# Ohio School Facilities Commission

## Design Manual Update

2012

**Ohio School Facilities Commission**
10 West Broad Street, Suite 1400
Columbus, Ohio 43215

*John R. Kasich*
Governor

*Richard M. Hickman*
Executive Director

**TO:** OSFC Members

**FROM:** Design Manual Update Committee

**RE:** 2012 Design Manual Update

Since the development of the Ohio School Design Manual in 1997, hundreds of facilities have been designed, constructed, renovated and occupied using this manual. The manual is a guide to provide quality standards and flexible guidelines for use by the commission, school districts, design professionals, and construction managers. All buildings must conform to the USGBC's "LEED for Schools" and obtain a silver or higher rating.

The update committee has upgraded, added and revised some items, working from a list of over 115 items pertaining to architectural, structural and mechanical. Separate planning and technology professionals have added significantly to the update.

A. Summary of Significant Changes

**1. Planning/Site**

a. Warning issued to not use materials that can be used as projectiles at exterior locations.
b. The "Maintenance Plan Advisor" (MPA) role will no longer exist. Some MPA responsibilities and duties will transfer to the Commissioning Agent.
c. Chapter 1020 updated to include reference to information supporting the passage of House Bill 153 to allow changes to the construction delivery methods known as Ohio Construction Reform or OCR.
d. OCR options are described and compared.
e. The design professionals, construction managers, and commissioning agents will be selected jointly by the state and school district.
f. Under Student Centered Learning Environment (SCLE) based facilities, square footage may be less than traditional, but overall costs must not exceed traditional facilities.

g. Under SCLE planning process templates are provided for District use.
h. Clarified use of vertical circulation factor on Program of Requirements.
i. Developed summary check sheets including gymnasium size seating and parking.

**2. Structural and Materials and Systems**

a. Provide fixed, permanent ladders for access to all low-sloped roof areas.
b. Wood windows are acceptable.
c. The air space in vented asphalt shingled roofs shall be 2 inches (minimum).
d. The building's air barrier system shall be inspected by the Air Barrier Association of America (ABAA).
e. The building air tightness requirements are stated. Uninterrupted air barrier around the building is required.
f. For all gymnasiums, the clear height from floor to nearest obstruction is fixed.
g. Membrane roofs shall be "solar ready."
h. The masonry mock-up requirements are expanded to include window.
i. Loose furnishings for students must meet the Consumer Product Safety Act that regulates lead in coatings.

**3. Plumbing and Electrical**

a. "Multipress" black iron gas piping is acceptable.
b. Location distance for sanitary sewer cleanouts was clarified.
c. Concrete, exterior lighting poles are added.

**4. HVAC**

a. Building systems shall maintain the building relative humidity below 60% RH, including summer months, to inhibit mold growth.
b. Allow expansion tank for ground source system to apply for supplemental heating system in lieu of separate expansion tanks in a combined system.
c. Remove unit ventilators as an approved system.
d. Provide a verbal clarification for heat exchanges in water- or ground-source heat pumps.
e. Identified three locations to align filter performance to the same requirement.
f. Clarify minimum performance requirements for energy recovery devices.

g. Add verbiage to allow multiple pumps for chilled water systems, not to exceed minimum requirement for heating water systems. Baseline is still one distribution pump for chilled water systems.
h. Remove "under slab" from requirement for use of polypropylene piping.
i. Maintain the option of combining condensing and near-condensing boilers at design professional's discretion as long as condensing boiler included and scheduled to operate during partial heating loads.
j. Revise HVAC Water Treatment specification to include chemical-free water treatment systems as an available design alternative.

**5. Technology**

a. Removed the 4 wired student drops in each classroom. Requirements added to provide a 10G Wireless Network (WLAN), capable of supporting 1:1 (or BYOD).
b. Added Cat. 6a cable to serve all WAP's. Cat. 6a above ceiling cable to each classroom included in baseline.
c. Requirements added for technology designer to utilize WLAN design software during design phase for proper design of 1:1 WLAN.
d. Additional requirements included for WLAN post installation systems tuning and optimization by the Contractor.
e. Added requirements for Design Professional and Technology Designer to coordinate rooftop space requirements for various systems antennas.
f. Removal of Broadband Coax System (backbone and horizontal cabling).
g. Expanded requirements for all A/V sources to be digital and routed via the network.
h. Revised classroom A/V System wiring to include UTP Solutions.
i. All classroom projectors changed to ultra-short throw, interactive projector type.
j. Removal of interactive whiteboards.
k. Quantity of portable media carts changed from two (2) to one (1).

**6. Career Technical**

a. Several Program name changes.
b. Manufacturing occupations have been deleted.
c. All space plates are updated with each program code in addition to the subject code.

**7. Costs**

a. OSFC developed a list of suggested OSDM changes to review for potential cost impact analysis. The list was pared down from over 100 potential suggested changes for this year.

b. Several of the suggested changes were identified as "optional" and a cost impact analysis was performed. There were no suggested changes identified as "required" for 2012.

c. While several of the suggested changes did have minor cost impact, based on current market conditions and the applied inflation factor, overall cost per square foot for new construction was not adjusted for these items for the 2012 OSDM.

d. The Regional Cost Factors from the 2010 remain unchanged in the 2012 OSDM.

e. The annual inflation factor of 2.62% has been applied to the new square foot costs indicated in the 2012 OSDM.

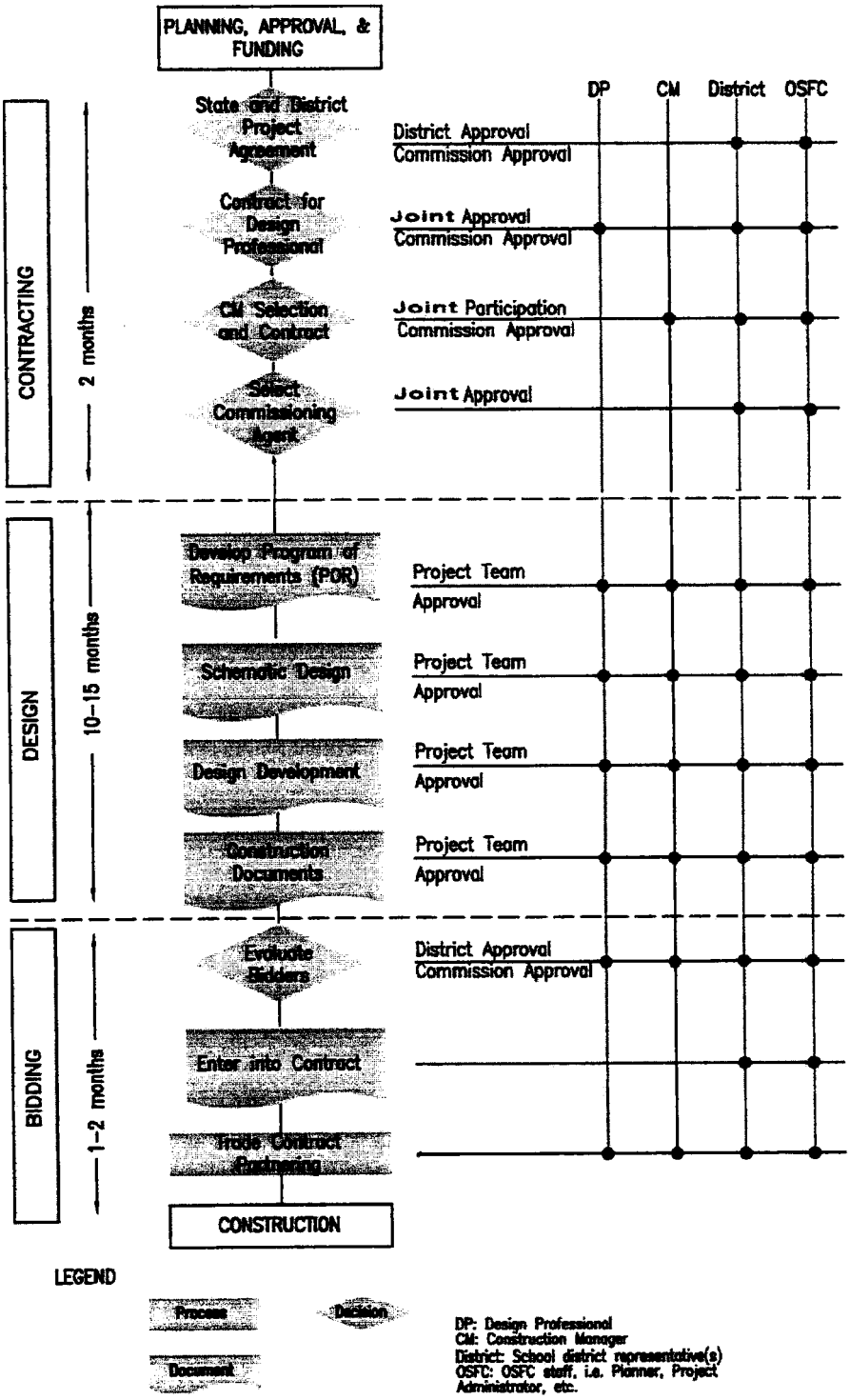
G. OUTDOOR LEARNING AREAS

1. Consider incorporating natural habitats, wetlands, and areas of specific vegetation as outdoor learning areas for student instruction. For example, garden plots could be used for classroom instruction or by the community areas.

***H. EXTERIOR BUILDING PERIMETER***

***1. Use caution in specifying materials that could be used as projectiles around perimeter of building, at special feature areas, or unprotected utility areas.***

## B. SUMMARY OF THE PLANNING, DESIGN, AND CONSTRUCTION PROCESS *(CM Agency)*



**3. Participants in *Implementing* the Master Facility Plan**

***Role: The Design Professional (DP)***

*Responsibilities*: The DP is involved in developing the Program of Requirements for the project. The DP, along with his or her consultants, is responsible for the documents that are developed during design and that are ultimately used for the construction of the project.

***Role: The Construction Manager (CM)***

*Responsibilities*: The CM is responsible for scheduling, estimating, and providing overall coordination for projects

***Role: School District Representative (District)***

Responsibilities: The School District Representative is responsible for making decisions during the planning, design, and construction of the school project.

***Role: OSFC Project Administrator (PA)***

*Responsibilities*: A Project Administrator is the primary interface for the school district, the CM, and the DP. The PA accommodates the unique needs of the school district within the framework of Commission policies and procedures.

***Role: Commissioning Agent***

*Responsibilities*: The Commissioning Agent is hired by the district to provide a single point responsibility to ensure efficiency of operation and performance of the building's major systems.

Every team member must understand and fulfill his or her responsibilities for the planning, design, and construction process to be successful. Fortunately, the team works together to be sure that everyone's voice is heard and decisions are made and implemented in a timely manner. Partnering sessions are held throughout the process to help all the stakeholders work together in an environment of mutual trust with open channels of communication.

*OHIO CONSTRUCTION REFORM*

***On June 30, 2011, Governor Kasich signed House Bill 153 which included the first changes I nthe state's method of performing public construction in over 134 years. These changes collectively known as Ohio Construction Reform, or OCR, will substantially alter how public improvement projects are completed and will allow for alternative construction delivery methods.***

***Ohio Construction Reform retains the current multiple-prime design-bid-build project delivery method, but gives public owners a number of other project delivery options that could be:***

- ***Faster***
- ***Have less risk***
- ***More flexible***
- ***Lower cost***

***Once Ohio Construction Reform goes into effect, these new delivery methods can be used by state agencies, colleges/universities, counties, townships, municipal corporations, school districts, or other political subdivisions. These changes do not impact the Ohio Turnpike or ODOT's road construction.***

***Alternative Project Delivery Methods:***

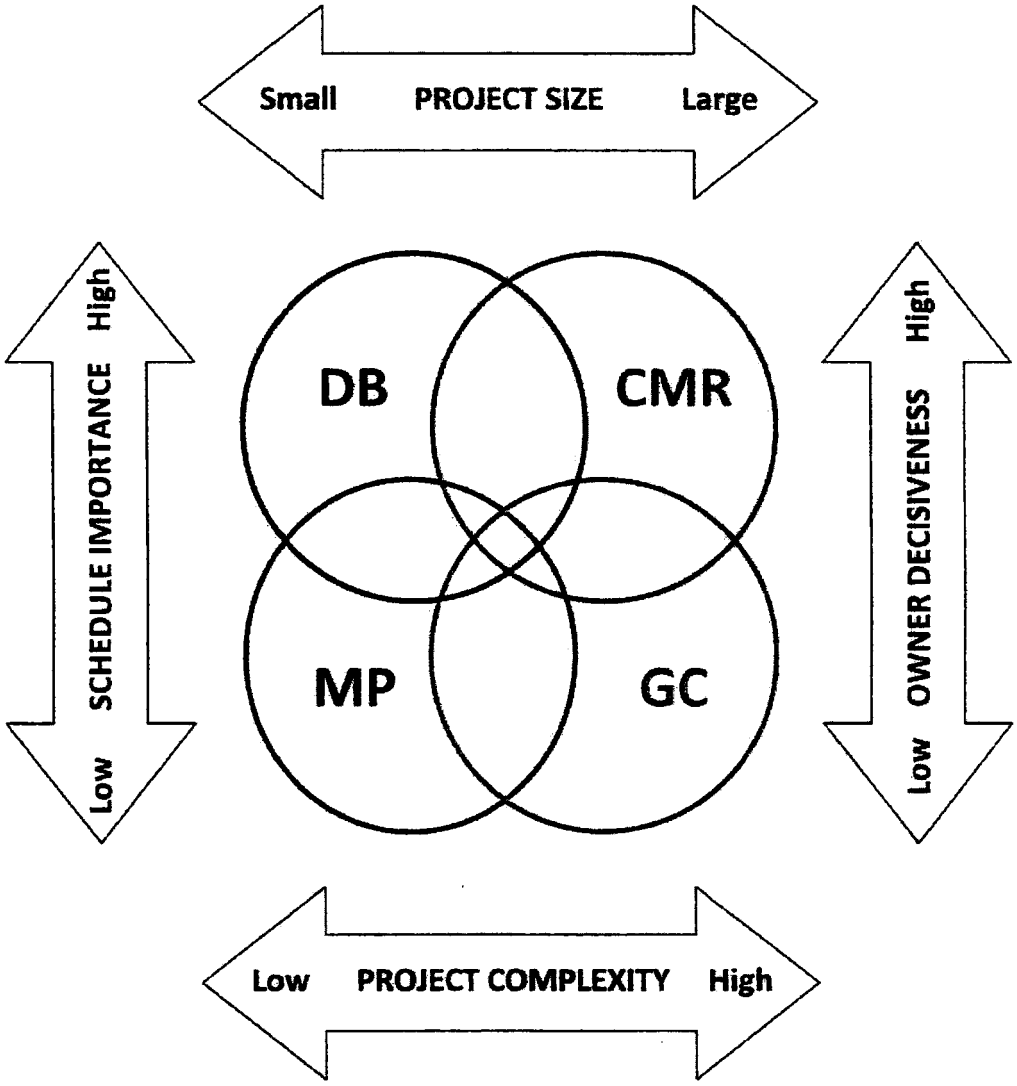
- ***Retains multi-prime design-bid-build project delivery***
- ***Removes limitations on single-prime design-bid-build project delivery – General Contracting***
- ***Allows design-build (D-B) project delivery – a single entity assumes risk for final design and construction of facility including cost overruns***
- ***Retains construction manager (CM) as agent delivery – the CM acts as owner's agent***
- ***Allows construction manager at risk delivery (CMR) – the CM holds subcontracts and assumes risk for cost overruns***
- ***Allows for open-book Guaranteed Maximum Price, design-assist, and subcontractor prequalification within design-build and CM at risk delivery methods.***

***See next page for a Project Delivery Method Comparison Guide.***

# Project Delivery Method Comparison Guide

| | Description | Advantages | Disadvantages |
|---|---|---|---|
| MULTIPLE PRIME | Traditional approach in which the owner hires an A/E to fully document the project criteria and design prior to bidding. Multiple packages are separately bid and awarded to the lowest responsive and responsible prime contractors. The owner holds all prime contracts and is responsible for coordination during construction. | • Familiar delivery method<br>• Fully defined project scope<br>• Both designer and contractor accountable to owner<br>• Creates most prime bidding opportunities (lowest bonding)<br>• Lowest initial price<br>• Good for simple projects that are not schedule-driven and not subject to change | • Linear process means longer schedule<br>• Limited control over contractor and subcontractor selection<br>• No design or cost input from contractor<br>• Lack of flexibility for change<br>• Can be adversarial in nature<br>• Not good for complex projects that are schedule-driven |
| CM as AGENT | An owner's agent is hired through a qualifications based selection process during the design phase. The owner's criteria and full design is documented by a separate A/E. The CMA provides estimates during design, assists with bidding and coordinates prime contractors during construction. The owner bids and holds all contracts for construction. | • Fully defined project scope<br>• Supplements owner's staff<br>• Independent professional services & expertise for owner<br>• Creates most prime bidding opportunities (lowest bonding) | • Adds level of bureaucracy<br>• Limited control over contractor and subcontractor selection<br>• Owner still holds contracts for construction<br>• Not suited for small projects<br>• Drawbacks common to the design-bid-build process |
| GENERAL CONTRACTING | A linear design-bid-build process in which the owner selects an A/E to fully document the project criteria and design prior to bidding. The lowest responsive and responsible GC (single prime) is awarded the contract. The owner holds a single contract with the GC. | • Familiar delivery method<br>• Fully defined project scope<br>• Both designer and contractor accountable to owner<br>• Simple procurement method<br>• Single contractor to manage<br>• Good for simple to moderately complex projects that are not schedule-driven | • Sequential process means longer schedule<br>• Limited control over contractor and subcontractor selection<br>• No design or cost input from contractor<br>• Can be adversarial in nature<br>• Not good for complex projects that are schedule-driven<br>• Bonding requirements |
| CM at RISK | A contractor is hired through a best value selection process during the design phase. The owner's criteria and full design is documented by a separate A/E. The CMR provides a guaranteed maximum price prior to bidding. The CMR bids to prequalified subcontractors and holds all subcontracts for construction. | • Contractor input on design<br>• Selection of contractor based qualifications and price<br>• Open-book GMP<br>• Faster project delivery than traditional design-bid-build<br>• Provides flexibility to handle changes during design phase<br>• Good for large or complex schedule-driven projects<br>• More control selecting subs | • Relationship changes during design to construction phase<br>• Increased contingency for assumption of risk<br>• Difficult to determine if best price has been achieved<br>• Bonding requirements<br>• Disputes if GMP scope not clear |
| DESIGN-BUILD | A single entity is hired through a best value selection process to deliver a complete project. The owner's criteria and design intent is documented by a separate criteria architect. The design is completed by the DB entity and a guaranteed maximum price is provided prior to bidding. The DB entity bids to prequalified subcontractors and holds all subcontracts for construction. | • Single point of responsibility for design and construction<br>• Contractor selection based on qualifications and price<br>• Fastest project delivery<br>Open-book GMP<br>• No changes orders for design errors and omissions<br>• Good for new construction that is time sensitive and not subject to change<br>• Good for less complex projects<br>• More control selecting sub's | • Owner has less control over selecting designer<br>• Owner has less input in details<br>• Over emphasis on price may compromise quality<br>• Difficult to determine if best price has been achieved<br>• Owner required to make quick decisions<br>• Changes difficult & expensive<br>• Bonding requirements<br>• Disputes if criteria not clear |

# Project Delivery Method Selection Diagram



## Design Manual Tolerance for Square Footage Requirements

### Square Footage Flexibility for the Total Building

For multi-story construction, the developed area may be increased for vertical circulation up to the square footage provided in the bracketing tool. The project budget is not increased due to offsetting reductions in site development costs with multi-story construction.

On a building-by-building basis, the total square footage developed for a building may vary from the square footage specified in the Master Facilities Plan or the square footage adjusted for vertical circulation by:

Plus 1/10$^{th}$ of one percent (0.001)
or
Minus ½ of one percent (0.005)

### Square Footage Flexibility for Non-Academic Spaces

Non-Academic Spaces are defined as those areas that do not comprise the academic core of the building and include specific areas such as: administration spaces, media center, physical education areas, food service, custodial spaces and building services. The Commission may apply discretion to approve reasonable flexibility for the square footage of non-academic spaces specified in the Design Manual. Increasing the square footage of non-academic spaces is not an acceptable justification for a reduction to the square footage of academic space, however the Commission does support expanding academic spaces through the reallocation of non-academic space to the academic core. Corridor area should be appropriately sized to accommodate the design solution for the project.

***See 1120-2 for SCLE exemption to minimum square footage.***

***Square Footage Flexibility for Academic Spaces***

***Academic Spaces are defined as all bracketed program areas except the non-academic spaces within a building. The Design Manual provides a range of flexibility for the square footage of such spaces. The total square footage of the academic core shall equal or exceed the total square footage of the academic core space specified in the Design Manual.***

***For all grade levels, academic spaces may be increased above the square footage of spaces specified in the Design Manual. Required non-academic spaces must still satisfy their intended uses. The total square footage of the building shall not be increased.***

1. ***For all grade levels, academic spaces may be reduced up to ten percent (10%) below the square footage of spaces specified in the Design Manual. Designers are encouraged use this flexibility to accommodate, where applicable to a district, reduced class size or for Extended Learning Areas, however the flexibility is not limited to these applications. Extended Learning Areas (ELAs) are defined as academic areas that provide supplemental space to support adjacent classroom needs. ELAs may be used for a variety of activities such as: gross motor skills, computer-based learning, tutoring, individual reading and study activities, informal social interaction, hands-on projects, wet/dry learning areas, or small group special projects. ELAs are spaces adjoining multiple classrooms and should be shared by all. To permit observation by the classroom instructor, it is recommended that the ELA have a visual connection to each classroom that the ELA supports. ELAs should not be construed as regular classrooms or teaching stations and will not be furnished as such. Soft seating or large worktables are preferred. For additional information on ELAs, refer to the Ohio School Design Manual.***

***Variance Requests for Design Manual Systems, Materials and Square Footages***

***The design professional is required to pursue a Design Manual Variance Request from the Commission for deviations from the standards, material and system specifications, and area square footages provided in the Design Manual. The design professional may provide data to support the use of alternative products through the Design Variance Request process. Variances may be requested via the Construction Manager website at http://www.cmw.osfc.state.oh.us using the online Design Manual Variance Request tool. The Commission has established a Design Manual Variance Request Committee that is tasked to review these requests, to conduct proper research on each request, and to make appropriate recommendations.***

## D. PLANNING PROCESS

An educational planning process is a required part of an SCLE project. While a process is required, OSFC is flexible in its steps, approach, and execution. The sample planning process shown below in section E provides an outline for the **required** planning process. The primary purpose of the educational planning process is to give opportunity for all stakeholders to be involved, define the characteristics of an SCLE, and to assure that the educational goals of the District will be met in the new or renovated facility(ies).

## E. SAMPLE PLANNING PROCESS

Every school district is unique, therefore the planning process implemented by each district should be unique and tailored to each district's individual needs, visions, and goals. Although each district's process and timeline will be unique, it is the responsibility of the district to provide, at a minimum, the deliverable documents and any other supporting documents deemed necessary to convey the ability of the planning concepts to support the district's educational mission / vision. The final deliverable document will serve as the SCLE Educational Specifications.

It is recommended that ALL stakeholders be included and involved in the planning process. The planning process requires customization to optimize the efforts and results. It is a flexible and responsive process. The eventual outcome, including the impact of the deliverables, is dependent on all of the phases being executed.

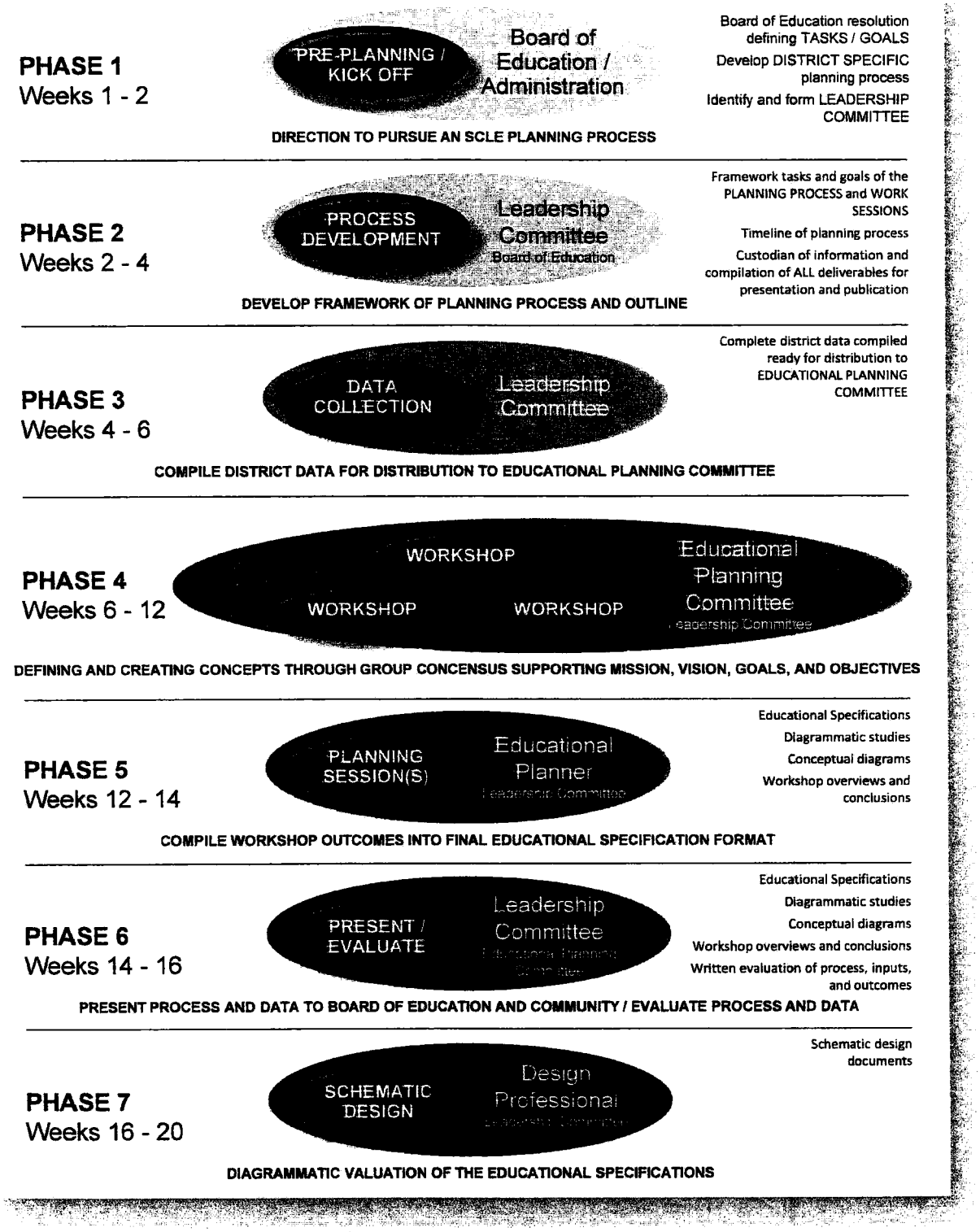
Below is a summary of a planning process. A word document for district use is included as a separate file within the Design Manual CD. The document contains the SAMPLE PLANNING PROCESS OUTLINE described below as well as a SAMPLE PLANNING PROCESS TIMELINE DIAGRAM. The attached document should serve as a template to be edited and modified by the district for use in developing their own planning process and timeline.

***PLANNING PROCESS WILL VARY BASED ON PROJECT DELIVERY METHOD SELECTED***

### 1. PHASE 1: PRE-PLANNING / KICK-OFF MEETING


- **PARTICIPANTS**
  - Control / Direction
    - Board of Education
    - District Administration *(superintendent, business manager, curriculum director, principals, other district representatives as appropriate)*
  - Guidance / Oversight
    - OSFC Planner
    - OSFC Project Administrator (PA)
    - Design Professional (Agency DP)
    - Educational Planner (EP)
- **TASKS / GOALS**
  - Define in writing DISTRICT'S
    - Educational Mission, Vision, Goals, and Objectives
      - *Educational Mission, Vision, Goals, and Objectives could be part of EDUCATIONAL PLANNING COMMITTEES charge*
    - Curriculum delivery methods *(traditional, SCLE, other)*
      - *Curriculum delivery methods could be part of EDUCATIONAL PLANNING COMMITTEES charge*
  - Develop a DISTRICT SPECIFIC planning process using the separate word template files provided within the design manual and modifying them for the districts specific use.
  - Identify and form a LEADERSHIP COMMITTEE
    - LEADERSHIP COMMITTEE tasks
      - Guide, manage, endorse and supervise the planning process
      - Custodian of information and compilation of ALL deliverables for presentation and

## F. SAMPLE PLANNING PROCESS TIMELINE DIAGRAM



## C. PLANNING ATTRIBUTES

### 1. MINIMUM PRE-REQUISITES (ATTRIBUTES)

Learning environments should be considered holistically. While each SCLE will differ, the following **MINIMUM PREREQUISITE ATTRIBUTES MUST** be incorporated. Students need to move seamlessly from large group instruction to small-group collaboration to independent study to formal presentation to outdoor environments. The activities of reading, writing, research, sharing, investigating, analyzing, performing, introspection, and kinesthetics should be accommodated thoughtfully within the "students place."

- **AGILE / INSTANTLY FLEXIBLE**
  Learners should be able to quickly change from listening to one instructor (traditional "Chalk and Talk" lecture or demonstration) to working in teams to working independently. While specialized spaces for each kind of activity can accommodate each kind of work, the flow of activities is often immediate. Spaces need to be capable of quick reconfiguration to support different kinds of activity, movable tables and chairs, movable partitions, and movable casework and furnishings are a few examples. Additionally, spaces should be designed with building systems that allow the ability to reconfigure spaces with minimal costs.

- **COMFORT**
  Individual seating must take into account different body sizes and the periods of time learners need to occupy seating. Varying types of movable and reconfigurable seating and lounging will provide comfort for varying types of learners. Discomfort makes a compelling distraction to learning. Areas should provide surfaces for writing and supporting computers, books, and other materials. Natural lighting, day lighting and natural ventilation as well as controls should be available to occupants to customize the comfort of spaces dependant on the current activity.

- **AMBIANCE**
  Learners yearn for color, natural and task-appropriate lighting, and interesting room shapes and configurations. Spaces with multiple and accessible levels help to create interest and attract learners and mentors. The ability of spaces to attract learners will be the most successful environments for learning. Provide interior and exterior views and vistas to create variety.

- **TECHNOLOGY / CONNECTIVITY**
  Collecting, analyzing, displaying, and disseminating knowledge typically involves technology. SCLE's require seamless, flexible technology. As technology changes, smaller devices will travel with users, who will expect wireless environments, the capacity to network with other devices and display vehicles, as well as ample access to power. SCLE's will need flexible plug-and-play capabilities based upon the current configuration of the space. Technology should be as transparent as the pencil and paper were in the 1950's. Technology should be something you use, not something you do.

- **PLACES**
  Implications for space planning should include the whole facility, campus, or district as a learning place rather than emphasizing traditional classrooms. Provide universal flexible places for discussion and study. All spaces should fuse the three R's with the four C's (collaboration, communication, critical thinking, and creativity).

- **INTEGRATED SUSTAINABILITY**
  Solar, rain harvesting, recycling, natural ventilation, day-lighting, edible gardens, and LEED strategies should be integrated into the facility and become part of the diversified curriculum strategies.

SECTION 055000

METAL FABRICATIONS

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for metal items fabricated from standard metal shapes and plates that are not classified in other locations.

1.2 PRODUCTS

A. Materials: Steel plates, shapes, and bars. Steel tubing, steel pipe, slotted channel framing, iron castings, and aluminum.

B. Miscellaneous Framing and Supports: Galvanized where indicated.
1. Steel framing and supports for ceiling-hung toilet compartments, operable partitions, overhead doors, overhead grilles, countertops, and mechanical and electrical equipment.
2. Elevator machine beams, hoist beams.
3. Steel shapes for supporting elevator door sills.

C. Shelf Angles: Galvanized at exterior walls.

D. Metal Ladders - Including Elevator Pit Ladders: Steel, unless otherwise noted.
1. Exterior ladders: Galvanized or aluminum.
***2. Provide fixed, permanent ladders on wall9s) for access to all low-sloped roof areas.***

E. Ladder Safety Cages: Match ladder.

F. Alternating Tread Devices: Steel.

G. Metals Ships' Ladders: Steel.

H. Metal Floor Plate: Steel.

I. Structural-Steel Door Frames:
1. Exterior frames galvanized.

J. Miscellaneous Steel Trim: Steel angle corner guards, steel edgings, and loading-dock edge angles.
1. Exterior trim galvanized.

K. Metal Bollards: Schedule 40 steel pipe.

L. Pipe and Downspout Guards.
1. Galvanized.

M. Abrasive Metal, Nosings, Treads, and Thresholds: Cast iron, cast aluminum, or extruded aluminum.

***SECTION 085200***

***WOOD WINDOWS***

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for fixed and operable wood framed windows used singly and in multiples.

1. Aluminum or vinyl clad

1.2 QUALITY ASSURANCE

A. Provide wood windows of performance class and grade indicated that comply with ***AAMA / WDMA 101 / I.S.2 / NAFS***

1. Performance Class: C minimum.
2. Performance Grade: 30 minimum.

B. Energy Performance: Windows shall have energy performance ratings per ***NFRC-100.***

1. Thermal Transmittance (u-factor): Shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.

1.3 WOOD WINDOWS

A. Window Operation

1. Projected.
2. Casement.
3. Fixed.
4. Single-Hung.

1.4 MATERIALS

A. Aluminum Cladding

1. Trim Members: Provide aluminum-clad wood, hollow-aluminum extrusions, or roll-formed aluminum trim members.

B. Vinyl Cladding

1. Trim Members: Vinyl-Clad Wood.

C. Hardware

1. Operating Device: Combination lever handle or crank Cam latch lock.
2. Hinges: Heavy-duty, two-knuckle butt hinges (Minimum of two per ventilator).

D. Glazing: Sealed Insulated Units

1. Refer to Division 08, Section "Glazing".

1.5 AUXILIARY MATERIALS

A. Insect Screening

1. Provide at operable vents.
2. Screen: Glass-fiber-mesh or aluminum wire fabric.
3. Wickets: Sliding or hinged.

B. Blinds Between Glazing: Where required at vision glass, provide remotely operated horizontal louver blinds in the space between glazing panes. Construct blinds of aluminum slats equipped to tilting, raising, and lowering by standard operating hardware located on inside face of sash.

***C. Insulating-Foam Sealant: Refer to Division 08, Section "Thermal Insulation."***

***D. Aluminum subsill and sill flashing.***

## A. APPLICATION

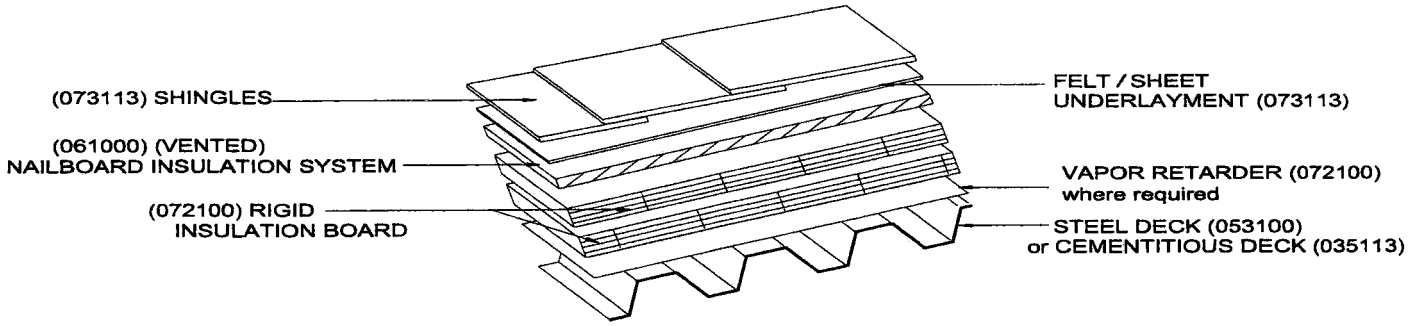
1. Steep Roofing
2. Slope - Minimum 4:12
3. ***Hip roofs require special consideration***

## B. COMPONENTS

1. Roof Membrane
   a. Shingles
   b. Underlayment
2. Roof Insulation
   a. (Vented) nailboard / insulation ***(2" minimum air space)***
   b. 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
   a. Self-adhering sheet
   b. Closed-cell polyurethane insulation

## C. PERFORMANCE

1. Features
   a. Impact resistant
   b. Moisture resistant
   c. Thermal resistant
   d. Detail roof/wall and roof plane intersection to provide a continuous air barrier system.
   e. Refer to NRCA Roofing Manual: Chapter 3, "Condensation Control & Ventilation for Steep-Slope Roof Assemblies"




Shingle Roof System
Figure A-1

4. The continuous air barrier shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical ventilation.

*D.* Air Barrier Installation: The following areas of the continuous air barrier in the building envelope shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage:

***1. Installer shall be certified by the Air Barrier Association of American (ABAA) Quality Assurance Program.***

***2.*** Joints around fenestration and door frames (both manufactured and site-built).

***3.*** Junctions between walls and floors, between walls at building corners, between walls and roofs or ceilings.

***4.*** Penetrations through the air barrier in building envelope roofs, walls, and floors.

***5.*** Building assemblies used as ducts or plenums.

***6.*** Joints, seams, connections between planes, and other changes in air barrier materials.

***7. All steel support members at openings in exterior walls shall be isolated from direct thermal transfer by the continuous air barrier.***

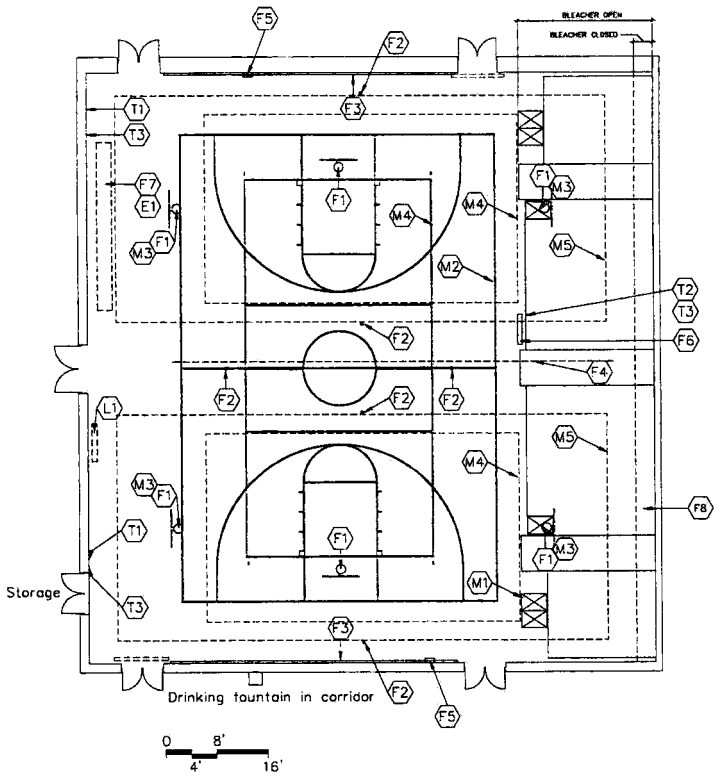
***8. Install an air barrier transition from window to air barrier in masonry cavity.***

***E. Quality Control: Provide for site inspections by ABAA to verify conformance with manufacturer's instructions and ABAA's Quality Assurance Program. Inspections at 5, 50, and 95 percent completion with written report.***

1.2 MATERIALS AND ASSEMBLIES

A. Continuous air barrier materials and assemblies for the opaque building envelope shall comply with one of the following requirements.

1. Materials that have an air permeance not exceeding 0.004 cfm/ft$^2$ under a pressure differential of 0.3 in w.g. (1.57 psf) when tested in accordance with ASTM E 2178. The following materials meet the requirements of 5.4.3.1.3.a:
   a. Plywood – minimum 3/8 in.
   b. Oriented strand board – minimum 3/8 in.
   c. Extruded polystyrene insulation board – minimum 1/2 in.
   d. Foil-faced urethane insulation board – minimum 1/2 in.
   e. Exterior gypsum sheathing or interior gypsum board – min. 1/2 in.
   f. Cement board – minimum 1/2 in.
   g. Built up roofing membrane
   h. Modified bituminous roof membrane
   i. Fully adhered single-ply roof membrane
   j. A Portland cement/sand parge, stucco, or gypsum plaster – minimum 1/2 in. thick.
   k. Cast-in-place and precast concrete.
   l. Sheet metal.
   m. Closed cell 2lb/ft$^3$ nominal density spray polyurethane foam – minimum 1 in.
2. Assemblies of materials and components (sealants, tapes, etc.) that have an average air leakage not to exceed 0.04 cfm/ft$^2$ under a pressure differential of 0.3 in w.g. (1.57 psf) when tested in accordance with ASTM E 2357 ASTM E 1677, ASTM E 1680 or ASTM E283; the following assemblies meet the requirements of 5.4.3.1.3 b.
   a. Concrete masonry walls that are:
      1) Fully grouted, or
      2) Painted to fill the pores.




Please see page 5109-5 for an enlargement of this diagram.

CAPACITY: 25 - 60 students
SIZE: 7,000 – 12,000 SF
ANCILLARY SPACES:
Physical Education Storage
M-PE-7

PROGRAM ACTIVITIES:
- P. E. students will practice and participate in exercise, sports activities, intramural events, and physical fitness.
- Student assemblies
- Community use

SPATIAL RELATIONSHIPS:
- Direct access to outdoors
- Near student dining

ENVIRONMENTAL CONSIDERATIONS:
- Adequate sound control/acoustics
- Clear, ***fixed*** height of 23' from floor to nearest obstruction
- Environmental sound control - wall minimum STC 60

NOTES:

1. Loose furnishings shown represent one of many possible arrangements.

| FINISHES[1]: | Spec. Ref.# |
|---|---|
| Flooring: | |
| Wood flooring or | 096466 |
| Fluid-applied athletic flooring | 096766 |
| Base: | |
| Ventilated resilient base | 096466 |
| Ceiling: | |
| Painted exposed structure | 099100 |
| Walls: | |
| Painted | 099100 |
| Sound absorbing concrete masonry units or abuse-resistant | 042000 |
| acoustical wall treatment | 098000 |

LOOSE FURNISHINGS:
L1 Portable chalkboard

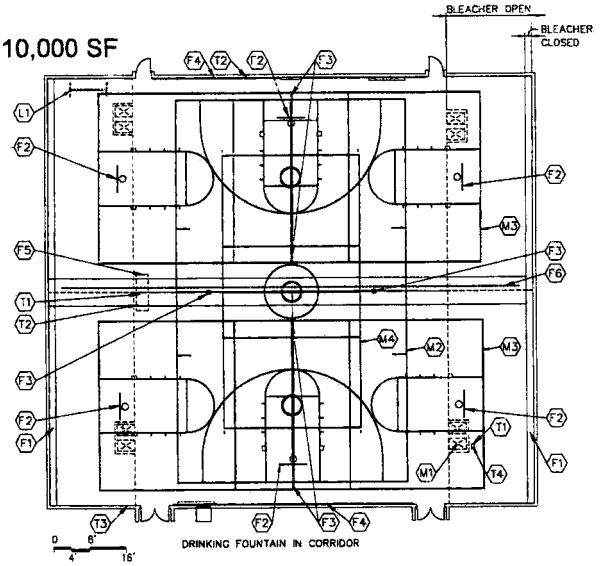
Miscellaneous:
M1 Bleacher seating (ADA accessible)
Court markings (***optional***)
M2 74' x ***42'*** main basketball court
M3 2 cross courts to fit
M4 30'x 60' volleyball courts
M5 36' x 78' tennis courts
Provide wire guards on light fixtures and wall-mounted electrical devices.

EQUIPMENT:
E1 Wrestling mat

| FEATURES[1]: | Spec. Ref.# |
|---|---|
| Fixed Items: | |
| F1 (6) basketball backstops, glass | 116623 |
| F2 Volleyball sleeves and standards on a cart | 116623 |
| F3 Safety wall wainscot (see note 2) | 116623 |
| F4 Divider gym curtain | 116623 |
| F5 Chin-up bar (optional) | 116623 |
| F6 Scorer table | 126600 |
| F7 Wrestling mat hoist (optional) | 116623 |
| F8 Telescoping bleachers | 126600 |
| Fire Suppression: | |
| Fire suppression system | 211000 |
| Plumbing: | |
| Drinking fountain directly outside the entrance | 224000 |
| HVAC: | |
| Supply/return air system | Div. 23 |
| Independent temp control | 230923 |
| Electrical: | |
| Multi-level switching | 262726 |
| Fluorescent lighting | 265100 |
| Illumination level: See Table 8600-5 | |
| 8 duplex receptacles | 262726 |
| Double duplex receptacle adjacent to each data and video port | 262726 |
| Emergency lighting per code | 265100 |
| Means of egress lighting per code | 265100 |
| Electrical connections to P.E. equipment where necessary | 262726 |
| Scoreboard (control outlets in the face of bleachers) | 116643 |
| Telecommunications Grounding | 270526/260526 |
| Communications:: | |
| T1 2 video ports, 1 monitor with cart | 271533/271543/274119 |
| T2 1 voice port | 271513/273113 |
| T3 3 data port | 271513 |
| Clocks with wire guards | 275313 |
| Central sound system | 275123 |
| Gymnasium sound system | 275124 |
| Electronic Safety and Security: | |
| Life safety devices per code | 283111 |

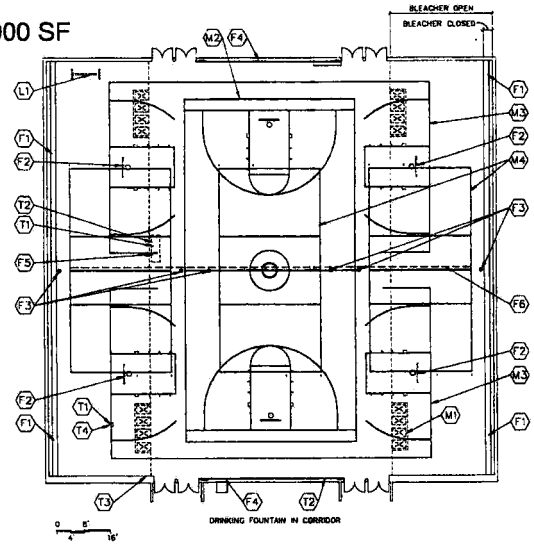
NOTES:
1. Finishes/Features: Refer to Chapter 9 for specification references.
2. Extend safety wall wainscot 5 feet beyond side game lines at both ends of main basketball court.

10,000 SF




Please see page 6110-*7* for an enlargement of this drawing.

16,000 SF




Please see page 6110-8 for an enlargement of this drawing.

CAPACITY: 60 – 75 Students
SIZE: 9,300 – 17,400 SF
ANCILLARY SPACES:
Physical Education Storage
H-PE-5

PROGRAM ACTIVITIES:
- Physical education classes and interscholastic athletic competition
- Student assemblies
- Community use

SPATIAL RELATIONSHIPS:
- Near locker rooms
- Adjacent to outdoors
- Near student dining

ENVIRONMENTAL CONSIDERATIONS:
- Environmental sound control - walls minimum STC 60
- Acoustical requirements and other factors as determined by final configuration of the space
- Clear, ***fixed*** height of ***23'*** from floor to nearest obstruction

NOTES:

1. Loose furnishings shown represent one of many possible arrangements.

SECTION 075000

MEMBRANE ROOFING

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. General qualitative requirements for roofing system applied to the structural substrate, over insulation, or protected with insulation (protected membrane) as appropriate to the particular assembly.

1. Built-up bituminous roofing
2. Elastomeric membrane roofing
3. Thermoplastic membrane roofing
4. Modified bituminous membrane roofing

1.2 SYSTEM DESCRIPTION

A. General: Provide installed roofing membrane and base flashings that remain watertight, do not permit the passage of water, and resist uplift pressure calculated according to ASCE 7, thermally induced movement, and exposure to weather without failure.

B. Design Requirements

1. All roofs shall be designed and built to ensure positive drainage.
   a. Positive Drainage: The drainage condition in which consideration has been made during design for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall, during ambient drying conditions.
2. ***Roofs shall be "solar ready" in accordance with O.R.C. 3318.112.***

1.3 QUALITY ASSURANCE

A. Exterior Fire Test Exposure: Class A, comply with ASTM E108.

1.4 SEQUENCING

A. Work shall begin only after opening and penetrations are in place and adjacent work required for complete tie-in are in place. This includes flashing in masonry walls with special attention given to roof to wall transitions.

1. Work shall not begin before the "Preinstallation Conference" and conditions exist necessary for a successful completion of roofing have occurred.
2. Work shall not begin without the presence of manufacturer's representative, A/E and Testing Laboratory, if required.

B. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas.

C. After work on roof is started, no traffic will be permitted on the roof other than necessary for the roofing application and inspection. Materials shall not be piled on the roof to the extent that design live loads are exceeded. Roofing materials shall not be transported over unfinished or finished roofing or existing roofs unless adequate protection is provided.

1.5 WARRANTY

A. Roofing Warranty: Minimum manufacturer's 20 year total system warranty.

SECTION 042000

UNIT MASONRY

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for unit masonry assemblies.
   1. Masonry mortar and mixing masonry assemblies.
   2. Masonry grout and mixing masonry grout.
   3. Masonry anchorage and reinforcement devices.
   4. Masonry accessories.
   5. Manufactured concrete masonry units; both loadbearing and nonloadbearing and intended for use in unit masonry assemblies with mortar.
      a. Concrete masonry units
      b. Sound absorbing concrete masonry units
      c. Sound diffusing concrete masonry units
      d. Decorative concrete masonry units
   6. Manufactured clay masonry units; both loadbearing and non-loadbearing.
      a. Brick
      b. Structural-Clay Facing Tile

1.2 QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1 / ASCE 6 / TMS 602, unless otherwise noted.
   a. Provide a 2-inch minimum clear air-space.

B. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

C. Mockups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials, execution, and aesthetic effect. ***Observation and evaluation of the mock-up shall be by the masonry installer, general trades contractor, A/E, CM, OSFC-PA, Commissioning Agent, window installer, and testing agency.***
   1. Build mock-up of typical wall area(s) as shown on Drawings including Movement Control Joints (Sealant Filled) 1'4" (minimum length), Air Barrier, Blocking for Window, Horizontal and Vertical Reinforcing Shelf Angles and Supports, Bond Beams and Lintels, Brick Ties and Anchors Flashing, End Dams, Weeps and Vents, Cavity Drainage Material (if required), Window Head, Sill and Jamb Details.
      a. Include a sealant-filled joint at least 16 inches long in each exterior wall mock-up.
      b. Include lower corner of window opening at upper corner of exterior wall mock-up. Make opening approximately 12 inches wide by 16 inches high.
      c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mock-up approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).

2. ***The window contractor shall provide and install in the mock-up wall a sample window of the type and profile used in the classrooms. (leaving portions of the perimeter exposed for inspection of the fasteners and air barrier transition to the masonry; some portions to receive final caulking inside and out)***
3. Prior to starting general masonry cleaning, prepare mock-up for cleaning using the same cleaning materials and methods proposed for the Work.
4. Protect accepted mock-ups from the elements with weather-resistant membrane.
5. The construction of the mock-up shall be photographed or videotaped by the masonry contractor to be part of a presentation for groups of trades people as they join the project work force.

1.3 CONCRETE MASONRY UNITS

A. Concrete Masonry Units (CMU): Light weight, medium weight, or normal weight.

B. Concrete Building Brick

C. Sound Absorbing Concrete Masonry Unit (SACMU)
1. Face sizes, unit weights, and finish textures shall match those of required regular concrete masonry units.
2. Provide flared slots, metal septa, and incombustible fibrous cavity fillers of the following:
a. 8 inch (53 STC) and 12 inch (56 STC) thick walls.

D. Sound Diffusing Concrete Masonry Units (SDCMU)
1. Aggregate shall meet ASTM C90 and ASTM C129.
2. Fiberglass inserts shall be installed at the block plant to ensure proper positioning.

E. Decorative Concrete Masonry Units: Light weight, medium weight, or normal weight.
1. Finish: Exposed faces of the following general description matching color, pattern, and texture of Architect's samples:
a. Normal-weight aggregate, ground finish (not acceptable if used as a comparison for LFI calculations)
b. Normal-weight aggregate, split-face finish
c. Normal-weight aggregate, split-ribbed finish
d. Normal-weight aggregate, standard finish, scored vertically so units laid in running bond appear as square units laid in stack bond
e. Normal-weight aggregate, standard finish, triple scored vertically so units laid in running bond appear as vertical units laid in stacked bond

F. Prefaced Concrete Masonry Units: Light weight hollow or solid units with smooth resinous facing.

G. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength.

1.4 BRICK

A. Face Brick: ASTM C 216
1. Grade and Unit Compressive Strength: Provide units with grade indicated below:
a. Grade: SW., Type FBX or FBS

## A. LOOSE FURNISHINGS/EQUIPMENT

1. Loose furnishings and equipment in the project are those items that are not attached to the building such as furniture, special subject equipment, appliances, trash receptacles, cleaning equipment, etc. The type of loose furnishings and equipment for a school should be selected to support the educational curriculum and the function of the spaces, but also provide flexibility for change and development in the future. The exact items and styles may vary from school to school.

2. The recommended furniture and equipment is identified on each space plate in chapters 4, 5 and 6. Following are guidelines for a level of quality, durability, and function for various types of furniture that may be used in a school as well as features for consideration and review with school district representatives.

*3* Maintenance items such as sweepers, lawn care machines, mops, brooms, buffers, scissors hoist, etc., are funded by the school district.

***4. Student tables, student desks, and student chairs must comply with The Consumer Product Safety Improvement Act (CPSIA) of 2008 which regulates testing requirements for children's products. Section 102 of CPSIA provides regulations for lead in paint and similar surface coatings. Upon request, manufacturers must submit a third party testing and certification complying with Section 102 of the CPSIA with the requested bid.***

## B. QUALITY GUIDELINES AND FURNITURE SELECTION CONSIDERATIONS

1. Student Tables
   a. Tops
      .1 1 inch to 1 1/4 inch plywood with patterned horizontal grade plastic laminate on top and exposed, sanded, sealed, and lacquered plywood edge. Include steel stretcher support bar on tables over 60 inches in length.

   b. Legs or T Bases
      .1 19-gauge steel tubing with self-adjusting, rubber-cushioned, swivel type, nonremovable glides. Nickel plated chrome or electrostatically applied epoxy powder coat finish. Adjustable legs for flexibility for elementary schools and middle schools are beneficial to accommodate a wide range of student sizes at a given grade level. Tables 29 inches high are a standard height for adults and meet the Americans with Disabilities Act guidelines.

## 1.06 SANITARY PIPING SYSTEM (cont.)

F. Where the temperature of water in the sanitary line can reach 140 degrees, cast iron waste and vent piping shall be installed. Kitchen waste piping is an example.

G. Sanitary sewer cleanouts shall be installed at 50 feet on center up to 4" diameter/ 100 foot on center for ***above 4"*** diameter, and at changes in direction of 90 degrees or more, at the bottom of vertical risers and as the sewer exits the building.

H. All cast iron piping shall comply with ASTM A 888 (or A 74) and be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

## 1.07 PLUMBING FIXTURES/PLUMBING SPECIALTIES

A. Water closets shall be china, white, standard flush valve, wall hung, and low water consumption type. Automatic/battery or direct wired flush valve is optional.

B. Urinals shall be china, white, standard flush valve, wall hung, and low water consumption type. Automatic/battery or direct wired flush valve is optional. Waterless-type urinals are acceptable.

C. Lavatories shall have lever handles for hot and cold water. An option to the lever handle faucet shall be a battery or hardwired infrared faucet. Faucets accessible to students shall be infrared sensor battery with the battery and electronics/solenoid built into the spout. Temperature control shall be integral with the faucet or remote mixed.

D. Showers shall be low water consumption, pressure-balanced type.

E. Drinking water coolers/fountains shall be handicap accessible.

F. Sinks shall be 18-gauge, 302 or 304 stainless steel.

G. Science lab sinks shall be connected with acid-resistant material. The science casework manufacturer shall provide sinks.

H. In large group restrooms with 3 or more lavatories, the lavatories can be substituted with a comparably sized wash fountain with infrared sensing.

I. All plumbing fixtures and trim designed or designated for use by the handicapped shall meet the Americans with Disabilities Act guidelines.

J. Water supply (hot and/or cold) to the lavatories, sinks, and drinking fountains shall have angle stops with loose key handles.

K. All lavatories, water closets, and urinals shall have wall carriers.

L. Floor drains shall be installed in each large group restroom, locker room, mechanical room, and kitchen area. Provide a sediment bucket in the floor drain if conditions exist where solids may enter the drain.

1.10 POLES

***A. Structural Characteristics: Comply with AASHTO LTS-5.***

1.11 STEEL POLES

A. Poles complying with ASTM A 500 Grade B carbon steel with minimum yield of 46,000 psig.

B. One piece construction.

C. Weld ½ inch threaded lug for grounding conductor connections.

D. Vibration dampeners for Mode 1 and Mode 2

E. Factory-painted finish.

1.12 ALUMINUM POLES

A. Poles complying with ASTM B429 / B429M constructed with extruded seamless 6063 alloy.

B. Heat treated full length shaft to produce a T6 temper.

C. 1/2" threaded lug for grounding conductor connections.

D. A356 aluminum anchor base welded to shaft.

E. Vibration dampeners for Mode 1 and Mode 2.

F. Integrally-colored or electrolytically deposited color coating complying with AAMA 611.

1.13 FIBERGLASS POLES

A. 65% fiberglass with resin.

B. Resin color uniform throughout entire wall thickness UV inhibited.

C. Direct embedded along pedestrian walkways.

D. Concrete base mounted in vehicular traffic areas.

***1.14 CONCRETE POLES***

***A. Poles: Manufactured by centrifugal spin-casting process or of cast concrete.***

***B. Cure with wet steam and age for a minimum of 15 days before installation.***

***C. Fabricate poles with a hard, non-porous surface that is resistant to water, frost, and road and soil chemicals and that has a maximum water-absorption rate of 3 percent.***

END OF SECTION

## 1.01 GENERAL

A. The heating, ventilating, and air conditioning system design criteria denoted as a part of this Design Manual have been developed or are obtained directly from accepted engineering design references such as the ASHRAE manuals and standards, the state of Ohio code references, and good engineering practice. The HVAC Design Professional should review each requirement and obtain or develop the necessary information for each specific building before proceeding with the systems evaluation as denoted in Section 8410.

## 1.02 OUTDOOR AIR DESIGN VALUES

A. Summer and winter outside air design values shall be derived from standard ASHRAE compiled weather data located in the latest edition of the ASHRAE Fundamentals Handbook. The city nearest the proposed construction project is to be selected for evaluation. Use the 99 percent design values for heating design dry-bulb and the 2 percent design values for cooling design dry-bulb and mean coincidental wet-bulb.

B. In addition, it is strongly recommended that outdoor conditions be considered in the overall design where there is a high wet bulb temperature coincident with an outdoor dry bulb temperature equal to the proposed building supply air temperature for any air handling units with ventilation. For instance, address what happens to building indoor humidity levels when the outside air is 75 deg F/90% relative humidity and a 100% outdoor air unit is supplying 75 deg. F supply air to the facility.

## 1.03 INDOOR AIR DESIGN VALUES

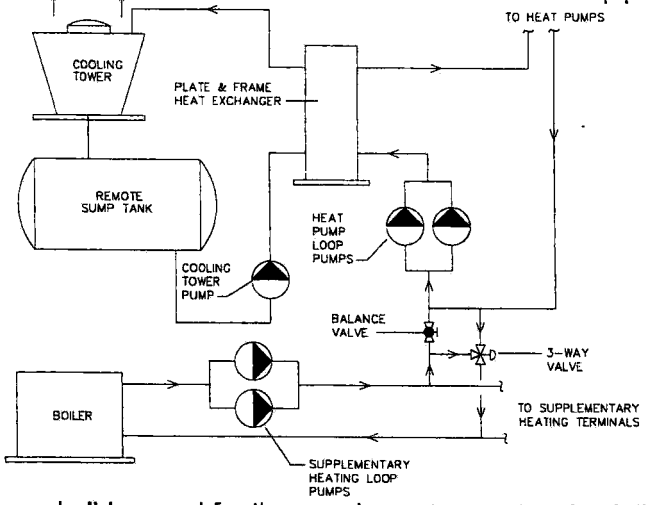
A. Indoor air temperature design values must reflect the need for energy conservation and shall be in accordance with the Ohio Building Code, Mechanical Code.

B. The occupied temperatures used for building load calculations shall be within the range denoted for summer and winter values. The HVAC Design Professional must consider occupant comfort, as well as energy conservation, in selecting the actual temperature for design and operation of the systems. Summer design values shall range from 75 degrees Fahrenheit to 78 degrees Fahrenheit. Winter design values shall range from 70 degrees Fahrenheit to 72 degrees Fahrenheit. The relative humidity of the building spaces shall be targeted at 50 percent during the summer. Humidification in the winter is not required. For mechanical and electrical spaces, the indoor winter design temperature shall be minimum 60 degrees Fahrenheit and the indoor summer design temperature (except for boiler rooms) shall be 85 degrees Fahrenheit.

C. Night setback temperatures shall be used for all systems. Winter setback temperature shall be 55 degrees Fahrenheit. The summer setup temperature shall be 85 degrees Fahrenheit with an additional requirement that the system shall operate as required to maintain a relative humidity in the building area that is between ***55*** and ***60*** percent, ***maintaining 65 percent during summer, unoccupied period and 60 percent at all other times.*** Maintaining humidity levels below 60 percent will result in the periodic operation of the HVAC system during the summer months to reduce the potential for mold and mildew in the building.

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

3. The supplementary heat distribution system is separate from the heat pump condenser water system and should make use of a direct return piping arrangement.




Water Source Heat Pump Schematic

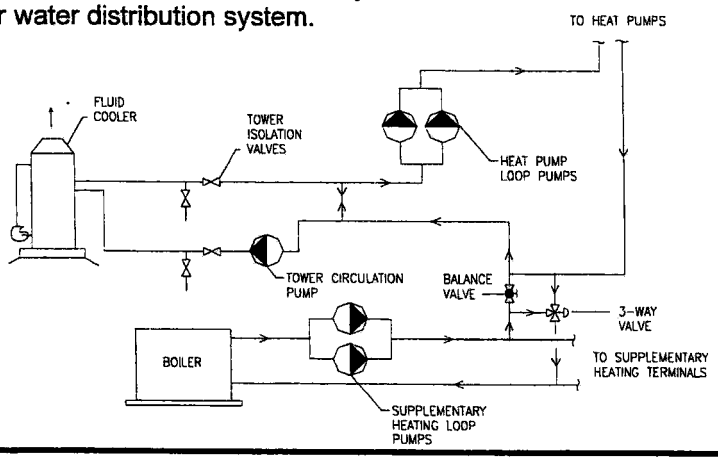
(open tower)

Figure E-1

4. A minimum of 2 pumps shall be used for the supplementary water circulation system. It is recommended to use 2 pumps, each sized at 100 percent of the total system flow and pressure up to 300 gallons per minute. For total system flows above 300 gallons per minute or 10 brake horsepower, each pump should be sized for 50 percent of the total flow and 100 percent of the required pressure.
   a. A parallel pumping configuration is required.

5. A separate air removal and/or containment method is required on the supplementary heating water circulation system. ***The HVAC Professional may utilize the expansion tanks for heat pump condenser water circulation system provided that the tanks are sizes for the combined system volume and temperature range.***
   a. Expansion tanks
   b. Air separators
   c. Air vent

6. Chemical treatment of the supplementary heating water system is not required due to mixing available through the three-way valve connection to the heat pump condenser water distribution system.




Water Source Heat Pump Schematic

(closed circuit fluid cooler)

Figure E-2

SECTION 238219

FAN COIL UNITS – FOUR PIPE

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for fan coil units and accessories.

1.2 SUBMITTALS

A. Submittals are required and shall include product data noting capacity, materials, controls, dimensions, and accessories.

1.3 QUALITY ASSURANCE

A. Units must meet minimum efficiency requirements of ASHRAE Standard 90.1.

B. Performance rating shall conform to N.E.C requirements and shall be UL labeled.

C. Unit capacities shall be certified in accordance with ARI Standard 440-98.

1.4 WARRANTY

A. The entire unit shall be warranted for 5 years.

1.5 COMPONENTS

A. Cabinet and frame construction
   1. Welded, heavy gauge galvanized steel frame
   2. Zinc-coated steel with primer coat and baked enamel finish
   3. Minimum 2 inch, 2 pound density fiber insulation
   4. Hinged filter and grille for access

B. Filters
   1. 1 inch thick, disposable and ***MERV 7*** efficiency.
   2. Provide extra set at completion of work.

C. Centrifugal supply air fan
   1. Fan shall be forwardly curved double width-double inlet, with common shaft mounted on a removable fan board, driven by a three-speed permanent split capacitor motor having built-in overload protection.

D. Chilled water cooling coil
   1. Coil shall consist of seamless copper tubes with bonded aluminum fins. Coils shall be designed for 300 psi w.p.
   2. A manual air vent shall be provided on each coil.

E. Hot water heating coil
   1. Coil shall consist of seamless copper tubes with bonded aluminum fins. Coils shall be designed for 300 psi w.p.
   2. A manual air vent shall be provided on each coil.

SECTION 237200

AIR TO AIR ENERGY RECOVERY EQUIPMENT

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for total energy heat recovery wheels and energy recovery modules.

1.2 SUBMITTALS

A. Submittals are required and shall include product data noting capacities at the specified conditions, materials, sizes, and dimensions.

1.3 QUALITY ASSURANCE

A. Recovery performance shall be tested in accordance with ASHRAE Standard 84.

B. Units shall bear the ETL label and shall be ETL certified.

C. Recovery performance at specified conditions shall be guaranteed by the manufacturer.

1.4 COMPONENTS

A. Energy Recovery Wheel
1. The energy recovery wheel shall have a ***minimum heating and total cooling effectiveness of 80%, based on balanced airflow (relief airflow matching outside airflow). The effectiveness of this wheel shall not be below 70% under design airflow conditions.***
2. The unit shall be constructed of structural steel tubular frame with epoxy primer and finish. The cabinet shall be of 16 gauge bright galvanized steel construction.
3. The heat wheel transfer media shall be a coated aluminum or polymer media with air permeable matrix with laminar flow flutes coated with a renewable desiccant. The heat wheel media shall be driven by an electric motor.
4. The face velocity across each side of the media (supply and exhaust) shall be less than 800 FPM and more than 350 FPM with a purge method that prevents exhaust air from being recirculated.
5. Each unit shall include a frost control method. The control of the unit shall be provided by the DDC control system.

B. Energy Recovery Module
(This type of energy recovery does not meet the prescriptive path requirements of the energy code. If this type is to be used, compliance with the energy cost-budget method must be demonstrated – ASHRAE 90.1-2007.)
1. The energy recovery module shall have a heating net total effectiveness of 62% and a cooling net total effectiveness of 41%.
2. The module shall be constructed of 16 gauge galvanized steel with epoxy primer. Access doors shall have gasket, hinge, and door latches to provide a tight seal.

**1.02 CENTRAL PLANT VARIABLE AIR VOLUME SYSTEM WITH HOT WATER REHEAT TERMINALS (cont'd)**

4. Chillers should be selected at 100 percent of the building design load.

5. Design water supply temperatures shall range between 40 degrees Fahrenheit and 45 degrees Fahrenheit.

6. Design water temperature rise in the system shall be maintained between 14 degrees and 16 degrees Fahrenheit.

7. Chilled water distribution loop shall make use of a reverse return or direct return piping arrangement.

8. The use of a primary/secondary-piping loop is required when multiple chillers are used. Multiple chillers are to be set up in a parallel arrangement.

9. A single pump shall be used for water circulation to the building system. A second pump will be required if a primary/secondary loop is included. Additional pumps may be required for additional chillers.
   a. System pump shall be sized at 100 percent of total flow and 100 percent of total pressure.
   b. The chilled water system shall be capable of a minimum 50 percent flow reduction through the use of two-way control valves, three-way control valves and constant speed pumps or by the use of two-way control valves and variable speed pumps.
   ***c. Multiple pumps may be used for chilled water distribution, but not to exceed recommendations provided for heating water distribution.***

10. Variable speed pumping shall be utilized on systems that require 10 horsepower or greater horsepower. Variable speed pumping shall not be utilized where detrimental to the equipment. Each pump shall have its own variable frequency drive and is not permitted to share a variable frequency drive with another pump.

11. Air removal and/or containment methods are required on closed loop applications.
   a. Expansion tanks
   b. Air separators
   c. Air vent

12. Each closed loop system shall be provided with a manual chemical water treatment system to prevent corrosion and scaling in the chilled water system.

13. Cooling towers are required for water-cooled chiller systems and should include one of the following cooling tower types:
   a. Induced draft (cross-flow)
   b. Forced draft (counter-flow)

14. 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.

SECTION 221116

DOMESTIC WATER PIPING SYSTEM

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for domestic water piping.

1.2 SUBMITTALS

A. Submittals are required and shall include product data noting materials, sizes, and dimensions.

1.3 QUALITY ASSURANCE

A. Follow manufacturer's requirements for installation.

B. Welding procedures per ANSI/ASME Section 9, AWS D10.9 and D1.1 and the National Certified Pipe Welding Bureau.

C. Brazing procedures per ANSI B31.5 and the ASME Boiler and Pressure Vessel Code SFA-5.8, Section II.

D. Soldering procedures per ANSI B16.18.

E. Comply with ANSI B31 pressure code for pressure piping.

1.4 PLUMBING PIPING

A. Domestic water piping (hot water, cold water, hot water return) shall be type L copper conforming to ASTM B88. Fittings shall be wrought copper conforming to ANSI B16.22.
   1. Grooved copper piping with ductile iron or bronze couplings and EPDM gasket may be used as an option.
   2. Copper press fittings may be used as an option per ASTM B16.18 or ASTM B16.22. O-Rings shall be EPDM.

B. An option to A. for domestic hot and cold water shall be as follows:
   1. Cross linked polyethylene (PEX) plastic tubing per ASTM F876,F877. Installed in a conduit or sleeve, ***if under slab.***
   2. Polypropylene Schedule SDR 7.4 and ***SDR*** 11 meeting NSF14, 61 and 51. Piping shall also meet ASTM F2389 and Plumbing Code Chapter 605. Piping installed in air plenums shall have a Foil Wrap to meet the 25/50 smoke and fire ratings for plenum spaces. Follow manufacturer's instructions for installation and hanger requirements. Verify expansion requirements.

1.5 INSTALLATION

A. Provide pipe and tube of type, joint type, size and weight (wall thickness or class) indicated for cold water, hot water, and hot water return.

END OF SECTION

## 1.01 GENERAL

A. The descriptions of the four accepted heating, ventilating, and air conditioning systems have been included in this manual as listed below. It will be the responsibility of the HVAC Design Professional to utilize a system as described in this section, unless suitable documentation to justify a different system type has been submitted.

## 1.02 CENTRAL PLANT VARIABLE AIR VOLUME SYSTEM WITH HOT WATER REHEAT TERMINALS

A. Central Heating Plant

1. A minimum of 2 heating water boilers shall be provided. ***Boiler selection shall consider the operating efficiency of the heating plant. Efficiency shall be capable of providing up to 95% efficiency and shall not be below 83% efficiency at any point in the operating range.***
   a. Gas-fired, forced draft boilers
   b. Gas-fired, atmospheric boilers
   c. Fuel oil boilers
   d. Dual-fuel (fuel oil and gas) boilers
   **e.** Gas-fired, high efficient, forced draft boilers

2. Total heating capacity of the boiler plant shall be approximately 130 percent of the building design load.

3. Design water supply temperatures shall be ***in the range of 130 to 190 degrees Fahrenheit. Heating plant shall be capable of resetting supply water temperature in order to optimize performance based on equipment efficiency ratings. Low supply water temperatures will necessitate the use of at least one condensing boiler. If a combination of condensing and non-condensing boilers are selected, care shall be given to ensure that non-condensing boilers do not operate when return water temperature is below 140 degrees Fahrenheit.***

4. Design water temperature drop in the system shall be maintained between 20 degrees Fahrenheit and 40 degrees Fahrenheit.

5. Heating water distribution loop shall make use of a reverse return or direct return piping arrangement. Direct return systems shall use automatic flow controllers for water balancing.

6. The use of a primary/secondary-piping loop is not mandatory.

7. A minimum of 2 pumps shall be used for water circulation to the building system. It is recommended to use 2 pumps, each sized at 100 percent of the total system flow and pressure up to 300 gallons per minute. For total system flows above 300 gallons per minute, or 10 brake horsepower, each pump should be sized for 50 percent of the total flow and 100 percent of the required pressure. Additional pumps will be required if a primary/secondary-piping loop is included. Direct return systems shall use automatic flow controllers for water balancing.
   a. A parallel pumping configuration is required (not necessarily running at the same time).

SECTION 232500

HVAC WATER TREATMENT

GENERAL GUIDELINES

1.1 SECTION INCLUDES

A. Qualitative requirements for closed water treatment system for heating hot water, chilled water, geothermal, and heat pump condenser water systems.

B. Qualitative requirements for open water treatment system for cooling tower condenser water systems.

1.2 SUBMITTALS

A. Submittals are required and shall include product data noting catalog data, specification data, dimensional and operational data, wiring requirements with diagram, chemical specification data, and warranty data.

1.3 QUALITY ASSURANCE

A. Chemical shall meet all state and local pollution control regulations.

B. Water chemistry and makeup must meet the installed equipment's operational and warranty requirements.

1.4 WARRANTY

A. Provide a 1 year ***service program including testing and required materials and maintenance.***

***1. Chemical feed systems shall include all chemicals and additives.***

B. Filter media is to be provided as necessary to maintain the required water quality over the installation, start-up, and ***warranty*** periods.

1.5 Applicable System Types

***A. Closed Water Treatment Systems***

***1. Manual bypass chemical feeder.***

***2. Automatic glycol feeder pump.***

***B. Open Water Treatment Systems***

***1. Automatic chemical injection system.***

***2. Chemical-free Magnetic Field with alternating and reversing polarity field orientation.***

***3. Chemical-free Pulsed Electric Field.***

***4. Chemical-free Hydrodynamic Cavitation.***

***C. Open systems employing a chemical-free water treatment system shall also include a side stream filter and manual bypass chemical feeder for use with initial flushing, cleaning and cooling tower passivation. Bypass feeder shall also be utilized for additional biocide treatment if required by evidence of sampling and testing.***

| FINISHES[1]: | Spec. Ref.# |
|---|---|
| Flooring: | |
| Carpet, carpet tile | 096816 |
| Optional: linoleum, ET, | 096516 |
| sheet vinyl, or rubber | 096500 |
| | 096813 |
| Base: | |
| Resilient base | 096500 |
| Ceiling: | |
| Suspended, acoustical | 095113 |
| Walls: | |
| Painted concrete masonry units | 042000/099100 |

LOOSE FURNISHINGS:

- L1 Student desks and chairs
- L2 Teacher desk or workstation/computer support and chair
- L3 File cabinet
- L4 9' of low bookcases (fixed or mobile)
- Wastebasket

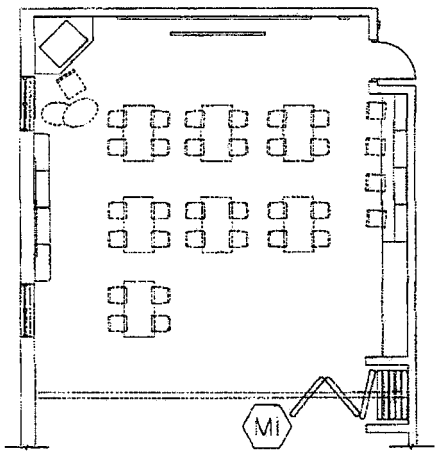
Miscellaneous:

- Pencil sharpener ***(optional)***
- M1 Operable partitions between classrooms are optional 02226
- ***E1 Duplex receptacle with dedicated circuit for wireless devices***

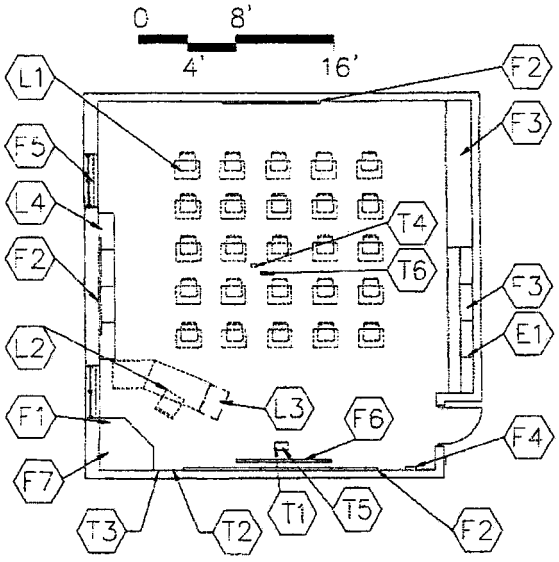
| FEATURES[1]: | Spec. Ref.# |
|---|---|
| Fixed Items: | |
| F1 Tall wardrobe with file drawers | 123550 |
| ***F2*** 20'-32' combination marker board, tack board and tackable wall surface | 101100 |
| ***F3*** 18'-24' combination base and wall cabinets | 123550 |
| ***F4*** Pencil sharpener support (optional) | 062000 |
| ***F5*** Windows with integral blinds | 085113 |
| ***F6*** Projection screen (optional) | 115213 |
| ***F7*** Technology support casework | 123550 |
| Fire Suppression: | |
| Fire suppression system | 211000 |
| Plumbing: | |
| N/A | |
| HVAC: | |
| Supply/return air system | Div. 23 |
| Independent temperature control | 230923 |
| Electrical: | |
| Fluorescent lighting: | 265100 |
| Illumination level: See Table 8600-5 | |
| Multilevel switching | 262726 |
| 4 duplex receptacles | 262726 |
| Double duplex receptacle adjacent to each data and video port | 262726 |
| Communications: | |
| T1 1 video port | 271543 |
| T2 1 voice port and phone | 271513/273123 |
| T3 1 data port near teacher workstation | 271513 |
| T4 ***Wireless access point cable above ceiling*** | 271513 |
| Clock | 275313 |
| Central sound system | 275123 |
| Sound reinforcement system | 275127 |
| T5 ***Ultra-short throw interactive*** projector | 274119 |
| ***T6 Wireless access point (WAP) as determined by Design – refer to Note 4*** | ***272133*** |
| Electronic Safety and Security: | |
| Life safety devices per code | 283111 |

NOTES:

1. Finishes/Features: Refer to Chapter 9 for specification references.
2. Technology components may be placed in a separate small cabinet, or integrated in the other casework in the room.
3. Where appropriate, some casework may be mobile to add flexibility and could become part of the loose furnishings.
4. ***Baseline includes WAP cable per classroom. WAP device quantity / placement per 272133 requirements.***




CLASSROOM WITH OPTIONAL FOLDING WALL




TYPICAL CLASSROOM

CAPACITY: 25 students
SIZE: 900 SF

PROGRAM ACTIVITIES:

- Large group, small group, and individual instruction
- Group and individual work
- Demonstrations
- Accommodates any of the core academic disciplines

SPATIAL RELATIONSHIPS:

- Near other academic core classrooms
- Proximity to large group restrooms
- Near teacher prep area/workroom
- Classrooms should be located in academic "zone" that is away from noisy or public activities
- Classrooms with access to media center and administrative services
- Flexibility of space

ENVIRONMENTAL CONSIDERATIONS:

- Required: View glass – minimum 5% without daylighting design; minimum 3% with daylighting design.
  Recommended: Daylighting design with glazing area determined by design solution.
- Environmental sound control -
  wall only minimum STC 45
  ceiling minimum CAC 35, NRC 0.70

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 placed in this classroom or could be placed in a teacher prep area/workroom.

14. LCD TVs
15. Master Clock System (as required)
16. Mechanical Closets
17. Miscellaneous Network Attached Devices
18. Pay Station Phones (as required)
19. Point of Sale Terminals (as required)
20. Printers
21. Projectors
22. Security and Access Control Systems
23. Set Top Boxes (as required)
24. Teacher Technology Centers
25. Video Conference Units
26. Wall mounted phones

*E.* ***Provide horizontal Category 6a cable drops for wireless access points.***

*F.* Telecommunication outlet/connectors that serve an individual work area may be located in multiple faceplates.

1.8 MODULAR PATCH PANELS

A. All patch panels shall be in accordance with ANSI/EIA/TIA 568B.2 (or latest) and shall be equipped with eight position, modular jacks with insulation displacement connectors, rear cable-management bars/standoffs and front label designation strips.

B. Provide 24 or 48 port, Category 5e / Category 6 rated patch panels for termination of all horizontal cabling. When the Equipment Room (ER) or Telecommunications Room (TR) serves more than one floor, sequentially group the cables by floor on separate patch panels.

*C.* ***Provide 24 or 48 port, Category 6a rated patch panels for termination of all wireless horizontal cabling. When the Equipment Room (ER) or Telecommunications Rooms (TR) serves more than one floor, sequentially group the cables by floor on separate patch panels.***

*D.* Provide color-coded, Category 5e / ***Category 6a (wireless)*** rated patch cords for all connections (plus 10% spare).

1.9 INSTALLATION

A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BISCI standards.

B. All horizontal voice / data cabling shall be terminated on patch panels and jacks as noted above.

C. Consider providing cable slack at both ends of the horizontal cables to accommodate future cabling system changes.

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

J. 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.

K. 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.

***L. The Technology Designer shall submit required technical data validating the WLAN design to achieve "one-to-one" or BYOD with the technology phase submissions. Refer to Section 27 21 33 for new requirements.***

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

## 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.

***i.*** Section 27 31 13 -- IP-Enabled PABX System.

*B.* ***Provide 10/100/1000/10G Base T Layer 2 Manageable Ethernet switch with ports in quantity to support all wireless access point devices with 15% spare.***

*C.* Switches must provide uplinks to the core switch with the following minimum bandwidth ratio:
1. 24:1 for switches supporting standard computers, printers, and telephones.
2. 12:1 for switches supporting wireless access points, multi-media devices and CCTV cameras.

*D.* The 10/100/1000 switches shall be "non-blocking" and support a minimum forwarding bandwidth equal to the number of switch ports x 1 Gbps.

*E.* ***Consider 10GB uplinks for all uplinks. Switches may be stacked, but provide each stack*** with a minimum of two uplinks for redundancy.

*F.* Chassis mounted units are acceptable for Edge Switches, provided that dual power supplies and equivalent uplink bandwidth is supplied.

*G.* The Network switches shall support advanced services such as:
1. IP Telephony.
2. Wireless Access Points.
3. Building Management Systems.
4. Video Streaming.

*H.* PoE switches shall be rated to provide POE class 3 on all ports simultaneously.

*I.* The 10/100/1000 switches shall support the following features and specifications:
1. 1000BASE-LX/LH.
2. 1000BASE-SX.
3. 1000BASE-X (SFP).
4. 1000BASE-ZX.
5. Access Control Lists (ACL).
6. Advanced QoS.
7. IEEE 802.1s.
8. IEEE 802.1D Spanning Tree Protocol.
9. IEEE 802.1p CoS Prioritization.
10. IEEE 802.1Q VLAN.
11. IEEE 802.1s.
12. IEEE 802.1w.
13. IEEE 802.1x.
14. IEEE 802.3 10BASE-T specification.
15. IEEE 802.3ab 1000BASE-T specification.
16. IEEE 802.3ad.
17. IEEE 802.3af and 802.11at POE.
18. IEEE 802.3u 100BASE-TX specification.
19. IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports.
20. IEEE 802.3z 1000BASE-X specification.
21. IPv6.
22. Rapid Spanning Tree.

***H. All equipment shall meet or exceed 802.11n requirements.***

1.4 SYSTEM WARRANTY

A. The Wireless Network Electronics and software shall be warranted by the contractor for a period of ***two (2)*** years from date of substantial completion. Provide advanced replacement for all Network Electronics for the ***two (2)*** year-period.

1.5 WIRELESS NETWORKING

***A.*** GENERAL

***1. Design Wireless System to assume coverage for 1:1 and/or BYOD throughout all educational areas 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.***

***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 or via a Mid-Span IEEE 802.3af POE Injector connected to the IP Network.***

9. Coordinate 802.31x, VLAN and Security Settings/Requirements with the District.

***10. Shall provide proper network authentication and authorization***

***11. Security shall have the ability to check antivirus software***

***12. Wireless network management shall utilize the same firewall, NAC, and RADIUS as the LAN***

***13. System shall allow different user groups to be created with each group mapped to specific VLANS, access control list, and QoS parameters***

***14. 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***

***15. Once the system has identified the device, a policy can be applied to control a device's reach and behavior***

***16. The device ID along with the user ID shall be used together to map that instance to a specific user group***

17. Provide Wireless coverage for the entire building and associated perimeter area.

18. Provide minimum of ***-65 dB*** signal level at all locations in building for 802.11n coverage.

***19. Provide a minimum of 7 Mbps throughput per user.***

***20. Technology Designer shall verify quantity of users with the District.***

21. Supply sufficient Access Points to provide for expected throughput and load sharing.
22. For labs and other high-density areas, make sure that the users can "see" at least 3 Access points to provide for load sharing and balancing.
23. ***Wireless system shall have full multi-media capabilities by integrating:***
    - a. ***802.11e***
    - b. ***WMM***
    - c. ***QoS***
    - d. ***Stateful Firewall***
    - e. ***Wired to wireless mapping and traffic management services based on device, user and/or traffic types. This include priority queuing for multiple traffic types as well as multicast snooping and pruning.***
    - f. ***All APS/Arrays shall provide the ability to optimize multicast traffic by converting to unicast and/or optimize multicast traffic transmit rates to better match speeds of connected users.***
24. ***Wireless system shall provide the following security functions:***
    - a. ***Dedicated 24/7 threat sensor radio***
    - b. ***Stateful firewall***
    - c. ***Integrated RADIUS***
    - d. ***Integrated ACLs, 802.11i, 802.1***
    - e. ***Line rate encryption, no matter the traffic volume of encryption protocol in use.***
25. ***Wireless Design Validation***
    - a. ***During Design Phase, the Technology Designer shall utilize wireless software to plan the wireless access point deployment in a building and/or campus.***
    - b. ***The Technology Designer shall submit a predictive analysis survey via use of WLAN modeling software, along with the OSFC DD and CD technology phase submissions for review.***
    - c. ***As a minimum, this analysis shall indicate protocol throughout and client decisions(??).***
    - d. ***The WAP quantity and layout shall be based on this modeling.***
26. ***Wireless Installation Validation***
    - a. Prior to installation of cabling for Access Points, the contractor shall perform an on-site Validation Survey. This survey shall be utilized to obtain actual site conditions including RF environment and RF properties of the construction. Prepare an AP placement plan utilizing the Validation Survey information and using the AP controllers "planning" tools. Provide a report to the Owner and Technology ***Designer*** for review and approval.
    - b. After complete install of all AP's, perform a final survey ***and tune/optimize the system*** to verify coverage. Move any AP's required to guarantee that coverage and performance requirements are met. Provide final report to the Owner and Technology ***Designer*** for review and approval.
27. Coordinate with local Law Enforcement and Safety Forces regarding their requirements for remote and wireless access into building Security and Energy Management Systems.
28. Law Enforcement and Safety Forces shall be responsible for providing their own remote access equipment.

*B. CABLING INFRASTRUCTURE FOR WIRELESS LOCAL AREA NETWORK*

1. *Shall consist of single mode fiber for the backbone to enable 10Ggig backbone and provide upgradability for future.*
2. *Shall utilize CAT 6A horizontal cable solution.*
3. *Baseline includes CAT6A cable to each classroom. Wireless design will determine quantity and placement of WAP's.*
4. *Shall utilize 1 Gig uplink to the switch and a 10 Gig uplink to the headend equipment.*

*C. WIRELESS SYSTEM SPECIFICATIONS*

1. *RF Management*
2. *In-band per IAP Spectrum Analysis*
3. *Dynamic Channel Configuration*
4. *Dynamic Cell Size Configuration*
5. *Monitor radio for threat assessment and mitigation*
6. *Wired and Wireless Packet Captures (including all 802.11 headers)*
7. *Radio Assurance for radio self test and healing*
8. *RF Monitor*
9. *High Availability Supports Hot Stand-By for mission critical areas*
10. *Supports ability to turn off radios based on schedule configuration*

*D. WIRELESS PROTOCOLS*

1. *IEEE 802.11*
2. *IEEE 802.11 a*
3. *IEEE 802.11 b*
4. *IEEE 802.11 d*
5. *IEEE 802.11 e*
6. *IEEE 802.11 g*
7. *IEEE 802.11 h*
8. *IEEE 802.11 i*
9. *IEEE 802.11 j*
10. *IEEE 802.11 n*

*E. WIRED PROTOCOLS*

1. *IEEE 802.1p – Layer 2 Traffic Prioritization*
2. *IEEE 802.1q – VLAN Tagging*
3. *RFC Support*
4. *RFC 768 UDP*
5. *RFC 791 IP*
6. *RFC 2460 IPV6 (Bridging only)*
7. *RFC 792 ICMP*
8. *RFC 793 TCP*
9. *RFC 1122 Requirements for Internet Hosts – Communication Layers*
10. *RFC 1542 BOOTP*
11. *RFC 2131 DHCP*

*F. SECURITY*

1. *IEEE 802.11iWPA2, RSN*
2. *RFC 1321 MD5 Message-Digest Algorithm*
3. *RFC 2246 TLS Protocol Version 1.0*

SECTION 271543

AUDIO-VIDEO COMMUNICATIONS HORIZONTAL TRANSPORT SYSTEM

GENERAL GUIDELINES

1.1 GENERAL

A. The baseline A/V system shall utilize digital sources and digital transport medium, to all display devices. The Technology Designer shall provide active electronics where required due to cable distance limitations. Coordinate infrastructure sizes and routing with the Electrical Designer.

B. The use of analog sources and transport medium shall be ***legacy only***.

C. ***All new work shall be digital systems.*** This Section defines the general design requirements for a uniform Audio-Video Horizontal Transport System Infrastructure that shall be followed for all OSFC Technology construction projects.

***D.*** Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

***E. Refer to Figure 1 – Typical classroom audio-visual system components for general overview of equipment and interconnectivity***

1.2 SECTION INCLUDES

A. AUDIO-VIDEO COMMUNICATIONS HORIZONTAL TRANSPORT SYSTEM
   1. ***Instructor AV interface outlet.***
   2. ***Guest AV Interface Outlet (optional)***
   3. ***Wardrobe AV equipment interface outlet***
   4. ***Instructor AV equipment interface outlet***
   5. ***Classroom Interactive Projector AV interface outlet***
   6. ***Public Monitor/TV AV Interface Outlet***

1.3 QUALITY ASSURANCE

A. All equipment shall be UL listed.

B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.

C. All equipment Installation Practices shall comply with the Local Electric Code.

D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.

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

1.4 SYSTEM WARRANTY

A. System shall carry an industry standard, performance based warranty, by the contractor, for a period of at least 20 years on the cabling; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of one (1) year from date of substantial completion.

1.5 ***AV INTERFACE OUTLETS***

A. ***Each classroom/lab shall be provided with AV system interface outlets to transport digital media from and to the required AV equipment.***

B. ***The video cabling shall utilize the appropriate media to transport digital signals including HDMI, DVI and USB. In addition, where required the cabling shall be provided to transport analog audio media, RS-232 controls and IR controls.***

C. ***Instructor AV Interface Outlet***

1. ***Provide Digital AV interface of HDMI or DVI for connection to the room projector or room HDMI/DVI switch. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.***

2. ***Where the room sound enhancement system is not co-located at the Instructor location, provide additional analog audio cabling to the sound enhancement system.***

3. ***Provide interface for USB cabling to local interactive projector.***

D. ***Guest AV Interface Outlet***

1. ***Provide Digital AV interface of HDMI or DVI for connection to the room projector or room HDMI/DVI switch. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.***

E. ***Wardrobe AV Equipment Interface Outlet – Provide the following cables as required by room interconnectivity design***

1. ***HDMI/DVI switch***
   a. ***Provide Digital AV interface of HDMI or DVI for connection from the Instructor AV Interface, Guest AV Interface, local AV device (BluRay player, Set-top box) and the room projector. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations***
2. ***Sound Enhancement System***
   a. ***Provide speaker, line level audio (from Instructor AV Interface Outlet, HDMI/DVI switch) and IR sensor cabling.***

3. ***Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.***

F. ***Instructor AV Equipment Interface Outlet - Provide the following cables as required by room interconnectivity design.***

1. ***Provide Digital AV interface of HDMI or DVI for connection from the Guest AV Interface, local AV device (BluRay player, Set-top box) and the room projector. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.***

2. ***Sound Enhancement System***
   a. ***Provide speaker, line level audio (from Instructor AV Interface Outlet, HDMI/DVI switch) and IR sensor cabling.***

3. ***Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.***

G. ***Classroom Projector AV Interface Outlet***

1. ***Provide Digital AV interface of HDMI or DVI for connection to the Instructor AV Interface Outlet, the Wardrobe AV Equipment Interface Outlet and/or the Instructor AV Equipment Interface Outlet. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.***

2. ***Provide interface for USB cabling to Instructor AV Interface Outlet***

3. ***Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.***

H. ***Public Monitor/TV AV Interface Outlet***

1. ***Provide CAT 5e/6 network connectivity as a dual data drop.***

2. ***Where required to have local input - Provide Digital AV interface of HDMI or DVI for connection to the Guest AV Interface Outlet, the Wardrobe AV Equipment Interface Outlet and/or the Instructor AV Equipment Interface Outlet. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.***

## *1.6 AV INTERFACE CABLES*

### *A. Digital Video Cables*

1. ***Provide listed cabling to support digital format such as DVI, HDMI, etc. Provide active electronics where required for selected cable distance limitations or for UTP based solutions.***

2. **The use of HDMI cables may present specific challenges due to the limited bending radius of the cables, the depth of the outlet boxes, and the conduit installation requirements to pull the pre-terminated cables through.**

***B. Line Level Audio Cable***

1. ***Provide shielded twisted pair cable connected to Female RCA connectors (White/Red).***

***C. Projector Network Cable***

1. ***Option 1 – Provide one (1) Category-5e/6 UTP cable connected to Category-5e/6 patch panel in associated Telecommunications room.***

2. ***Option 2 – Provide one (1) RS-232 cable connected to RS-232 to IP Interface.***

***D. Set-Top-Box Network Cable***

1. ***Provide one (1) Category-5e/6 UTP cable connected to Category-5e/6 patch panel in associated Telecommunications room.***

***E. Instructor Technology Center Network Cable***

1. ***Provide two (2) Category-5e/6 UTP cables connected to the Category-5e/6 patch panel in associated Telecommunications room.***

***F. USB Cable***

1. ***Provide one (1) UTP to USB converter on each end with corresponding cabling to connect interactive projector and Teacher Workstation together through UTP based cabling.***

## *1.7* VIDEO COVER PLATES

A. Plates shall be modular to fit all video jack components and shall match the associated voice/data plates.

## *1.8* INSTALLATION

A. Contractor shall provide and install ***AV Interface*** Wiring System.

B. Cables and associated connectors shall be terminated in accordance with industry standards.

C. Route the classroom Sound Reinforcement Amplifier IR sensor coax and associated speaker cables through the LO faceplate to the Amplifier.

1.4 SYSTEM WARRANTY

A. The Video Display Equipment Systems and associated software shall be warranted by the contractor for a period of ***two (2) years*** from date of substantial completion.

1.5 FLAT PANEL ***MONITORS*** AND PROJECTOR MOUNTS

A. Provide wall type flat panel mounts with appropriate forward tilt, or fully articulating arm, as required.

B. Provide Ceiling or Wall Mounts for projectors with appropriate provisions for electrical outlet and A/V cables.

C. Utilize security/theft-deterrent mounting hardware on all projectors, displays and mounts as required.

1.6 INTERACTIVE PROJECTORS

A. Ambient light considerations shall be coordinated with the Architect and Electrical Engineer/Lighting Designer to produce a minimum contrast ratio of 10:1. This often requires blocking of daylighting and dimming of electric lights to produce no more than 10-14 vertical foot candles (108-151 lux) on the projection surface.

B. Provide high resolution video/data projectors for each classroom, laboratory, and media center.

C. Conference Rooms may be equipped with either a small venue projector or a flat-panel ***TV/Monitor.***

D. ***Ultra-short throw interactive*** projectors are required in classrooms. They shall be capable of being interfaced with ***any*** interactive technology ***in the classrooms.***
   ***1. Verify ADA requirements are met for mounting locations.***

E. The aspect ratio of projectors shall be 16:9 or 16:10. Aspect ratios of 4:3 should be used only to accommodate legacy equipment.

F. Provide all projectors with an Ethernet control interface, either through direct connection or via Ethernet-to-RS-232 adaptor. Provide global central management control/tracking software.

G. Small Venue (Classroom/Labs/Small Rooms) ***Interactive*** Projectors
   1. The projector shall produce a minimum of 3000 ANSI Lumens for standard projectors or 2500 ANSI Lumens for ultra-short throw projectors.
   2. It shall have a minimum native resolution of 1280 x 800 and be capable of displaying resolutions up to 1080p (720p).
   3. ***Inputs/Outputs – Shall consist of the following:***
      ***a. HDMI***
      ***b. Computer / component video: D-sub 15 pin***
      ***c. Composite video: RCA***
      ***d. Audio in x 3: RCA (L and R), Mini stereo***
      ***e. Variable audio out: Mini stereo***

1.8 VIDEO CAMERA SYSTEM

A. Provide ***1*** digital Video Camera with a wheeled tripod for remote origination of video broadcasts, and announcements. Equip each camera with a dual MPEG 4/H.264 Encoder Unit for broadcasting low and high bit rate digital streams.

B. It shall be possible to broadcast the portable camera signal across the IP Network to Monitors, Projectors and/or PCs in the school or any of the other schools within the District, and simultaneously record the signal if desired. The Camera can be used for Video Announcements, recording of lessons and/or events or as a point-to-point link between any two (2) schools.

1.9 VIDEO BLU-RAY SYSTEM

A. Provide ***1 Blu-Ray*** player located in the Media Center for live streaming and recording. Equip each unit with a dual MPEG 4/H.264 Encoder Unit for broadcasting low and high bit rate digital streams.

***1.10 DIGITAL BROADCAST MEDIA SOURCE SYSTEM***

***A. Provide 6-12 channels of digital broadcast media sources. Connect sources to A/V MPEG-4/H.264 encoder input for streaming to the network.***

***B. The Technology Designer shall coordinate with the District to determine applicable digital broadcast media sources, such as specific CATV channels, off-air channels and satellite channels, as can be incorporated within the budget.***

***1.11*** INSTALLATION

A. Contractor shall install and program all Digital Video Distribution Equipment and establish all necessary VLANs as required.

***1.12*** LABELING

A. Cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District.

B. All Video Cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.

***1.13*** TESTING

A. Video Wiring system and associated systems shall be tested end-to-end complete.

***1.14*** TRAINING

A. Provide minimum of sixteen (16) hours training for District personnel on the operation and maintenance of each of the AV Media systems.

B. ***Provide four (4) hours of follow-up training during the 11 month walk-through period.***

***C.*** Provide ***a digital video copy*** of all training.

***D.*** MPEG-4 encode and place a copy of training video on VOD server.

END OF SECTION