APPENDIX O

RECOMMENDED GUIDELINES FOR AUDIO/VISUAL TECHNOLOGIES (AV TECHNOLOGY)

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A. GENERAL REQUIREMENTS

1. Institutional learning spaces should support diverse learning styles, be versatile and configurable, comfortable, attractive and provide appropriate audio/visual and learning technology. This should be balanced with use of institutional standard AV technology with a faculty-friendly control system that is easy to use and consistently deployed throughout the institution.

2. In addition to these design guidelines, the A/E is responsible for smart classroom design and system components that meet the institution's standards. Also, the A/E is responsible for coordinating location of all devices to accommodate furniture layout. These guidelines apply to classrooms, conference rooms or other similar spaces where presentations, seminars, instruction or conferencing are a required function. The intent is to establish a starting point for design that will meet with the institution's requirements; it is expected revisions to this guideline will be made to fit the project.

B. MECHANICAL SYSTEM

Note: The mechanical system design shall meet the OFPC Division 23 guideline specifications.

1. Design classroom zone HVAC air-handling components using low velocity ductwork systems.

2. Design HVAC systems with a minimal need to access systems via classroom for maintenance.

3. Resiliently caulk all fixtures at the penetration point. This includes pipes, ducts and conduit penetrating through walls, ceilings, and floors.

4. Design systems to reduce exterior noise from entering room. Classroom walls should extend above ceiling to deck.

5. Coordinate systems so that space is provided for classroom technology components that may require space above finished ceilings.

6. Isolate equipment mounted adjacent to and above a classroom from vibration.

7. Do not locate supply air or return air devices close to projection screens.

8. Select room air devices to meet the sound criteria in Section 2 of this guideline.

9. Design the classroom HVAC systems to operate as a separate zone with controls to operate independently from other spaces within building. Design equipment projection booths, rear projection rooms, and control rooms with separate HVAC zones independent of the classroom. Systems using Mylar rear projection system mirrors must be air-conditioned 7x24 to prevent the Mylar from sagging and wrinkling.

10. Maintain general building specifications regarding temperature and humidity. Rear projection room temperature should be maintained at 72-76 degrees with humidity of 45%-to-55%. Position air registers so that air does not blow directly onto the Mylar mirror. If a blackout curtain is used around the rear projection system, provide an even airflow and an adequate return air volume inside the blackout curtain space.

11. Place air-conditioning registers along the perimeter of the room and the air returns in the center, front or rear of the room. Select air devices for low velocity air conditioning system to minimize airflow noise in the room. Provide return air transfer duct with an offset inlet/outlet configuration to isolate the room from the noise in the plenum air space. If the mechanical room is in close proximity to the classroom, evaluate the requirement for sound attenuators based upon the classroom NC criteria in Section 2, to reduce the mechanical system noise to meet these guidelines.

12. Install and maintain mechanical systems (ducts and piping) along sidewalls for horizontal air flow into the room, and to allow the front central area projection screens to be constructed as high as possible.

13. Integrate systems that serve classrooms with the central monitoring system or energy management system.

14. Do not use fan coil units or other fan powered elements of the mechanical system in the classroom ceiling space.

C. ACOUSTICAL SYSTEM

1. Consider wall and ceiling treatments that improve intelligibility in the classroom and to keep noise outside and internal building noise from being audible inside the classroom. Specify flooring with IIC (Impact Isolation Class) that prevents sound transmission. Specify walls with sound transmission class minimum rating of 50. Provide sound rated doors with acoustical door seals. The surface of the ceiling must be designed to accommodate the required acoustical properties of the room. The area of the ceiling to be acoustical tile is a function of ceiling height. A 9’ ceiling height typically requires that 40% - 50% of the total ceiling area to be acoustical tile. A ceiling height of 10’ typically requires that 50% - 60% of the

ceiling be acoustical tile and a ceiling height of 12' typically requires that 70% - 80% of the ceiling area be acoustical tile.

The acoustical tile shall be arranged in center of the room with a sheetrock ceiling enclosing the acoustical tile area.

Ceiling tiles with a Noise Reduction Coefficient (NRC) of .65-.85 and a minimum Sound Transmission Coefficient (STC) of 50 shall be used.
Access hatches must be installed in the ceiling wherever gypsum board or plaster is used to facilitate access to otherwise inaccessible areas of the ceiling cavity.

2. Separate classrooms from external and internal sources of noise such as loading docks, parking lots, streets, mechanical and equipment rooms, vending areas, elevator, locker rooms and dining facilities.

3. Minimal acoustical requirements:

   a. NC Ratings
      General Classrooms: NC 35 or less
      Auditorium/Lecture Hall: NC 25-30, or less
      Distance Learning Classroom: NC 25-30, or less

   b. Reverberation Time
      General Classroom: RT60 of .4 seconds or less
      Small Auditoriums: RT60 of .8 seconds or less
      Large Auditoriums: RT60 of 1.5 seconds or less

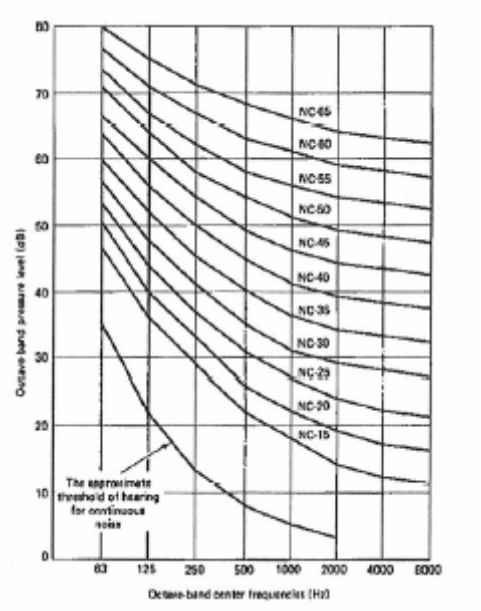
4. Overall noise criterion of less than 30 dBA is required, with the maximum sound level not to exceed 35 dBA.

5. In all conference rooms, use acoustically absorbent materials with an NRC rating of .85 or greater.

6. Acoustical Standard Testing Procedures

   a. Noise Criteria (NC)

      (1) A reference level based on a chart of frequency vs. sound pressure (dB) curves that displays sound levels perceived by the human ear as equal in magnitude. The highest NC curve touched by a plot is the sound NC level. NC curves apply to sound pressure levels in an occupied space, not equipment sound power levels.



(2) Conditions: Windows and doors closed, with the HVAC on in the room and minimal external noise from adjacent locations.

(3) Acquire Data: With microphone at 48 inches, AFF located in middle of the instructor station location area at the front of the room.

(4) Standard: NC of 35 or less for classrooms. NC of 25-30 or less for auditoriums and distance learning classrooms.

b. Reverb Time (RT60):

(1) Reverberation time is the time required for the sound level in the room to decay 60 dB. In other words, it is the time needed for a loud sound to become inaudible after turning off the sound source.

(2) Conditions: Windows and doors closed, with the HVAC on in the room and minimal external noise from adjacent locations.

(3) Acquire Data: With microphone at 48 inches, AFF located in middle of the instructor station area at the front of the room.

(4) Standard: RT60 of 0.40 seconds or less for standard classrooms, RT60 of 0.80 for small auditoriums (100 to 200 seats) and RT60 of 1.50 seconds for large auditoriums (more than 200 seats).

c. Equipment

(1) As specified.

D. ELECTRICAL SYSTEM

Note: The electrical system design shall meet the OFPC Division 26 guideline specifications.

1. General Power Requirements

   a. Audio-visual systems require clean, high quality AC power to operate correctly and reliably, as recommended by the equipment manufacturer. A conservative number of ac power circuits shall be dedicated exclusively to the audio-visual systems.

   b. Ensure that “Star” ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other, and are each “home-run” back to the dedicated breaker panel for AV systems.

   c. Provide isolated, insulated copper ground conductor, in a separate conduit, from the building ground at the transformer case to the room equipment electrical panel and from the panel ground bus to the equipment rack(s). All grounds will be connected to the main building ground and as required by National Electrical Code.

   d. All audio, video and control electrical circuits should be fed from "clean" legs of the power transformer free of high inductive loads. There shall be no elevator motors, compressor motors, blower motors, etc. on the secondary side of the power transformer that feeds the media equipment.

   e. In rooms where the data/video projector is to be ceiling mounted, a flush 120V duplex power outlet is required. Location of the outlet is to be determined during design.

2. Convenience outlets and floor boxes

   a. Conference rooms are to have a minimum 3 data RJ-45 data outlets and 1 analog fax/audio conference telephone line outlet installed. These connections are to be installed in the floor box in new construction or mounted on the front wall below the projection screen in existing construction.

   b. Classrooms will have a minimum of 3 RJ-45 data outlets in each of the floor boxes and 1 analog fax/audio conference line in the floor box designated for the instructor station connections. For existing classrooms, the connections are to be installed in the wall box with the instructor station connections.

c. Two additional data outlets are required for videoconference capable conference and classrooms. These additional RJ-45 data connections are to be located in the vicinity of the audiovisual support equipment racks.

d. The project manager should coordinate with institution to locate wireless access points.

e. Install 4 standard power outlets close to projector connection to serve additional equipment.

f. A/V floor boxes should include dedicated conduit for Data (1 inch), Security (1 inch), Power (1 inch) and A/V (1 1/2 inches). Box should be sized as small as possible to fit under table pedestals.

g. Install two additional data outlets close to projector location to provide network-connectivity to projector and network-connectivity for IP Surveillance Camera. The project manager should coordinate with institution to locate Network points.

h. Provide convenience outlets in the front of the room.

i. Coordinate special requirements for plasma display screens; ensure power and A/V connections are located behind display screen.

3. Dedicated distribution panels

a. All circuits for the system shall be taken from the same phase, with a dedicated distribution panel for all audio-visual classroom circuits.

4. Conduits

a. Requirements for raceway system shall be per OFPC Division 26 specifications.

b. Conduit from equipment rack location should include, at a minimum, Data (1 inch), Security (1 inch), Power (3/4 inch), Lighting control (1 inch), Screen control (1 inch), and three (3) A/V (1 ½ inch). One A/V conduit will go to floor box and two (2) conduits to stub out above drop ceiling for speakers and projector.

5. Conductors

a. Requirements for conductors shall be per OFPC Division 26 specifications.

6. Provide scaled elevation dimensioned drawings for all controllers, phones, and other device locations.

E. CATV

1. Provide a minimum of one CATV connection in all conference rooms and classrooms. In locations without access to CATV provide connections to local Cable-TV systems or satellite downlinks. In conference rooms the CATV connection should be on the wall below the projection screen. In classrooms there should be CATV connections at the instructor station location and audiovisual equipment support racks.

F. SECURITY SYSTEM

1. Provide security alert on all equipment as required. Provide conduit from the room to the telecommunications closet for running fiber optic security line to monitor the installed equipment. Coordinate with institution police department.

G. LIGHTING SYSTEM

1. General

a. Conference room non-videoconference capable. Measured at tabletop height 40 to 50 foot-candles horizontal all across the seating area of the room. Legible foot-candles on the projections screens.

b. Conference rooms videoconference capable.

(1) Measured at tabletop height: 40 to 50 foot-candles horizontal all across the seating area of the room.

(2) Measured at 40” above the finished floor: 50 to 70 foot-candles vertical all across the seating area, as measured looking toward the projection screen from the seating area.

(3) Measured from the presentation area looking toward the seating area: 40 to 50 foot-candles at instructor station height of approximately 40” to 75” above the finished floor and 60-80 foot-candles vertical measured from 40” to 75” above the finished floor.

(4) Measured at projection screen: negligible foot-candles on the projections screens. Wall wash on all but the projection screen wall should have a wash of 50 to 70 foot-candles.

c. Classroom non-videoconference.

(1) Measured at tabletop height 40 to 50 foot-candles horizontal all across the seating area of the room. 0 foot-candles on the projection screens. Presentation area 40 to 50 foot-candles at instructor station height of approximately 40" above the finished floor.

d. Classrooms videoconference capable.

(1) Measured at tabletop: height 40 to 50 foot-candles horizontal all across the seating area of the room.

(2) Measured at 40" to 75" above the finished floor: 50 to 70 foot-candles vertical all across the seating area. This would be looking toward the projection screen from the seating area. From the presentation area looking toward the seating area 40 to 50 foot-candles at instructor station height of approximately 40" above the finished floor and 70 to 110 foot-candles vertical measured from 40" to 75" above the finished floor.

(3) Measured at project screens: Negligible foot-candles on the projections screens. Wall wash on all but the projection screen wall should have a wash of 50 to 70 foot-candles.

e. The color temperature for all lighting fixtures should be the same. The color temperature target goal is 3200 degrees Kelvin. Color temperature in the range of 3000 to 3500 degrees Kelvin is acceptable as long as all the fixtures are the same.

f. In non-videoconference capable conference rooms both general fluorescent and compact fluorescent down lighting should be provided. Sufficient compact fluorescent down lights should be provided to achieve an even 40-50 foot-candles of light across the seating area at tabletop height when the projection screen is used. Care should be given to select luminaries that will provide a minimum light spill on to the projection screen.

g. In non-videoconference capable classrooms both general fluorescent and compact fluorescent down lighting should be provided. Sufficient compact fluorescent down lights should be provided to provide an even 40-50 foot-candles of light across the seating area at tabletop height when the projection screen is used. In the presentation area directional lighting fixtures should be used to provide 40-50 foot-candles of light on the instructor station and keep the light from spilling on to the screen. One or two compact fluorescent down lights should be used above the instructor station to light the workspace on the instructor station. Care should be

given to select luminaries that will provide a minimum light spill on to the projection screen.

h. In videoconference capable conference rooms asymmetrical fluorescent luminaries should be provided. Asymmetrical luminaries direct the light away from the projection screens and minimize glare from the ceiling for wide angle camera views that often include the ceiling and provide adequate down light for general meetings and videoconferences. A sufficient number of asymmetrical fluorescent luminaries shall be provided over the seating area to provide a range of 50-70 vertical foot-candles looking toward the presentation area. Adjustable fixtures with pattern adjustment capabilities should be used to provide 60-80 vertical foot-candles as the presenter looks toward the seating area. One or two compact fluorescent down lights should be used above the instructor station to light the workspace on the instructor station. Use wall wash luminaries to light all but the presentation walls for videoconferences. Adjustable pattern wall wash fixtures shall be used to light the wall behind the presenter without spilling onto the projection screen. Use wall wash fixtures to light markerboards.

i. In videoconference capable classrooms asymmetrical fluorescent luminaries should be provided. Asymmetrical luminaries direct the light away from the projection screens and provide adequate down light for general meetings and videoconferences. A sufficient number of asymmetrical fluorescent luminaries shall be provided over the seating area to provide a range of 50-70 vertical foot-candles looking toward the presentation area. Adjustable fixtures with pattern adjustment capabilities should used to provide 70-110 vertical foot-candles as the presenter looks toward the seating area. One or two compact fluorescent down lights should be used above the instructor station to light the workspace on the instructor station. Use wall wash luminaries to light all but the presentation walls for videoconferences. Adjustable pattern wall wash fixtures shall be used to light the wall behind the presenter without spilling onto the projection screen. Use barn doors or internal shutter to cut off the light above the bottom of the projection screen.

j. Placement of light fixtures should not obstruct sight lines to screens or projection throws.

2. Requirements for lighting control
(Lighting control shall meet AHRAE 90.1 requirements)

a. Control system cover plates such as lighting switches and projection screen switches shall be labeled or permanently etched clearly in 3/16 inch high lettering.

b. Light dimming capabilities shall be provided as an integral part of all conference rooms and classrooms.

c. For non-videoconference capable conference rooms and classrooms provide wall mounted dimmers for at least 4 zones.

(1) Zone 1 shall be the fluorescent luminaries immediately in front and to the side of the projection screen.
(2) Zone 2 shall be the rest of the fluorescent luminaries in the room.

(3) Zone 3 shall be the compact fluorescent down lights above the seating area.

(4) Zone 4 shall be the compact fluorescent down light and adjustable pattern fixtures for the presentation area.

d. For non-videoconference capable conference rooms provide an electronic controlled dimming system. Include an audiovisual control system interface. Provide a minimum of zones with one 5-button entry control panel and a multi-scene wall mounted master controller.

(1) Zone 1 shall be the fluorescent luminaries immediately in front and to the side of the projection screen.

(2) Zone 2-3 shall be the rest of the fluorescent luminaries in the room.

(3) Zone 4 shall be the lighting for the instructor station.

e. For videoconference capable classrooms provide an electronic controlled dimming system. Include an audiovisual control system interface. Provide a minimum of 13 zones with one 5-button entry control panel and a multi-scene wall mounted master controller.

(1) Zone 1 shall be the fluorescent luminaries immediately in front and to the side of the projection screen.

(2) Zone 2-4 shall be the rest of the fluorescent luminaries in the room.

(3) Zone 5 shall be the compact fluorescent down light for the instructor station.

(4) Zone 5-6 adjustable pattern fixtures for the presentation area.

(5) Zone 7 shall be the wall wash fixtures behind the instructor station.

(6) Zone 8-10 shall be the wall wash fixtures on the rear and 2 side walls.

(7) Zone 11 shall be the lighting in any technician control area.

(8) Zone 12-13 shall be for rear projection equipment rooms.

f. Basic classroom lighting controls shall be placed at all entrances in new construction. Controls for presentation writing surface lighting must be placed on both sides of the front wall. For new construction, lighting controls for the presentation writing surface shall be configured to allow the projection screen and instructor's writing surface to be used simultaneously. That is, the lights over the writing surface shall be controlled in separate sections to provide illumination of a portion of the presentation writing surface while a projection screen is in use.

3. Illumination Level Standards

Full capacity, overall even illumination - 60 foot-candles (Even illumination is defined as ±10 foot-candles from mean and distributed uniformly)
Note-taking illumination – 5 foot-candles (Required)
Marker or Presentation Board – 75 foot-candles

4. Lighting Standard Testing Procedures

a. Work Surface Lighting Levels: The level of light in foot-candles on the working surfaces of the room.

b. Conditions: Lights on at full capacity. Room shades and blinds closed.

c. Acquiring Data: Divide the floor area into a 3 by 3 grid pattern evenly dispersed across the student seating area. Measure levels at table height of 30 inches AFF.

Front of room looking down

1	2	3
4	5	6
7	8	9

d. Standards

(1) 60 foot-candles is the minimum design level required, ±15 is acceptable. All readings shall be mean averaged and noted.

(2) Even lighting is defined as ±10 foot-candles from mean. Deviation within a space in excess of 10 foot-candles shall be noted.

e. Equipment: as specified.

5. Reduced Note-taking Light Testing Procedures

a. Conditions: Lights on at low volume. Room shades and blinds closed.

b. Acquiring Data: Dividing the floor area up into a 3 by 3 grid pattern evenly dispersed across the student seating area. Measure levels at table height of 30 inches AFF.

c. Standards: Five foot-candles is required. ±10 is acceptable. All readings shall be mean averaged and noted.

d. Equipment: as specified.

6. Glare

a. Glare in the field of view of the presentation surfaces shall be a contrast ratio of 3:1 or less.

7. Glare Contrast Measurement Testing Procedure

a. Glare is defined as any brightness in the field of vision that causes discomfort, reduction in vision or eye fatigue. Glare is the result of excess light that is in the normal line of sight in the work area. Excess light can be emitted directly from the fixture, or be reflected from a glossy surface.

b. There can be actual intensity levels exceeding 1:250 within the space, but the ratio of highest intensity to that of background intensity is more crucial in determining glare conditions. A ratio of 2:1 or greater between the peak and the median begins to feel uncomfortable. Any ratio of 3:1 or greater positively produces a sensation of discomfort and should be avoided.

c. Conditions: Lights on at full capacity. Room shades and blinds closed.

d. Acquiring Data: Divide the students' field of view into a 5 by 2 grid pattern evenly dispersed across the field of view from the middle of the student seating area. Acquire data and note. Then look at the brightest point in the field of view, and note as the peak reading.

Looking at front presentation area

1	2	3	4	5
6	7	8	9	10

e. Standards: A contrast ratio of 3:1 or less is acceptable. Average the light level in the field of view and note. Give the ratio to the peak measurement.

f. Equipment: as specified.

8. Energy efficient fixtures shall be used. (Design shall meet ASHRAE 90.1 requirements.)

9. Emergency directional exit signage and emergency egress lighting (Design shall meet NFPA requirements.)

10. Motion detectors. (Design shall meet ASHRAE 90.1 requirements.)

11. Color and reflectance values

a. Specify colors and finish materials with minimum reflectance values and to enhance A/V functionality of classrooms.

H. NETWORKING AND TELECOMMUNICATIONS SYSTEM

1. Location for telephones

a. A telephone outlet shall be installed in the presentation area of the classroom. When a classroom includes a booth, the booth also shall have a telephone outlet.

b. Telephone outlets for wall-mounted phones shall meet ADA requirements.

c. Classrooms shall have a minimum of four data connections in a single-gang box located in coordination with the A/V system requirements. When the classroom has a booth, the booth shall have a minimum of two data connections. If a storage room exists within the classroom space, it shall have a minimum of two data connections.

d. Conference room table locations shall have provisions for speaker phone.

e. Coordinate with institution for location of wireless access.

I. AUDIO VISUAL SYSTEM

1. Projection Capable Classroom: A classroom that has data/video projection capabilities, Internet connectivity at the instructor station, a VCR and/or other input device, a user-friendly laptop interface/control system, and capabilities for other add-on modular features. Projections-capable classrooms use standardized control/interface systems and employ a standardized operational protocol.

2. Instructor station

    a. Connection of umbilical cable to instructor station.

    b. Design to meet ADA requirements.

3. Projection

    a. A 120V, 20-amp duplex outlet is required at the support for the projector-mounting bracket structural ceiling.

    b. Coordinate where the projector shall be placed with institution.

    c. Locate projection screen writing area separate from projection surface so that the writing is not covered.

    d. Provide electrically operated projection screens, unless noted otherwise. Controls shall be located at switch height next to lighting controls. Presentation lighting fixtures shall not be directly in contact with or interfere with the movement of the projection screen(s).

    e. Ensure screens in lowered positions clear chalk/white board trays and do not obstruct control switches, exit signage, motion detector, A/V fire alarm devices, clocks etc.

    f. Projector appropriate for room size, minimum 1024 x 768 native resolution.

    g. Connections for the projector at the instructor station to be mounted on wall or in floor (as appropriate to room).

    h. Connections on interface panel to include VGA connector, composite video connector, Component (S-video) connector, and audio connections for both computer and video models.

4. Sound System

    a. Input to follow the data projectors video input.

    b. Speakers to be mounted in a location that allows stereo sound to be provided to the classroom.

    c. Speakers must have enough power to provide comfortable listening level in the classroom (powered speakers or a separate powered amplifier as necessary).

d. Speaker system to have wireless mike capability and the "audio-out" can be captured on the presentation computer.

e. Provide ability to connect other equipment as required (document camera, whiteboard, smartboard etc.)

f. Design to meet ADA hearing assisted device requirements.

J. CLOCK/BELL SYSTEM

1. Clocks shall be placed on a wall in each classroom (other than the front wall).

2. Clocks shall be self-correcting for accuracy. If DC-powered, the battery shall have an extended (multi-year) life expectancy.

3. Clocks shall be integrated into existing system.