# AV Basis of Design

**Illinois Project #:**

**Space Location:**

**Date of Creation:**

**Latest Revision:**

**Project Name:**

**Space Type:**

**Space Usage:**

**Other Notes:**

## General Information

<table>
<thead>
<tr>
<th>Room Types</th>
<th>Presentation Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Numbers</td>
<td>1</td>
</tr>
<tr>
<td>System Type</td>
<td>AV Presentation</td>
</tr>
<tr>
<td>Room Size</td>
<td>25’D x 22’W</td>
</tr>
<tr>
<td>Ceiling Height</td>
<td>10’-8”</td>
</tr>
</tbody>
</table>

## Architectural Integration Items

### 1. Equipment Racks

- **Type:** Small type
- **Location:** Built into lectern
- **HVAC Load:** Approx. 1,500 BTU each

### 2. Video Projectors

- **Quantity:** One per room
- **Location:** Off-center of room to match side screen location.
- **Mounting:** Ceiling mounted
- **Size (Clear Dimensions):** 12” H x 12” W x 18” D
- **Weight:** 30 Lbs. (Approx.)
- **AC:** 1 – Outlet
- **HVAC Load:** Approx. 2,000 BTU each

### 3. Screens

- **Quantity:** One per room
- **Type:** Pull-down w/ heavy-duty hardware
- **Sizes (Image Dimensions):** 50”H x 80”W
  - 16:10 Aspect Ratio
- **Location:** Front Wall of Room
  - Off center to stage right side
- **Mounting:** Ceiling flush mounted
- **AC:** None
<table>
<thead>
<tr>
<th>Provided by</th>
<th>General Contractor</th>
</tr>
</thead>
</table>

### 4. Lecterns/Mill Work

<table>
<thead>
<tr>
<th>Type</th>
<th>Custom made lectern Provided by owner’s Mill Shop</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Specific Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦ Room for small equipment rack</td>
</tr>
<tr>
<td>♦ Removable front access panel for rear access to rack.</td>
</tr>
<tr>
<td>♦ Hinged lockable front door</td>
</tr>
<tr>
<td>♦ Room for control/connector panel on top surface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wiring</th>
<th>Umbilical to wall plates with cover</th>
</tr>
</thead>
</table>

### 5. Computers

<table>
<thead>
<tr>
<th>Provided by</th>
<th>Provided by user as needed</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Laptop</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Jack/Interface Location</th>
<th>Wall plate on top of lectern</th>
</tr>
</thead>
</table>

### 6. Program Speakers

<table>
<thead>
<tr>
<th>Quantity</th>
<th>2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Front wall of room, left &amp; right of screen</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Wall surface mounted</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Mounting Height</th>
<th>7’ 0” A.F.F.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>9” H x 8” W x 6” D (Approx.)</th>
</tr>
</thead>
</table>

### 7. Control Plates

<table>
<thead>
<tr>
<th>Control Plate w/ Buttons</th>
<th>Wall plate with surface box on top of lectern</th>
</tr>
</thead>
</table>

### 8. AV Connector Plates

<table>
<thead>
<tr>
<th>Location</th>
<th>Wall plate with surface box on top of lectern</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Pre-manufactured wall plate</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AC</th>
<th>AC outlet part of wall plate</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Net</th>
<th>Net outlet part of wall plate</th>
</tr>
</thead>
</table>

### 9. Wall Plates

<table>
<thead>
<tr>
<th>Location</th>
<th>Front of room, to side of lectern</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AC Plate</th>
<th>Adjacent to AV wall plate</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Net Plate</th>
<th>Adjacent to AV wall plate</th>
</tr>
</thead>
</table>

### 10. Room Lighting

<table>
<thead>
<tr>
<th>Type</th>
<th>Wall switches</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Switch Location</th>
<th>At doorways and front of room</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Fixtures</th>
<th>Two tube linier fluorescent</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Circuiting</th>
<th>Zone 1 – Fluorescent – 1st tube</th>
</tr>
</thead>
</table>

| Zone 2 – Fluorescent – 2nd tube |
| Zone 3 – Fluorescent row near screen |

<table>
<thead>
<tr>
<th>Provided by</th>
<th>Provided by E.C.</th>
</tr>
</thead>
</table>
11. Security

<table>
<thead>
<tr>
<th>Security Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locks</td>
<td>Locks are provided in the front and back of the lectern and the wall plate cover.</td>
</tr>
<tr>
<td>Wall Plate Cover</td>
<td>A custom built millwork box covers the wall plates as a shroud. Provided by owner’s Mill Shop</td>
</tr>
<tr>
<td>Harness</td>
<td>A physical aircraft cable harness connects the lectern to the wall plates and runs within the cable umbilical.</td>
</tr>
<tr>
<td>Electronic Security</td>
<td>The owner provides an electronic security system</td>
</tr>
</tbody>
</table>
System Description

A. A/V System:

1. Room is equipped with A/V presentation system. The AV system is a small system and characteristic of the type of system that is used in a small classroom or conference room.

2. A lectern is located in the front of room. The lectern is provided by the University’s Mill Shop and is not provided by the AV contractor. The lectern houses small equipment rack which encloses most of the electronic equipment. The electronics tie into the room via a umbilical cable to wall plates.

3. Video images project on pull-down front projection screen, located on the front wall of the room. The screen is mounted to the side of the front wall to allow for additional room for presenter. Video projector is mounted to the ceiling in front of each screen.

4. The A/V presentation system provides audio and video playback of program material. Sources include a rack mounted Blu-ray/DVD/CD player, an HDMI connector, VGA input connectors, RCA input connectors. Portable, user furnished, laptop computers or other AV devices may be plugged into the connectors that are mounted to a wall plate on the top of the lecterns.

5. Program audio sources (computers and Blu-ray, etc.) are reproduced through a program audio system. The speaker system consists of front left and right speakers. The speakers are wall-mounted with wall mount brackets. The amplifiers are rack mounted in the lecterns.

6. The systems include push button control panels. The control panels are mounted to surface mounted boxes on the top of the lecterns. There is a network feed from each of the control panels. Control system programming is provided by the university’s AV department (U of I Technology Services CCME) and not the AV contractor.

7. An elaborate security system is Owner provided. The security system is provided by the university’s AV department (U of I Technology Services CCME) after the completion of the AV contractor’s work on the project. The AV contractor will provide one serial wire from the rack to the video projector and one ¼” aircraft cable, within the cable umbilical from the rack to the wall plates. Physical aircraft cable harnesses connect the lecterns to the wall plates and run within the cable umbilical. Custom built millwork boxes cover the wall plates as shrouds. The box covers are provided by university’s Mill Shop.
Sample Only, the designer will need to provide calculations based on the system being designed.

Design Calculations

Display Height

\[ S_H \text{ is the required minimum screen height.} \]

\[ S_H = \frac{D}{SL} \]

Where:
\[ D = \text{Distance to the farthest viewer of the screen} \]
\[ SL = \text{Level of screen detail (4 = Inspection, 6 = Detail & 8 = General Viewing)} \]

\[ D = 25' (300") \]
\[ SL = 6 \]

For the above project variables, the \( S_H \) is 50”

Screen Resolution

Because of the proliferation of WXGA computer display resolutions, a Screen Resolution of 1280 x 800 (WXGA) is required.

Screen Size

\[ \text{Screen Size is the width and calculated height of the screen for the desired aspect ratio.} \]

\[ \text{Aspect Ratio} = 16:10 \text{ (For computer data display resolution)} \]

For the above aspect ratio, the Screen Size is 50”H x 80”W
**Screen Area**

*A* is the total surface area of the screen.

\[ A = H \times W \]

Where:
- \( H = \text{Screen Height} \)
- \( W = \text{Screen Width} \)

\( H = 50'' \)
\( W = 80'' \)

For the above project variables, the \( A \) is **4000 Sq. In. (27.8 Sq. Ft.)**

**Image Luminance**

*Lumens* is the required projector lumen output.

\[ \text{Lumens} = \left( (L \times 15) \times A \right) / .75 \]

Where:
- \( L = \text{Ambient light level at screen location} \)
- \( 15 = \text{Desired contrast ratio (For “Basic Decision Making” category for ANSI/InfoComm Projected Image System Contrast Ratio Standard)} \)
- \( A = \text{Screen Area (in Square Feet)} \)
- \( .75 = \text{Performance derating value (25%)} \)
- \( \text{Note: Assumes a 1.0 screen gain} \)

\( L = 8 \text{ Foot Candles (Estimated)} \)
\( A = 27.8 \text{ Sq. Ft.} \)

For the above project variables, the *Lumen requirement is 4,448.*

**Computer Video Signal Bandwidth**

**Highest Frequency (HF)**

\[ HF = \left( (H_{\text{pix}} \times V_{\text{pix}} \times f_v)/2 \right) \times 3 \]

Where:
\[ H_{pix} = \text{Total number of horizontal pixels} \]
\[ V_{pix} = \text{Total number of vertical pixels} \]
\[ f_v = \text{Refresh rate} \]

\[ H_{pix} = 1920 \]
\[ V_{pix} = 1200 \]
\[ f_v = 60 \]

For the above variables, the Computer video signal bandwidth \((HF)\) is 207.36 MHz

**Computer Video System Bandwidth**

**Signal Frequency (SF)**

\[
\begin{align*}
SF &= HF \times 2 \text{ (Minimum)} \\
SF &= HF \times 3 \text{ (Maximum)}
\end{align*}
\]

Where:

\[ HF = \text{Highest frequency} \]

\[ HF = 207.36 \text{MHz} \]

For the above variables, the minimum signal frequency \((SF_{\text{MIN}})\) is 414.72 MHz

For the above variables, the minimum signal frequency \((SF_{\text{MAX}})\) is 622.08 MHz
**Speaker Coverage Calculation**

\[ D = 2 \times (H - h) \times \tan \left( \frac{C}{2} \right) \]

- \( D \) = Diameter of the loudspeaker’s coverage circle at ear height
- \( H \) = Overall ceiling height
- \( h \) = Height of the listener’s ears
- \( C \) = The loudspeaker off-axis coverage angle of the polar pattern

**SPL Required**

\( SPL \) is the required sound pressure level.

\[ SPL = BGN + 20 + HR \]

Where:
- \( BGN \) = Background noise level (dBA)
- \( HR \) = Desired headroom (dB)

\( BGN = 45 \) (Estimated)
\( HR = 10 \) dB

For the above project variables, the required \( SPL \) is 75 dBA.

**Electrical Power Required (EPR)**

\[ EPR = 10 \frac{SPL + H - L_S + 20 \log(D_2/D_1)}{10} \]

Where:
- \( SPL \) = Desired Sound Pressure Level
- \( H \) = Headroom
- \( L_S \) = Loudspeaker Sensitivity (1Watt at 1 Meter)

\( SPL = 80 \) dB SPL
\( H = 10 \)
\( L_S = 89 \)dB 1W/1M
\[ D_2 = 4.4' \]
\[ C = 110' \]

For the above variables, the **EPR is 2.27 Watts.**

**Loudspeaker Impedance**

**Loudspeaker Impedance** \((Z_t)\) is the total impedance of all the loudspeakers in a circuit.

\[ Z_t = \frac{Z}{N} \]

Where:
- \( Z \) = the measured impedance of a sample speaker
- \( N \) = Number of speakers in the circuit

\( Z = 753 \text{ ohms} \)
\( N = 2 \)

**Amplifier Wattage (per Channel)**

**Amplifier Wattage** \((W_t)\)

\[ W_t = W \times N \times 1.5 \]

Where:
- \( W \) = Wattage tap used at the individual speaker.
- \( N \) = Total number of loudspeakers
- 1.5 = Upsizes the power amplifier by 50%

\( W = 7.5 \text{ watts} \)
\( N = 2 \)

For the above variables, the amplifier with a minimum **22.5 watts should be used.**

For systems where ceiling microphones and user microphones are used a separate PAG/NAG will need to be calculated for both systems.
Potential Acoustic Gain (PAG)

\[ PAG = 20\log\left(\frac{D_0 \times D_1}{D_2 \times D_S}\right) \]

Where:
- \(D_0\) = Distance from source to listener
- \(D_1\) = Distance from loudspeaker to mic
- \(D_2\) = Distance from loudspeaker to listener
- \(D_S\) = Distance from Source to microphone

\(D_0 = 20'\) approximately
\(D_1 = 4.4'\)
\(D_2 = 4.4'\)
\(D_S = 1.5'\)

For the above variables, PAG is 22.5dB

Needed Acoustic Gain (NAG)

\[ NAG = 20\log\left(\frac{D_0}{EAD}\right) \]

Where:
- \(D_0\) = Distance from source to listener
- Equivalent acoustic distance (EAD) = 6

\(D_0 = 20'\) approximately
\(EAD = 6\)

For the above variables, NAG is 14dB

Final Potential Acoustic Gain (PAG\(_F\))

\[ PAG_F = PAG - 10\log(NOM) - FSM \]

Where:
- \(D_0\) = Distance from source to listener
- Equivalent acoustic distance (EAD) = 6
D₀ = 20’ approximately
EAD = 6

For the above variables, \( P_{\text{AGF}} = 16.5\text{dB} \)
## Budget

<table>
<thead>
<tr>
<th>Sub-System Description</th>
<th>Budget Each</th>
<th>System Count</th>
<th>Budget Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV System</td>
<td>$0</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Lectern</td>
<td>$0</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Custom Millwork Shroud</td>
<td>$0</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Wall Box Cover</td>
<td>$0</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Screens</td>
<td>$0</td>
<td>0</td>
<td>$0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$0</td>
</tr>
</tbody>
</table>

The following items are **not** included in the AV system budget:

- Computers
- Conduit & AC power system
- Architectural integration by G.C.
- A/V Design Services
- Lighting Fixtures & Dimmers
- TV (Cable) Distribution System
- U of I TECHNOLOGY SERVICES CCME Programming, Commissioning and Support
- Lecterns
- Wall Box Cover
- Screens

This budget represents a budget estimate only. It does not constitute an offer to sell such products and services or a guarantee that the specified materials of labor can be purchased for the estimated prices.

Form is based on original form courtesy of Lipp A/V Design Inc.