipment or located as near the mechanical unit as possible and shall be controlled through the direct digital control system. Or as part of a packaged, indoor ventilation make-up air unit, the condenser may be water cooled and the unit may have an integral hot gas reheat coil.

f. The ventilation unit is to dehumidify the ventilation air to the level indicated in item c., above. Ventilation air dehumidification is not to be handled at the terminal heat pump level.

g. A return/recirculation damper shall be located in the air handler to allow unit operation during morning warm-up / cool-down. Unit shall revert back to 100 percent outside air operation when building enters occupied mode.



Water Source Heat Pump Schematic

Figure ***E-4***

2. Dual Technology 100 Percent Outside Air Handling Units

a. Unit shall be configured similar to that described in a. above. However, shall incorporate both a total enthalpy energy wheel and a desiccant dehumidification wheel. The capacity of the Desiccant wheel shall be controlled by either space or return air humidistat modulating face and by-pass dampers at the desiccant wheel.

b. Desiccant regeneration air shall be pulled from the exhaust air stream and shall be heated by gas or electric source.

1.07 CENTRAL PLANT WITH DISPLACEMENT VENTILATION SYSTEMS (cont'd)

2. Each occupied space in the building shall include space temperature control.

3. Zones shall be placed into occupied/unoccupied mode through the temperature control computer.

4. Variable volume air handling units shall provide air to match a discharge air temperature set point from the temperature control computer. Small, direct-expansion cooling systems shall be controlled from a return air set point in lieu of discharge air set point.

5. Single zone air handling units shall be controlled from a space-mounted temperature sensor. Space-mounted or return air humidity sensors shall be included in the event reheat is included for humidity control of gymnasiums and student dining. A return duct CO2 sensor shall be provided for large single zone variable occupancy systems utilizing demand ventilation control.

6. Through the temperature control system, it shall be possible to reset the space temperature sensors to a night setback temperature of 55 degrees Fahrenheit for heating to reduce energy consumption.

7. During unoccupied hours, the air handling unit shall cycle as required to maintain night setback temperatures.

1.08 *CENTRAL PLANT VARIABLE AIR VOLUME SYSTEM WITH DUAL-DUCT VARIABLE VOLUME TERMINALS*

A. Central Heating Plant

1. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals"

B. Central Cooling Plant

1. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals"

C. Air Systems

1. Variable Air Volume Air Handling Units

a. This system requires the use of blow-thru heating and cooling air handling units. Air handling units should be located strategically throughout the building to distribute cooling air and heating air to terminal units. Locations of air handling units can be dedicated mechanical rooms or mechanical decks. Air handling units may not be located exterior to the building.

b. Each air handling unit shall include the following components as a minimum: supply air fan, cooling coil, heating coil, and filters.

c. Supply air temperature distributed to the terminal units shall be designed for a cold duct temperature of 55 degrees Fahrenheit and a hot duct temperature of 95 degrees Fahrenheit or as required by the computer-generated building load output data.

d. Each air handling unit shall include a variable frequency drive for the fan motor to adjust the air volume available to the

1.09 SYSTEMS FOR SMALL ADDITIONS TO EXISTING BUILDINGS (cont'd)

3. Central Heating Plant
   a. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals" of this section.

4. Central Chilled Water Plant
   a. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals" of this section.

5. Other systems required to complete the project such as kitchens, etc. shall follow applicable requirements of this section.

6. Unit Ventilator Temperature Controls
   a. Units shall be a single zone VAV unit with modulating fan speed, economizer, face and bypass dampers, a heating coil and serpentine cooling coil.
   b. Start-Stop – optimal start, morning warm-up and cool down shall be provided thru the digital control system.
   c. Minimum outside air shall be under control of a demand control ventilation sequence to maintain the CO_2 level in the room to less than 700 ppm above outside air condition.
   d. A zone (one sensor for each room) humidity sensor shall override the system off mode if the humidity in the space is greater than 60% RH for more than 8 hours.
   e. The fan speed, economizer, face and bypass dampers, heating, cooling coil valves and dehumidification mode shall be controlled in sequence from a room-temperature and humidity sensor and unit mounted CO_2 sensor.
   f. Economizer shall be enabled when the outside air temperature is below 65 degrees F. and the outside air enthalpy is below 30 BTU/LB.

1.10 RECOGNIZED HVAC SYSTEMS REQUIRING SUBMISSION FOR VARIANCE APPROVAL

A. Alternate HVAC systems not specifically identified in this manual may be considered for inclusion in the building design through a Design Manual Variance Request. Systems identified in this section have been approved on a case-by-case basis with other districts.

B. Active Chilled Beams
   1. Central Heating Plant
      a. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals"

   2. Central Cooling Plant
      a. Reference "Central Plant Variable Air Volume System with Hot Water Reheat Terminals."

1.10 RECOGNIZED HVAC SYSTEMS REQUIRING SUBMISSION FOR VARIANCE APPROVAL (cont'd)

i. The chilled beam water pumping system shall be enabled when ambient temperatures rise above 50 degrees Fahrenheit during occupied hours.

j. The temperature control system shall prevent the return water temperature from dropping below the required temperature allowable at the boilers.

k. All air handling units shall be controlled to cycle during unoccupied hours in order to prevent space relative humidity in excess of 60 percent. Systems will shut down when the relative humidity falls below 55 percent. 100% Outside Air Units shall include recirculation dampers for operation during unoccupied hours without the need to open outside air dampers.

C. Variable Refrigerant Flow/Variable Refrigerant Volume

1. Variable refrigerant flow (VRF) is an air-conditioning system configuration where one outdoor heat pump condensing unit is connected to multiple indoor evaporator fan coil units.

a. VRF systems should be located strategically throughout the building and zoned to handle areas with similar occupancy schedules.

b. Outdoor units should be selected with a capacity of not less than 125% of the connected indoor unit capacity.

c. Design Professional shall investigate whether the VRF systems should include heat recovery to allow independent temperature zones to be in heating or cooling mode while the outdoor unit responds to the dominant load of the overall zone. It is recommended to include heat recovery unless all temperature zones within the system have a similar internal load profile and envelope exposure (i.e. all north facing classrooms).

1) For systems without heat recovery, the automatic switchover time from heating to cooling of the outdoor unit shall not exceed 30 minutes.

d. Refrigerant piping should be extended from outdoor unit to all indoor units. Design Professional shall consult manufacturer requirements for maximum length of refrigerant circuit and minimum length before first branch take-off.

2. Ventilation Air Systems

a. Reference "Water Heat Pump System"

3. Classroom Fan Coil Units

1) Fan coils shall be located above accessible corridor ceilings, arranged together on a mechanical deck or other appropriate locations. Units will not be permitted over classroom ceilings due to difficulty servicing while school is operating. Ceiling cassette units are not acceptable.

FINISHES[1]:	Spec. Ref.#
Flooring:	
Linoleum,	096516
ET, sheet vinyl, rubber,	096500
resinous flooring,	096723
polished concrete flooring, or	033510
or colored concrete finishing	033519
Base:	
Resilient base, or integral vinyl cove base	096500
Ceiling:	
Suspended, acoustical	095113
Walls:	
Paint 099100	

LOOSE FURNISHINGS:
- L1 Chairs
- L2 Bench
- L3 Mobile costume rack
- Wastebasket

FEATURES:	Spec. Ref.#
Fixed Items:	
F1 6'-16' of costume storage cabinets	123550
F2 Towel dispenser (optional)	102813
F3 4'-8' of tack board	101100
F4 3' sink base cabinet	123550
F5 8'-13' of work surface	123550
F6 48" high makeup mirrors - full length of work surface	088300
F7 2 minimum 20" wide x 60" high dressing mirrors	088300
F8 Shallow wall cabinet for makeup (optional)	123550
F9 Coat hooks	102813
Fire Suppression:	
Fire suppression system	211000
Plumbing:	
Sink	224000
Plumbing connections	224000/221116/221119
HVAC:	
Supply/return air system	Div. 23
Independent temperature control	230923
Electrical:	
Fluorescent lighting: overhead	265100
Fluorescent or LED lighting: over makeup mirrors	265100
Illumination level: See Table 8600-6	
Single level switching	262726
2 duplex receptacles	262726
Duplex receptacle at each makeup station under mirror	262726
Telecommunications Grounding	270526/260526
Communications:	
Clock	275313
Student Dining/Auditeria sound system	275121
Central sound system	275123
Electronic Safety and Security:	
Life safety devices per code	283111
Miscellaneous:	
N/A	

NOTES:
1. Finishes/Features: Refer to Chapter 9 for specification references.

1.5 MODULAR JACKS

A. Each 4-pair 100-ohm UTP data cable shall be terminated in an eight position, modular jack at the Work Area (WA).

B. The data cable shall be terminated directly to the modular jack with insulation displacement connectors.

C. The modular jack shall be a minimum of ***Category 6*** compliant and 6a compliant for wireless solution.

D. The modular jack pair/pin assignments shall be T568B.

1.6 COVER PLATES

A. Plates shall be modular, front-loading and colored to match the video/data wall plates.

B. All plate colors shall be coordinated with the architect to match furnishings and fixtures.

C. Wall mounted phones shall utilize 630 style faceplates.

1.7 HORIZONTAL CABLE

A. In accordance with ANSI/EIA/TIA 568B.2 all horizontal data cable shall be:
   1. UL listed, 4-pair 100 ohm, UTP, ***Category 6 / Category 6a (wireless)*** compliant
   2. Conductors shall be 24 AWG, solid bare annealed copper.
   3. Cable shall be insulated with FEP material.
   4. Cable shall be NEC CMP rated.

B. Cable shall be sequentially marked at 2-foot intervals.

C. Cable pairs shall be color coded:
   1. Pair 1- White/Blue and Blue.
   2. Pair 2- White/Orange and Orange
   3. Pair 3- White/Green and Green
   4. Pair 4- White/Brown and Brown

D. Provide horizontal voice / data cable drops for:
   1. Administrative Computers
   2. Bulletin Board System
   3. CCTV Cameras (as required)
   4. Classroom and Lab Computers
   5. Desk top phones
   6. Distance Learning Systems
   7. Door Phones (as required)
   8. Electrical Closets
   9. Elevator Phones
   10. Energy Management Systems (EMS)
   11. Fax Machines
   12. Fire Alarm Systems
   13. HVAC Equipment

1.4 SYSTEM WARRANTY

A. ***The Wireless Network Electronics and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warranty with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.***

1.5 WIRELESS NETWORKING

A. GENERAL

1. Design Wireless System for full building coverage and to assure coverage for ***ubiquitous high density coverage for an average of 15-20 users per AP in educational areas and standard high density coverage throughout the remainder of the building, as per parameters in this specification.***
2. Design Wireless System with 30% growth factored.
3. Design shall allow for additional bandwidth growth and shall be capable of limiting the bandwidth used by each device
4. Design shall provide for multi-state radios that can be switched from 2.4GHz to 5GHz
5. System shall allow bandwidth limits and time of day restrictions to be placed on particular users or particular device types
6. System shall allow network administrators to set QoS parameters for different traffic types
7. Provide 802.11n Wireless Access Points, management software and associated Wireless Network Controller(s), to support wireless Network Devices and Phones throughout the building and the associated campus. ***Provide upgrade path to 802.11ac.***
8. Provide a CAT 6A horizontal data cable drop for each AP. Terminate the AP Cable drop on a Patch Panel at the associated Telecommunication Room (TR).
9. Connect the AP to the IP Network via an IEEE 802.3af Power Over Ethernet (POE) 1 Gbps Switch Port.
10. Coordinate 802.31x, VLAN and Security Settings/Requirements with the District.
11. Shall provide proper network authentication and authorization
12. Security shall have the ability to check antivirus software
13. Wireless network management shall utilize the same firewall, NAC, and RADIUS as the LAN
14. System shall allow different user groups to be created with each group mapped to specific VLANS, access control list, and QoS parameters
15. System shall provide device fingerprinting identifying devices operating systems such as iOS, Microsoft Windows, Blackberry, or Android and shall classify the device type such as tablet, laptop, or smartphone.
16. Once the system has identified the device, a policy can be applied to control a device's reach and behavior
17. The device ID along with the user ID shall be used together to map that instance to a specific user group
18. Provide Wireless coverage for the entire building and associated perimeter area.
19. Provide minimum of -65 dB signal level at all locations in building for 802.11n coverage.
20. Provide a minimum of 7 Mbps throughput per user.
21. Technology Designer shall verify quantity of users with the District.

J. The specification of Technology Equipment (computers, A/V displays, etc.) that have the Energy Star label is preferred, when applicable.

K. The Technology Designer shall coordinate specific requirements of extended learning areas (ELAs) with the School District. As a minimum, provide access to the data network and one (1) video port for each ELA.

L. The Technology Designer shall verify with the School District during the Programming Phase if they will be implementing any special technology applications or interfacing with third party entities (i.e. hosting or cloud computing solutions) that would affect the Technology or Facility Design.

M. The Technology Designer shall submit required technical data validating the WLAN design to achieve ***ubiquitous high-density coverage throughout the building*** with the technology phase submissions. Refer to Section 27 21 33 for requirements.

N. The Technology Designer shall coordinate with other Design Professionals adequate dedicated rooftop space to accommodate current or future system antennas.

O. The Technology Designer shall coordinate with the District regarding their on-line testing assessment procedures and policies. This is to ensure that the technology design and infrastructure will meet the District requirements.

1.02 TECHNOLOGY SYSTEMS

A. Each OSFC Construction Project for new and remodeled facilities shall provide the baseline Technology systems. Additional non-baseline (optional) systems shall be added based on budget limitations.

B. The Technology Designer shall design the following required Technology Systems for all new and remodeled buildings. Refer to the OSDM sections listed below for additional information:

1. COMMUNICATIONS – DIVISION 27

   a. Section 27 05 26 -- Grounding and Bonding for Communications Systems.

   b. Section 27 11 00 -- Communications Equipment Room Fittings.

   c. Section 27 13 13 -- Communications Copper Backbone Cabling.

   d. Section 27 13 23 -- Communications Optical Fiber Backbone Cabling.

   e. Section 27 15 13 – Communications Copper Horizontal Cabling.

   f. Section 27 15 43 -- Audio-Video Communications Horizontal Transport System.

   g. Section 27 21 00 -- Data Communications Network Equipment.

   h. Section 27 21 33 -- Data Communications Wireless Access Points.

2) The system shall consist of remote call-in stations in the areas of refuge (typically stairwells) and a master station. The system shall also provide telephone connections to the master station for access to 911.

3) Note that this system is listed under optional systems category, as it typically would not be installed as a baseline system. It is listed here to advise the Technology Designer to verify building requirements with the Project Architect, to determine if it is a code required system and integrate with the telephone system accordingly.

j. ***Emergency Responder Radio Coverage***

1) The OBC requires approved radio coverage for emergency responders within the building.

2) Note that this system is listed under optional systems category, as it may or may not be required based on several factors.

3) The Technology Designer needs to determine compliance methodology with the Design Professional and AHJ during initial project phases.

END OF SECTION

SECTION 272100

DATA COMMUNICATIONS NETWORK EQUIPMENT

GENERAL GUIDELINES

1.1 GENERAL

A. This Section defines the general design requirements for a uniform Data Communications Network Infrastructure that shall be followed for all OSFC Technology construction projects.
   1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

A. DATA COMMUNICATIONS NETWORK EQUIPMENT
   1. File/Building Server – optional.
   2. Network Switches.
   3. Network Core Switch.
   4. Network Security Equipment.
   5. Uninterruptible Power Supplies (UPSs).

1.3 QUALITY ASSURANCE

A. All equipment shall be UL listed.

B. All equipment and Installation Practices shall comply with the latest BICSI® Telecommunications Distribution Methods Manual (TDMM).

1.4 SYSTEM WARRANTY

A. ***The Local Area Network Electronics and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warranty with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.***

1.5 GENERAL

A. Each Building shall be provided with a Local Area Network (LAN) System.

B. Existing Facilities that are being remodeled shall be upgraded to the current requirements stated herein.

C. Single Building projects shall be compatible with the existing District Network infrastructure.

1.14 TRAINING

A. Provide a minimum of ***forty (40)*** hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:
   1. System Equipment Connectivity
   2. Device Configurations
   3. Operation, maintenance, and upgrade procedures.

B. Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).

C. Training to occur in maximum of 2 hour increments per personnel or groups of personnel.

D. Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.

E. Training shall be by certified manufacturer instructor.

F. Training schedule shall be coordinated with District personnel and their needs.

G. Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.

H. Warranty certificate and agreement shall be provided to District IT personnel at initial training session.

I. Provide a digital video copy of the training sessions.

END OF SECTION