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SECTION 1 INTRODUCTION

Both project management and design standards apply to all learning spaces at The University of Hong Kong. The critical role of learning spaces for the University and the specialized nature of learning space design means that particularly rigorous standards of design and construction are required and are reflected in these guidelines.

1.1 OBJECTIVES

Teaching spaces throughout the University are places of social and personal interaction, where learning takes place and creative thinking is encouraged. The primary objective of these design guidelines is to provide a consistent arrangement of all audio-visual systems on campus such that operation, maintenance and management are simplified.

This document aims to prescribe a list of recommendations and considerations that should be included in the design of teaching and learning spaces. All centrally managed, shared teaching spaces should be carefully designed by LES to meet the many and various needs of the University's diverse user group.

1.2 LEARNING ENVIRONMENT SERVICES (LES)

Learning Environment Services is responsible for maintaining the University's shared teaching and learning spaces. LES are also responsible for inspecting new audio-visual installations in these spaces prior to hand-over to ensure that works are completed satisfactorily and meet the standards herein. If LES is providing agreed internal consultancy to a department of the University, then this may also involve inspecting new installations in a departmental space (i.e. a non-shared teaching space). Such agreements and commitments will be stated in writing. The department's end users shall invite a representative of LES to meetings with the Audio-Visual Consultant or System Integrator in conceptual design phase of projects when issues relevant to audio visual equipment/ projects works are discussed, and shall coordinate with the LES representative prior to completion of the design.

Any variation from the selection of audio visual equipment currently being used must be authorized by the LES representative in writing.

LES is responsible for maintaining the computers and related IT equipment in shared learning spaces. LES will purchase all computers and peripherals and install and set them up with standard software and operating systems in conformity with current standards, as defined by the Information Technology Services (ITS).

All computers shall be installed concurrently with the AV equipment, LES must be notified, as soon as possible, of the date at which commissioning of the AV equipment is to begin. Variations in the selection of computers may be made, but this shall be subject to tender policy from the University.

LES’ contact details are:
The University of Hong Kong –
Learning Environment Services, Information Technology Services
CPD-1.64, 1/F, Chi Wah Learning Commons
1.3 PROJECT RESPONSIBILITIES

Each project team shall, where appropriate, include a representative of the User Group to provide user needed requirements. However, the project team shall take account of the fact that all the University’s learning spaces are common learning spaces and are used by a variety of departments and disciplines. It is the responsibility of the AV Consultant/ System Contractor to ensure adherence to the standards herein, and to liaise with the User Group, LES staff and the University appointed Project Manager/ EO representative. A Learning Space Consultant may be included as a member of the project team for all projects including refurbishment or creation of new learning spaces.

1.4 BUILDING BLOCKS OF AV DESIGN PHASES

The Faculty / Department’s end users are recommended to invite a representative of LES to meetings with the Audio-Visual Consultant or System Integrator in need analysis stage to define the requirements and project’s scope of works. Users shall coordinate with the LES representative prior to completion of the design documents before Tendering Issue.

1.5 PROJECT STAKEHOLDERS

The following stakeholders will generally be involved in University projects:

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect</td>
<td>External consultant engaged to design the overall teaching space and coordinate all services. On occasion acts as superintendent</td>
</tr>
<tr>
<td>AV Consultant</td>
<td>External consultant engaged to design and coordinate the installation of the audio visual system. The AV Consultant shall be required to liaise with all other stakeholders listed below.</td>
</tr>
<tr>
<td>AV Contractor</td>
<td>External contractor engaged to perform audio visual works</td>
</tr>
<tr>
<td><strong>LES</strong></td>
<td>Learning Environment Services. University representatives who are responsible for the approval of AV designs, and the maintenance and management of audio visual systems within the University</td>
</tr>
<tr>
<td><strong>EO</strong></td>
<td>Estate Office. Typically assigned as Project Managers for projects.</td>
</tr>
<tr>
<td><strong>Services Consultant</strong></td>
<td>External consultant engaged to design and coordinate installation/modification of engineering services for teaching spaces</td>
</tr>
<tr>
<td><strong>User Group</strong></td>
<td>University representative selected to outline specific requirements for the teaching space.</td>
</tr>
</tbody>
</table>
## 1.6 RESPONSIBILITIES MATRIX
The following table outlines the project team's typical responsibilities.

<table>
<thead>
<tr>
<th>Task</th>
<th>Architect</th>
<th>AV Consultant</th>
<th>LES</th>
<th>EO PM</th>
<th>Services Consultant</th>
<th>User Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attend project workshops/meetings</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>Learning space design</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Furniture and joinery</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>AV system design</td>
<td>C</td>
<td>R</td>
<td>C</td>
<td>I</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Electrical/Data cabling services</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>C</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td>Mechanical services</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>C</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td>Fire services</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>C</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td>University LAN/WAN access</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Network switches</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Wireless access points</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>PCs, monitors, keyboards etc.</td>
<td>I</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Telephones</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Echo systems</td>
<td>I</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Video conferencing system setup</td>
<td>I</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>IP addresses (general)</td>
<td>I</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>AMX RMS setup</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Touch panel layouts and icons</td>
<td>I</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Lighting pre-sets and configurations</td>
<td>I</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>C</td>
</tr>
<tr>
<td>MATV services</td>
<td>I</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Padlocks for AV equipment</td>
<td>I</td>
<td>I</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
</tbody>
</table>

R - Member of the project team who is responsible for documentation the task
C - Requires coordination with this member of the project team
I - Must inform this member of the project team
N - Not involved with the nominates task
SECTION 2 TEACHING SPACES

2.1 GENERAL

The following section describes the various types of learning spaces at the University of Hong Kong, with their minimum audio-visual functional requirements and recommended equipment. Each type of learning space, as outlined below, has differing design considerations according to their intended use. The design of each space shall be coordinated closely with architectural, faculty and services requirements. The following table outline the seating capacity for each type of learning space.

<table>
<thead>
<tr>
<th>Learning Space Type</th>
<th>Seating Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Commons</td>
<td>Varies project by project</td>
</tr>
<tr>
<td>Study rooms in Learning Commons</td>
<td>Up to 15</td>
</tr>
<tr>
<td>Study booths in Learning Commons</td>
<td>Up to 6</td>
</tr>
<tr>
<td>Lecture halls</td>
<td>150 or more</td>
</tr>
<tr>
<td>Lecture theatres</td>
<td>100 to 150</td>
</tr>
<tr>
<td>Classrooms</td>
<td>Up to 100</td>
</tr>
<tr>
<td>Innovative Classrooms</td>
<td>Varies project by project</td>
</tr>
</tbody>
</table>

2.2 LEARNING COMMONS

2.2.1 Description

Learning Commons are unique learning spaces designed to enhance and facilitate interaction and shared communications. A range of different models have been developed by the University to bring about the functionality required for these spaces. The specific designs for each learning commons shall be developed to meet the requirements of the User Group on a project by project basis. Typically, all collaborative spaces will allow for some of the following functionalities:

1. Students to interact with the teacher via the installed computer
2. Students to work in large or small individual groups
3. Student groups to share content with other student groups
4. Interactive capabilities via interactive flat panel display (FPD), interactive whiteboard, tablet PC or touch screen
5. Capacity to connect laptop or other 3rd party device to share multimedia content

2.2.2 Study rooms in Learning Commons

2.2.2.1 Description

Study rooms in Learning Commons designed for small groups of students, staff and other users. The rooms tend to be small in size and cater for groups up to 15. These rooms are basic in their design and layout with tables and chairs, one panel whiteboard as well as an FPD display and AV playback devices.
2.2.2.2 AV System Functionality
As a minimum, study rooms shall be provided with the following audio-visual system functionality:
1. FPD to display the following sources:
2. University supplied computer
3. Laptop connection(s)
4. Source equipment shall be directly connected to the FPD
5. Lecture capture system compatible

2.2.2.3 AV Equipment
As a minimum the study rooms shall be provided with the following audio-visual equipment:
1. FPD/Interactive FPD
2. University supplied computer
3. Laptop connection plate(s)
4. IP based / USB Camera with lecture capture system compatible

2.2.3 Study Booths in Learning Commons
2.2.3.1 Description
Study booths in Learning Commons designed for small groups of students, staff and other users. The booths tend to be small and cater for groups up to 6. These booths are basic in their design and layout with tables and bench with FPD Display.

2.2.3.2 AV System Functionality
As a minimum, study booths shall be provided with the following audio-visual system functionality:
1. FPD
2. Laptop connection(s)
3. Source equipment shall be directly connected to the FPD

2.2.3.3 AV Equipment
As a minimum study booth shall be provided with the following audio-visual equipment:
1. FPD
2. Laptop connection plate(s)

2.3 LECTURE HALL

2.3.1 Description
Lecture halls are generally single function spaces with fixed seating and writing furniture on a tiered or sloping floor surface with a seating capacity of 150 or more. Each seat should have a clear unobstructed view to the lecturer, boards and screens. These spaces are generally well equipped for audio visual equipment including projection system, dedicated sound reinforcement system; touch panel control system and playback equipment installed within a dedicated lectern. The AV system including theatre lighting must be operable via an integrated touch panel control system. For dual projection, the lectern should be located in a suitable place decided by LES, whereas for triple projection, the lectern should move to either left or right of presentation area to avoid obstruction of the centre projection screen. Please refer section 3.2 about the projection system.
2.3.2 AV System Functionality
As a minimum, lecture halls shall be provided with the following audio visual system functionality:

1. Dual/triple video/data projection to display the following sources:
   1.1 University supplied computer
   1.2 Laptop connection(s)
   1.3 Blu-ray/DVD player
   1.4 Document camera

2. Local preview of all sources on confident screen(s)

3. All source audio shall be via front of house speakers

4. All microphone audio shall be reinforced via ceiling mounted speakers

5. Audio output plate on lectern (mix of microphone and source audio)

6. Lecture capture system compatible.

7. The control system processor and touch panel, as a minimum, shall interface with the following equipment:
   7.1 Video matrix switch
   7.2 Digital Audio processor
   7.3 Video/data projectors
   7.4 Blu-ray/DVD player
   7.5 Motorised screen(s) (as required)
   7.6 Motorised projector lift (as required)
   7.7 Motion sensor
   7.8 Equipment rack power controller
   7.9 Room lighting dimmers
   7.10 University AMX RMS network (via the LAN)

8. A fixed lectern installed at the front of the theatre to house the following AV equipment:
   8.1 University supplied computer
   8.2 Laptop input connection plate (mounted above the lectern)
   8.3 Touch panel
   8.4 Boundary microphones
   8.5 Document camera
   8.6 Blu-ray/DVD player

9. All other AV equipment shall be securely installed in a dedicated space inside lectern which shall be securely locked with a University standard lock
2.3.3 AV Equipment
As a minimum lecture hall shall be provided with the following audio-visual equipment:
- 2 x Video/data projectors
- University supplied computer
- Laptop input connection plate(s)
- Blu-ray/DVD player (Region free)
- Document camera
- Front of house speakers
- Ceiling mounted speakers
- Wired boundary microphones
- Wireless lapel microphone system and charging dock
- Wireless handheld microphone system and charging dock
- Video matrix switch
- Digital audio processor
- Audio amplifiers and 100V line transformers
- Touch panel
- Control system processor, AMX RMS enabled
- Dedicated local AV network switch
- Dedicated AV equipment rack
- Motorised projection screen (as required)
- Motorised projector lift (as required)
- IP based Camera with lecture capture system compatible
- Fixed lectern

2.4 LECTURE THEATRE

2.4.1 Description
Lecture theatres shall have a capacity of 100 to 150 and are designed for presentation of video/data via a single/dual projector. The AV system, input devices and theatre lighting shall be controlled via a dedicated wired touch panel installed on the University standard lectern. The lectern shall house one University supplied computer, Blu-ray/DVD player, laptop connection plate, and touch panel. All audio-visual switching and processing equipment shall be housed in a dedicated audio visual equipment rack/space located inside the lectern. Voice reinforcement shall include wired and wireless microphones along with ceiling speakers. Lecture theatres may be tiered or have a levelled floor. Lighting shall generally be controlled using a self-standing lighting control system accessed by a wall panel offering a limited number of standard lighting scenes and the option of ramping audience and board lighting. For dual projection, the lectern should be located centre of presentation area, whereas for single projection, the lectern should move to either left of right of presentation area to avoid obstruction of the centre projection screen. Please refer section 3.2 about the projection system.

2.4.2 AV System Functionality
As a minimum, lecture theatres shall be provided with the following audio-visual system functionality:
1. Single/dual video/data projection to display the following sources:
2. University supplied computer
3. Laptop connection(s)
4. Blu-ray/DVD player (Region free)
5. Document camera
6. All source audio shall be via front of house speakers
7. All microphone audio shall be via ceiling mounted speakers
8. Audio output plate on lectern (mix of microphone and source audio)
9. Lecture capture system compatible.
10. The control system processor and touch panel, as a minimum, shall interface with the following equipment:
    10.1 AV media presentation switch
    10.2 Digital audio processor
    10.3 Video/data projector
    10.4 Blu-ray/DVD player
    10.5 Motion sensor
    10.6 Equipment rack power controller
    10.7 University AMX RMS network (via the LAN)
11. A fixed lectern installed at the front of the theatre to house the following AV equipment:
    11.1 University supplied computer
    11.2 Laptop connection plate(s)
    11.3 Touch panel
    11.4 Document camera
    11.5 Blu-ray/DVD player
12. All other AV equipment shall be securely installed in a dedicated space inside lectern which shall be securely locked with a University standard lock
2.4.3 AV Equipment
As a minimum the lecture theatre shall be provided with the following audio-visual equipment:
- Video/data projector
- University supplied computer
- Laptop connection plate
- Blu-ray/DVD player (Region free)
- Document camera
- Front of house speakers
- Ceiling mounted speakers
- Wired boundary microphones
- Wireless lapel microphone system and charging dock
- Wireless handheld microphone system and charging dock
- AV media presentation switch
- Digital audio processor
- Audio amplifiers and 100V line transformers
- Touch panel
- Control system processor, AMX RMS enabled
- Dedicated local AV network switch
- Dedicated AV equipment rack/space inside lectern
- IP based Camera with lecture capture system compatible
- Fixed lectern

2.5 CLASSROOMS

2.5.1 Description
Classrooms have a capacity of up to 100 people, typically classes of 30. The use of different presentation media is restricted.
The AV system shall typically comprise of a projection system and front of house sound reinforcement. All systems shall be controlled via dedicated push-button keypad or touch panel. Control system shall be interfaced with all AV equipment.
The lectern should move to either left or right of presentation area to avoid obstruction of the centre projection screen. Please refer section 3.2 about the projection system.

2.5.2 AV System Functionality
As a minimum, seminar rooms shall be provided with the following audio visual system functionality:
- Single video/data projection to display the following sources
- University supplied computer
- Laptop connection(s)
- Document camera
- All source audio shall be via front of house speakers
- Audio output plate on lectern (mix of microphone and source audio)
- lecture capture system compatible
- The control system processor, as a minimum, shall interface with the following equipment:
  1. AV media presentation switch
  2. Digital audio processor
3 Video/data projector  
4 Motion sensor  
5 Equipment rack power controller  
6 University AMX RMS network (via the LAN)

- A fixed lectern installed at the front of the room to house the following AV equipment:  
  1 University supplied computer  
  2 Laptop connection plate  
  3 Push button keypad/touch panel

- All other AV equipment shall be securely installed in a dedicated space inside lectern which shall be securely locked with a University standard lock

2.5.3 AV Equipment
As a minimum the classrooms shall be provided with the following audio visual equipment:

1 Video/data projector  
2 University supplied computer  
3 Laptop connection plate(s)  
4 Document camera  
5 Front of house speakers  
6 AV media presentation switch  
7 Digital audio processor  
8 Wireless lapel microphone system and charging dock  
9 Wireless handheld microphone system and charging dock  
10 Audio amplifier  
11 Push button keypad/touch panel  
12 Control system processor, AMX RMS enabled  
13 Dedicated local AV network switch  
14 Dedicated AV equipment rack/space inside lectern  
15 IP based Camera with lecture capture system compatible  
16 Fixed lectern

2.6 INNOVATIVE CLASSROOMS

2.6.1 Description
Innovative Classrooms are unique teaching spaces designed to enhance and facilitate adaptable teaching, interaction and shared communications. A range of different models have been developed by the University to bring about the functionality required for these spaces. Some spaces are fitted out with several complex integrated AV and IT systems whilst others are provided with simplistic presentation systems.

The specific designs for each innovative classroom shall be developed to meet the requirements of the User Group on a project by project basis. Typically, all collaborative spaces will allow for some of the following functionalities:

1. Students to interact with the teacher via the installed computer  
2. Students to work in large or small individual groups  
3. Student groups to share content with other student groups  
4. Students to present to entire class  
5. Teacher to monitor each student computer  
6. Interactive capabilities via interactive flat panel display (FPD), interactive whiteboard, tablet PC or touch screen
7. Capacity to connect laptop or other 3rd party device to share multimedia content with classroom.
8. Lecture capture system compatible

2.6.2 AV Equipment

AV equipment nominated for innovative classrooms will vary to suit specific teaching requirements. Equipment manufacture, and technology must be consistent with University standards and quality to ensure that it can be readily supported by the LES staff.
SECTION 3 TECHNICAL REQUIREMENTS

3.1 GENERAL

The following section details the minimum technical requirements for audio visual equipment specified in The University of Hong Kong teaching spaces. The make and models of all audio-visual equipment nominated for The University of Hong Kong teaching spaces shall be verified by LES prior to installation.

3.2 PROJECTION SYSTEM

Projection systems play a primary role at the University and are present in the majority of learning spaces across the campus. It is imperative that the projection system for these spaces meet the technical and functional requirements of the space. Engineers shall confirm make, model and specifications of projector with LES representative prior to finalizing system configuration. As a minimum, projection systems at The University of Hong Kong shall comply with the following:

3.2.1 Projector Requirements

As a minimum, nominated video/data projector shall adhere to the following standards:

- Minimum of 4000 ANSI lumens. The specific brightness of the projector shall depend on the application and the particular space.
- Minimum contrast ratio 2000:1. The specific contrast of the projector shall depend on the application and the particular space.
- Capacity to support 4:3 and 16:9 aspect ratios
- Native 1920 x 1200 resolution
- As a minimum, projectors shall include the following video inputs:
  1. VGA/RGBHV - 15 pin D Sub connectors
  2. DVI - 15-pin mini D-Sub; Analog RGB signal
  3. HDMI
- RS232/Ethernet controllable
- Ethernet interface (for management)
- Minimum lamp life 4000 hours
- Low noise
- Ceiling mountable

The recommended projector brightness is determined by screen size, which, in turn, is proportional to the venue size. The following guidelines are to be taken into consideration when deciding minimum projector brightness:

1. The targeted projected Lux for small to medium sized venues, where screen sizes are no more than 3.5 meters diagonally, must be no less than 500Lux, preferably 600+ Lux.
2. The target projected Lux for larger venues, where screen sizes are more than 3.5 meters diagonally, must be no less than 315Lux, preferably 500+ Lux.

Commercially-available projectors are with brightness 4,000 – 18,000 ANSI Lumens. The design will base on ambient lighting level and size of the screen, and we target a minimum contrast ratio at the image of 10:1 (Infocomm recommendation but also proven by ourselves)

Lux level on screen = Projector brightness ÷ screen area
**There will be in addition, the ambient light from the room lighting and any other light sources**

This figure is good enough for a dimmed room with about 50 lux of ambient light, the contrast ratio achieved is (555+50) : 50 ~ = 12:1

These specifications will help to determine the correct projector for the venue and will help to identify the ANSI Lumens specification for that projector.

In larger venues, reduction in ambient light at and around the screen will need to be considered to reduce loss of projected Lux on the screen. This is addressed in the Ambient light spill on projector screen provision of this Standard.

Lecture theatres screen calculations are based upon:

1. **Target Screen height** = Maximum Viewing Distance (Dm)/8 is suitable for Video and also confirms achieve minimum height required above floor level which should be around 1.3 meters. For large venue with height ceiling and stacked seat plan.

2. **Screen aspect ratio** (Projection and LCD) 16:9 widths: height

3. **Target Screen Contrast** > = 10 (Ratio of projected light lux-level: Ambient light falling on screen). Typically, we aim for 500 lux from the projectors in a ballroom situation, where LUX=Projector brightness (Lumens)/Screen area – This criteria is used to achieve a balance between the quality of image and the costs involved along with aesthetics as well.

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>AREA</th>
<th>MAX VIEW DIST Dv, mt.</th>
<th>CALCULATED PROJ SCRN HEIGHT= Dv/ 8, m</th>
<th>SELECTED PROJ SCRN HEIGHT Sh, mt.</th>
<th>SELECTED PROJ SCRN WIDTH Sw, mt.</th>
<th>PROJECTOR (L=BRIGHTNESS IN LUMENS)</th>
<th>ESTIMATED PROJECTED LUX AT SCREEN (x0.5 at end of lamp life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3</td>
<td>CPD-3.04</td>
<td>17.9</td>
<td>2.25</td>
<td>2.25</td>
<td>4</td>
<td>5000</td>
<td>555</td>
</tr>
<tr>
<td>Level 2</td>
<td>CPD-2.42</td>
<td>10.4</td>
<td>1.31</td>
<td>1.68</td>
<td>3</td>
<td>3000</td>
<td>595</td>
</tr>
<tr>
<td>Level 1</td>
<td>CPD-LG.34</td>
<td>11.3</td>
<td>1.415</td>
<td>1.68</td>
<td>3</td>
<td>3000</td>
<td>595</td>
</tr>
</tbody>
</table>

### 3.2.2 Lines of Sight

Learning and teaching spaces at HKU require the capability to display information by means of data projection and other display technology. Consideration and advice to the responsible organizational unit at the planning stage of allowable sight-lines and screen viewing distances is fundamental to the success of any learning and teaching space. Having these standards accepted and incorporated at the design stage forms a critical aspect to delivering an acceptable level of information display recognition by the viewer.
Consideration must be given to the ability to view and interpret the information displayed from all areas of the learning and teaching space. These specifications form the nucleus of any design for learning and teaching spaces.

The following guidelines on appropriate sight-lines and screen-viewing distances are to be considered when designing, refurbishing and upgrading any learning and teaching space.

1. Screen size is determined by viewing distance and content. We use as basis in classrooms, the calculation that for video viewing, the maximum viewing distance is 8 x screen height, and for text viewing, the maximum distance is 6 x screen height. The screen size can be calculated backward by knowing the dimension of the room.

2. Text Size Text height will help determine the maximum viewing distance from your screen. In general, use what we call The 150 Rule: Text Height x 150 = Max distance from the screen. So, for instance, if a line of text is 3 inches, the maximum viewing distance is about 37.5 feet (3 inches' x 150/12 inches per foot).

3. The minimum viewing distance is determined by the closest viewer position (at the front row, center). This position shall not be any closer than twice the screen height at that position.

4. The maximum allowable horizontal viewing angle will be no more than 45 degrees to the centre sight-line of the screen.

5. The maximum allowable vertical viewing angle will be no more than 15 degrees to the centre of the display measured from the front centre viewing position.

6. The bottom edge of the screen shall be no less than 1.3 meters above the floor.

7. The minimum ceiling height will be determined by the maximum viewing distance rule and the screen height above the floor.

Optical calculations shall be executed to determine suitable projection parameters for each space; however, the following standards shall be applied:
• Furthest Viewer - no student shall be further than six image height lengths, from the projection surface
• Closest Viewer - no student shall be closer than two screen height lengths, from the projection surface
• Horizontal Viewing Angle - audience shall be positioned within an arc of 45 degrees from either side of the centre line of projection
• Vertical Viewing Angle - audience shall be limited to 15 degrees maximum head tilt above horizontal, in relation to the centre of the projection image
• Image position - The base of the projected image should be at least 1350mm AFFL

Whilst the horizontal viewing angle and closest viewer rules are slightly flexible, the furthest viewer rule is not flexible at all.
The size and the height of the image shall take into account environmental considerations such as ceiling height, ceiling mounted equipment, furniture, audience seating position etc.

3.2.3 Motorised Projector Lift
Where possible, video projectors shall not be mounted higher than 2700AFFL (Above Finished Floor Level). If projectors cannot be mounted within 2700AFFL on a fixed bracket, then a University approved custom built mechanical lift shall be fitted.

The projector shall be fitted within the lifts cage with University approved security screws and high tensile steel padlocks. The cage shall be modified to suit the projector. The cage should allow for removal and servicing of projector lamps, filters and lenses without having to remove the projector from the cage (often the underside of the cage is cut out to allow access).
The lift shall be wired back to the AV control system and controlled by the touch panel. The projector lift shall be installed securely on ceiling slab and configured for two drop stages, for projection and service. Service height shall be approximately 1500AFFL.
Electronic image correction and keystone adjustments shall only be used if approved in writing by LES.

3.2.4 Dual Projection
Dual projection systems shall have two images projected side-by-side ensuring that they do not overlap. Each projected image shall be of the same size, brightness and contrast. It is recommended the same projectors are used in dual projection rooms.
The AV control system shall be flexible enough to allow the user to select any input source, to be displayed on either or both of the projection systems concurrently.

3.2.5 Triple Projection
Triple projection systems shall have two images projected side by side ensuring that they do not overlap and one larger image projected in front of the two images. Each projected image shall be same brightness and contrast. It is recommended the same projectors are used in dual projection rooms.
The AV control system shall be flexible enough to allow the user to select any input source, to be displayed on either or both of the projection systems concurrently.
3.3 FLAT PANEL DISPLAY
Flat panel displays are used in smaller tutorial rooms and collaborative classrooms where video/data projectors are not suitable. The installation requirements for flat panel displays are governed by the same rules as the projections system. The University of Hong Kong currently only deploy FPD within teaching spaces. The following table lists the recommend panel size for the furthest viewer.

<table>
<thead>
<tr>
<th>Flat panel display size (diagonal)</th>
<th>Recommended furthest viewer</th>
<th>Recommended closest viewer</th>
</tr>
</thead>
<tbody>
<tr>
<td>32”</td>
<td>2.0m</td>
<td>0.8m</td>
</tr>
<tr>
<td>40”</td>
<td>3.0m</td>
<td>1.0m</td>
</tr>
<tr>
<td>46”</td>
<td>3.5m</td>
<td>1.0m</td>
</tr>
<tr>
<td>52”</td>
<td>4.0m</td>
<td>1.5m</td>
</tr>
<tr>
<td>55”</td>
<td>4.0m</td>
<td>1.5m</td>
</tr>
<tr>
<td>65”</td>
<td>5.0m</td>
<td>1.5m</td>
</tr>
<tr>
<td>70”</td>
<td>6.0m</td>
<td>1.5m</td>
</tr>
</tbody>
</table>

Flat panel technologies can be implemented into small venues. These venues are defined by the Specific room types section of this standard.

The following guidelines are to be followed for installation of flat panels:

1. Placement is in accordance with all rules that govern the placement of projector screens, see Minimum projector brightness, Minimum projector contrast ratio, Vertical and horizontal projector placement, Sight lines and screen-viewing distances and Projector, display and screen aspect ratio.

2. Flat panel technology is the preferred visual display in meeting rooms that perform videoconferencing functions.

3.3.1 FPD Requirements
As a minimum, nominated FPD shall adhere to the following requirements:

- Minimum HD resolution 1920 x 1080
- Widescreen, 16:9 aspect ratio
- High brightness
- Minimum 800:1 contrast ratio
- Standard sizes (as nominated in the table above) to meet room requirements
- Commercial grade
- NTSC/PAL Colour system
- RS232/Ethernet controllable
- VESA compliant, wall mountable
- As a minimum, the panel shall include the following inputs:
  3. VGA/RGBHV- 15 pin D Sub connectors
  4. Composite- BNC/RCA connector
  5. DVI - 15-pin mini D-Sub; Analog RGB signal
  6. HDMI
- Optional input slots for twisted pair receivers, TV tuners, cards readers etc.
- Optional speakers
3.3.2 Installation Requirements
FPDs shall be fitted with University approved mounting bracket with high tensile University padlocks and security mechanisms to prevent theft or malicious damage. The security mechanisms shall meet the University's security requirements. Any modifications to the installation bracket or security mechanisms shall be approved by LES. Final height of FPDs shall be coordinated with architectural drawings and optimal viewing angles. Ceiling mounted FPDs and panels mounted at high levels shall be angled down to ensure image integrity.

3.3.3 Panel Enclosure
FPDs installed in public and unsecured areas shall be fitted within a custom-built enclosure. As a minimum, the enclosure shall have the following:
- Fully sealed (Glass front)
- Lockable with keys or security screws (locks to be provided by HKU)
- Susceptible to all temperatures
- Integrated air movement
- Mounting options: Wall mount, ceiling mount, stand-alone pedestal etc.
- Accommodate LCD screen and speakers within the enclosure
- To suit nominated FPD
- VESA mounting compatible or equivalent
- P54 rated- dust and splash proof design
- Screen shall be accessible for servicing and maintenance

3.4 SOUND REINFORCEMENT

Despite the growth in the use of visual and computer means of communication, verbal communication remains the single most important method of teaching and learning. Irrespective of the size of the space, maximum attention must be paid to optimizing the acoustic properties of the space.

Amplification is required for all lecture theatres and classrooms. Auxiliary inputs for sound presentation (audio-cassette, CD, iPod and computer audio), is always required for language teaching, and is required for all lecture theatres. Typically, source audio shall be reproduced via dedicated front of house speakers and microphones audio shall be via ceiling mounted speakers.

3.5.1 Microphones
Wired and wireless microphones shall be used as required. Wired microphones shall be a condenser boundary type microphone with a low profile and semi-cardioid pattern. Wireless microphones shall operate on UHF frequency must be coordinated with the existing range of frequencies in use in nearby spaces. LES staff will assist in ensuring that interference is avoided. Appropriate amplification shall be installed when quality sound reinforcement system is required.

3.5.2 Ambience sound levels in Lecture Classrooms
The level of ambient sound must be kept to a minimum. Conversely, a sound-dead room is to be avoided as well. Ambient noise generators such as air-conditioning units and mechanical delivery devices located near the learning and teaching space must be avoided or mitigated at best. Advice from the acoustic consultant must be adhered to in the design process of any new or existing space to deliver acceptable levels of ambient sound.
The following guidelines detail the acceptable and best practice standards for ambient sound. The room types are defined as per the Specific Room Types section in this Standard:

1. Room type: Lecture theatre (CPD LG.07) must have a minimum ambient noise level of 45db(A) and a best practice level of 35dB(A)
2. Room type: Classrooms (CPD LG.59) must have a minimum ambient noise level of 35db(A) and a best practice level of 30dB(A)
3. Room type: Meeting Rooms (Videoconference/Board Rooms) must have a minimum ambient noise level of 40db(A) and a best practice level of 35dB(A)

3.5.3 Loudspeakers system selection and placement
Selection of speaker systems for implementation in learning and teaching spaces will vary from venue to venue depending on room dimension and function. This relates to the actual audio design required to provide full audio coverage and high intelligibility of voice and program materials reinforcement to the listening area, for those spaces that require it.

Provisions will need to be made at the acoustical design stage, with the assistance of computer modelling, to determine the correct number, the placement and technical specifications of the speakers to meet the requirements in this provision.

The following is a set of guidelines that provide a framework to assist in the selection and placement of the speaker system:

1. A targeted distribution of voice reinforcement at all listening positions at a minimum of 65dBA.
2. A targeted distribution of audio replay at all listening positions at a minimum of 80dBA.
4. Consideration of complementary speaker systems (distributed speakers or speaker arrays), depending on the venue’s geometry and acoustical performance to provide compliance with audio coverage requirements.
5. A minimum of two Front of House (FOH) speakers in all performance venues.
6. Zoning and speaker delay systems to be considered where there are issues with FOH and distributed speaker systems providing an unintelligible amount of delay variation to the listening position.

3.5 CONTROL SYSTEM
All teaching spaces provided with an audio visual system shall include a dedicated AMX control system fully programmed to control all audio visual devices. As a minimum each room shall be provided with a dedicated control system processor (AMX Netlinx Integrated Controller) and fixed control interface (touch panel or keypad).

3.6.1 User interface
The University typically use the following control interfaces:

<table>
<thead>
<tr>
<th>Device</th>
<th>Typical application</th>
</tr>
</thead>
<tbody>
<tr>
<td>10” Touch panel</td>
<td>Lecture hall and lecture theatre</td>
</tr>
<tr>
<td>Wireless Touch panel</td>
<td>Lecture hall and lecture theatre</td>
</tr>
<tr>
<td>7” Touch panel</td>
<td>Lecture theatres and classrooms</td>
</tr>
</tbody>
</table>
16/8 button keypad | Install near the entrance of all lecture theatres and classrooms

Alternative control interfaces shall be approved in writing by LES.

3.6.2 Device Integration
Typically, the following audio-visual equipment shall be interfaced the control system processor as follows:

<table>
<thead>
<tr>
<th>Device</th>
<th>Control Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Switch</td>
<td>RS232 or Ethernet</td>
</tr>
<tr>
<td>Audio DSP/ Digital audio processor</td>
<td>RS232 or Ethernet</td>
</tr>
<tr>
<td>Video/ Data projector / FPD</td>
<td>RS232 or Ethernet</td>
</tr>
<tr>
<td>Document Camera</td>
<td>RS232</td>
</tr>
<tr>
<td>Lighting Dimmers</td>
<td>RS232 or RS485. Interfaces to be provided by lighting contractor</td>
</tr>
<tr>
<td>Playback devices</td>
<td>RS232 if available or IR</td>
</tr>
<tr>
<td>Motorized projection screen</td>
<td>RS232</td>
</tr>
<tr>
<td>Motorized projection left</td>
<td>1/0 or Relays</td>
</tr>
</tbody>
</table>

Alternative configurations shall be approved in writing by LES.

3.6.3 Programming
Programming of control systems shall be coordinated with LES. The Control System programming shall be consistent with that of other teaching spaces at The University of Hong Kong where possible.

The Contractor shall organize workshops and submit samples of the touch panel and keypad layout to LES representative to verify the layouts are correct prior to commissioning. A range of configurations and automation shall be available from the touch panel. Selecting a function from the touch panel shall operate all required equipment to perform that function e.g. Selecting play on the DVD will switch the projector on, switch the AV switch to select DVD input and play the DVD.

Typical touch panel and keypad layouts are attached in Appendix A. Final touch panel layouts shall be developed on a project by project basis in conjunction with LES and User Groups. The Contractor shall supply the full working Netlinx source codes on CD format to the University on completion of the project. Software provided by the Contractor shall be procured and transferred in full compliance with the publisher's copyright, licensing and other requirements of ownership and use. License agreement: shall be registered in the Principal's name. The University shall retain full rights to all custom software and programming developed by the Contractor as part of the Project. This shall include, but not be limited to the right to use, reproduce and modify the software as reasonably required to operate the systems and to support their ongoing maintenance and development.

3.6.4 Shut Down/Motion Sensor (optional)
Ceiling mounted motion sensors shall be provided for all spaces equipped with a control system. The control system shall be configured to automatically turn off all equipment when the motion

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sensor has not detected any movement for a period (depend on the system design), and the control interface has not been active within this period. Additionally the control system shall be programmed to check status of the motion sensor at 11 pm every night. If no motion has been detected, the AV system shall shut down all equipment. If motion has been detected, the system will repeat check every 2 hours.

3.6.5 Remote Management Suite

All devices attached to an AMX control system with feed-back control (RS232, RS422, RS485 and TCP-IP) shall be able to be monitored and managed via the University Resource Management Suite (AMX RMS) network. All AMX Netlinx control systems provided for the University shall be provided with AMX RMS enabled. Contractors shall coordinate with LES to integrate centrally managed spaces.

As a minimum AMX RMS shall allow for the following functionality:

(Contractors shall confirm final requirements with LES)

Real-time monitoring and problem notifications

AMX RMS source usage shall have the following labels:

- Projector
- FPD
- Document Camera
- DVD
- Laptop input- VGA
- Laptop Input- HDMI
- Computer Input
- VCR
- Set-top box
- Videoconference
- Aux Video Input
- Wireless Microphone System(s) (monitor battery levels, frequency and name)
- Equipment/system status and hot list of equipment errors
- Flexible, intuitive interface that lets the user select how and what is monitored
- Professional help desk and monitoring
- Capacity to create the following web-based and/or log data reports:
  - Help requests
  - Room usage
  - Lamp hours
  - Both Lamps for dual projection
  - Lamp fail message for all lamps
  - Source usage
  - System & device usage
  - Monthly reports on all maintenance requirements

3.6 BYPASS FUNCTION

Contractor shall provide a pass function which can switch the screen and lighting to manual control mode when the control system is not working properly.
3.7 CABLING

The Contractor shall ensure that all cabling is installed to avoid sources of electromagnetic interference. Cabling shall be run concealed in ceilings, floor ducts or in wall cavities, and shall be labelled to indicate source, destination function. Surface duct or conduit shall not be used.

The cables installed shall be as listed below:

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Cable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Projector Control and AMX AXLink databus</td>
<td>Low capacitance, 72 pF/m. 4 x stranded inner pairs with overall foil and drain screening only. Pair colours as per CAT5</td>
</tr>
<tr>
<td>Video Coaxial Cable</td>
<td>Coax, 1 coax, 20 AWG, stranded (26x34) TC-tinned copper conductors, EPDM - ethylene propylene diene monomer rubber insulation, conductive textile wrap, tinned copper Spiral Serve Shield, 72% shield coverage, neoprene jacket</td>
</tr>
<tr>
<td>Computer Video Cable</td>
<td>Digital video coax 5-way snake, miniature RG59/U, 23AWG, solid, soft PVC, 95% braiding, black</td>
</tr>
<tr>
<td>Digital Video Cable</td>
<td>HDMI cable, CTS category 2 version 1.3b compliant, verified for 1080p. 4 pair, 25 AWG stranded with drain wire, FR-PVC jacket. For continuous runs for no longer than 10m</td>
</tr>
<tr>
<td>Audio Cable</td>
<td>1 pair, 22 AWG (7/0.32) tinned copper, polyethylene insulation, twisted beldfoil shielded pair, 22 AWG stranded tinned copper drain wire, PVC jacket.</td>
</tr>
<tr>
<td>Speaker Cable</td>
<td>2 core speaker cable 14 AWG, stranded, 75 degree insulated, PVC jacket</td>
</tr>
<tr>
<td>Twisted pair</td>
<td>Category 6 shielded twisted pair. Data twist / media twist. White colour PVC jacket for AV services.</td>
</tr>
<tr>
<td>Fiber (Medical and other specialist)</td>
<td>50/125 µm multi-mode fiber, OM3</td>
</tr>
</tbody>
</table>
### 3.8 CONNECTION PLATES AND CABLES

Cabling points and engraved connection plates shall be installed as nominated on drawings. All connection plates shall be engraved to indicate the function for each nominated outlet. The style and finish of all connection plates shall be consistent and match the decor of the space. Following table details University standard connections:

<table>
<thead>
<tr>
<th>Type</th>
<th>Video</th>
<th>Audio</th>
<th>Typical Installation location</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>University supplied computer input</td>
<td>HDMI</td>
<td>3.5mm mini stereo jack for audio</td>
<td>Installed below lectern in dedicated shelf for computer</td>
<td>COMPUTER</td>
</tr>
<tr>
<td>Laptop input</td>
<td>VGA 15pin HD connector and HDMI</td>
<td>3.5mm mini stereo jack for audio</td>
<td>Installed above lectern</td>
<td>LAPTOP</td>
</tr>
<tr>
<td>Document Camera input</td>
<td>HDMI/ SDI</td>
<td>XLR connector for audio (combined microphone and source outputs from digital audio processor)</td>
<td>Installed in AV equipment rack</td>
<td>PANOPTO</td>
</tr>
<tr>
<td>Lecture Capture System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microphone</td>
<td></td>
<td>3-pin XLR Female</td>
<td>Installed on lecterns, media link, bio-boxes and floor boxes</td>
<td>MICROPHONE</td>
</tr>
</tbody>
</table>

#-denotes the number

Contractors shall submit connection plate samples for approval by the LES. Contractors must provide all necessary connection cables for all devices. Laptop connection cables (HDMI and VGA) must be of Extron manufacture or equivalent.
3.9 POWER AND DATA REQUIREMENTS

The following table details the typical electrical and data requirements to support AV systems. The final requirements shall be coordinated on a project by project basis with Services Engineer to match the system design.

<table>
<thead>
<tr>
<th>Location</th>
<th>Electrical Requirements</th>
<th>Data Requirements</th>
<th>Typical AV Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV equipment racks</td>
<td>1 x 13Amp captive outlet on dedicated circuit</td>
<td>4 x Data outlets</td>
<td>AV switching processing equipment, video conferencing codec, AMX control system.</td>
</tr>
<tr>
<td></td>
<td>1 x Twin Socket Outlet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lectern</td>
<td>4 x Twin Socket Outlet within joinery</td>
<td>3 x Data outlets</td>
<td>Teacher’s computer and monitor, local AV switch, AV touch panel, DVD player,</td>
</tr>
<tr>
<td></td>
<td>1 x Twin Socket Outlet above joinery</td>
<td>within joinery</td>
<td>document camera, Blu-ray/DVD player, input connection plates and up to two permanently</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 x Data outlet</td>
<td>installed computers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>above joinery</td>
<td></td>
</tr>
</tbody>
</table>

3.10 LECTERN / TEACHER DESK JOINERY

The standard lectern and mini-lectern design as recommended by LES shall be used in all lecture theatres and teaching spaces. It provides control for lighting, an area for presenter's notes, microphones, and houses a touchscreen control panel, a computer monitor, document camera, Blu-ray/DVD player, input connection plates and up to two permanently installed computers.

All lecterns shall always include at least one square metre of surface for lecturers’ notes and books and subject to the requirements of the nominated user department; some lecterns may require an extended bench area for demonstrations.

One section of the lectern module is dedicated to the computers, interface and switching equipment, along with required power outlets, video and audio link cables, computer data link cables, telephone and LAN connections. It should be noted that computers vary in dimensions over the years, and computers will be replaced on an annual basis, so designers must take advice from the University on the dimensions of spaces required to house computers.

The lectern design, can be modified to match the aesthetics and to a limited extent, the design direction of individual lecture theatre projects. However, changes to the design must be approved by the Project Coordinator and LES, and must be consistent with the style and intention of the standard design as illustrated below.

A floor duct or trench is required to carry electrical and AV wiring to the lectern. The duct must be compartmented to provide separation between services. The lectern must be securely fixed in position to meet electrical regulations. Internal fittings and electronics packages are accessed via several hinged doors and removable access panels.

Substantial ventilation is needed to support the installed equipment. Each lectern may require dual computer grade fans with speed controllers, with power switched automatically under AV
system control. Fans, speed controllers and internal power wiring are supplied and installed by
the electrical contractor.

The lectern light is a standardized unit, through the Project Coordinator and installed by the
Electrical Contractor. A standard fixture for mains power, LAN connection and AV inputs shall
be provided. All connection plates shall be coordinated to ensure that style, colour and finish of
all plates are consistent.

The lectern doors and access panels shall be secured with the LES master keys.
A telephone is fixed securely in a position on the lectern where is easily seen and usable without
bending and where it does not interfere with the main flat surface of the lectern.
The installed computer monitor is screw fastened to the lectern carcass for security.
Final joinery details shall be coordinated and approved by LES.

3.11 AUDIO VISUAL EQUIPMENT STORAGE

The following equipment cabinets are required:
- AV equipment cabinets for ready access by presenters using the LES master key,
recessed completely into a wall at the front of the theatre, and utilizing the international
19" rack mounting standard and readily accessible to service staff;

- A dimmer cabinet usually adjacent to the switchboard far from the AV equipment, and
never physically adjacent to the AV systems rack.

3.12.1 Ventilation
Ventilation shall be provided to maintain the temperature of all AV equipment within the
manufacturer’s specifications. Ventilation requirements shall be determined by the services
consultant, methods may include:
- Air inlets at low level and air outlets at high level, must be provided to provide airflow
through the rack, lectern, joinery or other relevant enclosure requiring ventilation;

- Ventilation slots or grilles shall be selected following consultation with the Architect;

- Natural convection or fan driven ventilation shall be provided to accommodate the heat
load of the AV equipment requiring ventilation.

- Lighting dimmer cabinets will also require ventilation to maintain temperatures within the
range of the dimmer manufacturer’s specification.

3.12.2 Locks
Two of key-lock are required in each teaching space or lecture theatre.
Locks for main entry doors, which are master-keyed to the University system, shall be opened
and re-locked by the relevant Building Supervisor. Teaching and LES technical staff do not have
these room keys.
Locks for AV cabinet access by LES technical staff only.
3.12.3 Lectern Cabinet
The Lectern cabinet shall house all AV equipment and local switches. All AV equipment will be installed on 19" Rack strips. Sufficient space shall be provided for cable management. Front and rear access to lectern cabinet shall be provided. Both doors shall be secured by key for servicing and maintenance purposes.

3.12.4 AV Equipment Rack
The AV Equipment Rack shall house all AV switching and processing equipment and thus be appropriately sized. The 19" AV equipment racks shall meet the following specifications:

1. 540mm wide x 540mm deep
2. Sized to accommodate equipment plus 20% spare capacity in AV cabinets.
3. Complete with 19" patch panels for termination of AV cabling
4. Vertical and horizontal patch-lead management
5. 1 x 8 way vertical power strip fitted with captive plug tops
6. 1 x 8 way vertical power strip for switched power, connected to output of the power controller
7. Power surge protection
8. 2 x 100mm cable trays fitted to the inside of the equipment rack
9. Fix the power controller to one of the cable trays
10. Install manual reset button. To be configured with power controller
11. Allow for security panels as shown on the drawings
12. Lockable doors and side panels
13. Heavy duty castors to allow rack to be pulled out of cabinet for servicing.
14. Shall be of reputable local manufacture

The colour finish and labelling of the cabinets shall be approved by LES. Seminar rooms, Professional spaces and other small teaching spaces shall be provided with 19" rack strips installed within teacher’s desk, in place of dedicated equipment racks. The size or rack strips shall be selected to accommodate equipment. Detailed shop drawings shall be submitted for approval prior to manufacture, indicating the layout and labelling of the patch panels.

3.12 GROUNDING

Audio system noise performance may be compromised by poor management of equipment earthing.

A single phase, star power earthing arrangement to the AV equipment rack or technical earth for all AV equipment within the room should be explored with the Electrical Consultant. Appropriate consultation and earthing design will minimise the potential for issues from ground loops and multiple phase connection of AV equipment. Balanced audio systems with high common mode rejection ratio (CMRR) provide maximum protection against ground loops and other sources of interference and are the preferred audio design.

3.13 OVERFLOW
Selected theatres shall be provided with overflow displays (FPDs / projection systems) in the foyer area outside. Overflow displays are used in special circumstances when the theatre does not have enough seating capacity within the venue.

Nominated theatres must be provided with PTZ camera(s) within the theatre that can capture and display the presenter to the overflow display. Additionally, a dedicated feed from the video matrix switch must also be provided so that the overflow display can replicate the same content shown on the primary projection system within the theatre. The size of the overflow display and installation locations shall be confirmed with LES.

3.14 MEDIALINKS

Selected theatres shall be provided with media outlets to allow external parties, such as news services, to connect for recording purposes. Additionally, audio visual links shall also be provided to adjacent theatres so allow media and other external parties to view lectures. The specific number of connections and the number of links required shall be confirmed with LES.

3.16.1 AV Links

The following links, if available, must be transmitted to adjacent theatres:
1. HDMI video content from primary projector
2. SDI video content from primary projector
3. Composite video content from primary projector
4. Video from PTZ camera
5. Combined audio from digital audio processor. Audio shall be a mix of source and microphone.

3.16.2 Media Connection

As a minimum, media outlet shall consist of the following connections:
1. 4 x Female XLR connections for external microphones inputs
2. 2 x Male XLR connections for sound feed channel
3. BNC-SDI type connections for video
SECTION 4 HANDOVER AND SUBMISSIONS

4.1 Testing Commissioning and handover

Practical completion will be granted when the following minimum requirements have been fulfilled by the AV Contractor:

1. System has been tested and commissioned
2. System has been inspected by LES and the AV Consultant and deemed to be operational and practically complete
3. Serial numbers of all new equipment has been submitted to LES
4. All documentation has been approved by AV Consultant and submitted to LES
5. All control system source codes have been handed over to LES and become the intellectual property of the University
6. Interface testing to the University AMX RMS system has been successfully completed (for rooms provided with AMX control systems)
7. All trainings have been completed
8. All accessories, software, connection cables and remote controls have been handed over to LES
9. All packages of information handed over to LES shall be scheduled in a transmittal, copied to the EO project manager and AV Consultant

4.2 DOCUMENTATION AND SUBMISSIONS

As a minimum the following documentation shall be submitted to LES:

1. Installation manuals with full description of the installed system including maintenance requirements
2. Operational manual with clear and concise description on how to operate the AV system
3. Quick reference guide. A one page summary, briefly describing the basic operation of the AV system for each room
4. Equipment manuals of all equipment installed
5. Details of equipment manufacturers and distributors
6. As-built drawings including the following:
   6.1 Audio schematic
   6.2 Video schematic
   6.3 Control system schematic
   6.4 Floor plans, elevations and sections of teaching space indicating equipment locations, mounting heights and installation details
   6.5 Cabling schedule
7. Serial numbers and MAC addresses of all equipment provided
8. Commissioning test results (See Appendix B for template)

Contractors must provide an electronic copy of all documentation in PDF format on a DVD disc. Contractors shall also submit a copy of all control system source codes on a separate CD/DVD media.