MIDDLE TENNESSEE STATE UNIVERSITY

Guidelines for Instructional Spaces

Revised March 2019 by:

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1. Introduction

- These campus standards were developed by an ad hoc committee consisting of Provost Office, Institutional Equity and Compliance Office, ITD, Construction and Renovation, Facilities Services, and Campus Planning, and are maintained by the Information Technology Division.

- "Guidelines for Instructional Spaces" are a collection of design guidelines developed from MTSU's current practices with additional information obtained through research of best practices, designers assigned to capital projects and literature reviews. They are to be used for both capital projects and internal renovation projects.

2. General areas around instructional spaces

- Instructional spaces will be accessible, yet away from distractions such as vending areas, elevators, restrooms, mechanical rooms, and informal studying/gathering spaces.
- Building signage will be ADA compliant, accessible, easy to change, and appropriate to direct individuals to the instructional spaces.
- Bulletin and display boards will meet ADA and building codes for paths of travel.
- If possible, appropriate seating for students waiting on classes should be provided.

3. General instructional space considerations

- If possible, the classroom should be configured so the front of the room is the longest wall and the wall closest to the door.
- Tiered configurations will be incorporated based on room capacity, geometry, and academic program.
- Typically, the front of the room will have accent paint. The color of the other walls should be one of the campus-standard paint colors as referenced on the campus planning website.
- The maximum capacity for a general-purpose classroom is calculated as the total square footage minus 50 square feet for the instructor, 20 square feet for open seating and 15 square feet for fixed seating. To obtain the maximum student capacity divide the remaining square footage. For instructional spaces with student computers, the remaining square footage is divided by 30 square feet. If a room has a capacity greater than 50 people, the room must have two exits. Maximum capacity may be reduced due to furniture and equipment placement, student comfort, and/or pedagogical reasons.

- **Doors**
  - Doors should include a security mesh window (blinds not required). The purpose of this window is to provide a view into the classroom and the hallway. Side windows and door view kits must meet the most restrictive requirements of applicable adopted codes.
  - Campus Planning signage standards are to be used for corridor signage.
  - BEST is the campus standard for locks. Access to master classrooms should be controlled by Stanley Security Solutions/BEST B.A.S.I.S. online access control system utilizing magnetic card readers formatted to accept University issued ID cards. Doors should be equipped with ADA and ANSI 117.1 and required lever-type handles. Any additional doors are monitored through the card access system. Key override is required for police and security. A lock down switch is also installed for emergency override of the card swipe access programming.

- **Whiteboards and bulletin boards**
    - Whiteboards (marker boards) are used for all instructional spaces. Departments are responsible for cost of markers. Suggested mounting of whiteboards is bottom edge at 36" above finished floor. Whiteboards should be seamless (without divider strip moldings) with round or beveled edge for the marker tray. Whiteboards should cover the entire front wall of the room.

- **Shades and blinds**
    - Motorized shade/blinds are used to block light during projection. These shades are to be controlled through the A/V control system with a manual override switch in close proximity to the instructor station.
    - Manual shades/blinds are optionally available at the request of the college or department.

- **Flooring**
    - Resilient floor covering will be used in all campus classrooms.

- **Ceiling tiles**
    - Ceiling tiles to be used will have an NRC 1810 rating and will be non-directional, white or an equal product and adhere to the MTSU campus standard.
    - Acoustical wall panels are recommended in large classrooms (>50 people) or any classroom without an acoustical ceiling and required in any space with ceiling mounted microphones.

- **Instructor station**
    - The classroom instructor's station should provide a secure environment to house the AV equipment needed to connect devices such as a laptop, computer, document camera, etc. The equipment must be rack mounted and distributed according to heat dissipation. The cabling needs to be separated by signal strength.
    - All equipment that needs interaction from the user must be easy to reach. All equipment that does not need to be accessed by the end user must be separate and locked. The locked portion of the instructor's station must be easily accessed by ITD's staff.
    - The location and position of the instructor's station must come from the direction of the Dean of the College and/or Department Chair over the classroom in question. Recommendations will be given on location due to construction, technological, and financial constraints.
    - Consideration for upgrades, maintenance, and serviceability must be incorporated.

- Acceptable instructor station models may be found in Appendix E.17 and E.18.

- **Standard Classroom Configurations**
  - Campus classroom details and schedules can be found on the 25Live website at https://25live.collegenet.com/mtsu

- **Furniture**
  - It is important to determine and account for all furniture needs, including, but not limited to, student seating, instructor's station, computer equipment, printers, scanners, and storage.
  - Furniture should be flexible and mobile rather than fixed.
  - Tables and chairs should be used whenever possible. Preferably, 18x60 tables with cable management and armless chairs. Sled-based chairs are also acceptable.
  - Whenever fixed seating is necessary, the tablet arm should be as large as possible while allowing for the passage of students to other seats in the row.
  - In a collaborative classroom setting, furniture can be arranged into a variety of shapes and configurations.
  - A mobile, height adjustable lectern and instructor's stool will be included for every classroom space.
  - Non-fabric, armless chairs are strongly recommended.
  - All furniture should be purchased through Construction and Renovation or Campus Planning.

4. Technical Guidelines & Formulas

- **Screen Specifications**
  - When in the lowered position, the bottom of the screen must be 48" above the finished floor. Screen aspect ratio will be 16:9 and sized according to the classroom dimensions. Screen placement will be determined using factors such as room dimensions, viewing angles, and seating layout.
  - Acceptable display screen models can be found in Appendix E.

- **Optimum Ceiling Heights**
    - The minimum ceiling height for rooms less than 50’ deep should be at least 10’; for larger rooms the following heights are recommended:

Distance to Last Row	Rear of the Lecture Hall	Front of the Lecture Hall
50 feet	10 feet	14 feet
75 feet	10 feet	16 feet
100 feet	10 feet	20 feet

    - In consideration of new building designs, alternative delivery will be considered if optimum ceilings height cannot effectively be included in the design of the building.

- **Sound – Playback only and/or Public Address**
    - The quantity and position of the loud speakers will allow for minimal dead spaces covering the students listening space. The space between the front wall and the front of the first row of students will have no audio coverage to minimize feedback if a professor is using a microphone. 70 Volt ceiling speakers are preferred in general classrooms (Appendix A). The tap setting should be set to reach a level of 75 – 80 dB’s. In classrooms where higher quality audio is needed a 4-8 Ohm based audio system will be required. If the capability to playback DVD movies in true 5.1 or 6.1 Dolby Digital Surround is required, a high-end amp/receiver is needed to provide a signal to five or six speakers as well as a line signal to a powered subwoofer. These rooms will have a center speaker near the screen, two speakers in the front on either side of the screen, and two speakers in the rear corners of the room. The subwoofer should be placed on the floor next to the teacher station. The cables for these speakers should be run in ¾” conduit. An electrical outlet may be needed if the speakers selected are powered speakers. (Appendix A)
    - If a room is large (larger than 30’ X 30’ or 50 people or more) it will be necessary to install a microphone system. Acoustical treatments on the side and rear walls are often necessary to make the sound clean and audible to all students. PA systems may require additional amplifiers, DSP’s, and various microphones, both wired and wireless. These components will be located in the AV equipment rack inside the instructor station. If there is a lot of ambient noise in the room or nearby, it may be necessary to add a PA system for rooms as small as 25 seats (a good example is DSB 130). (Appendix A)
      All classrooms need to meet the current American National Standard for Acoustical Performance Criteria, Design requirements, and guidelines for schools. (ANSI S12.60-2002)

Assistive Listening Systems (ALS)

- Assistive Listening Systems are required in every assembly area in accordance with 2010 ADA Standards 219 and 706. To comply with this, every new construction or renovation of a teaching space, requested or not, will at minimum have installed an IR radiator with a mounting bracket. Cabling- (1) Cat-6, (1) RG-58 in ¾" conduit stubbed up, with a 4x4 backbox and single gang mudring. The 4x4 backbox must be at minimum 80" AFF or higher and within direct line of sight to the audience. An Assistive Listening Notification sign must be posted at the entrance of the room. (Appendix A)
- Upon request from the office of Disabilities, ITD's Classroom Technology will install the ALS channel transmitter in the AV rack to receive all audio and transmit it through the Infrared (IR) radiator. The requestor will need to check out a T-coil equipped ALS receiver from the office of disabilities. (Appendix A)
- In small to medium size assembly areas an IR system will be required. In large teaching spaces or auditoriums IR technology may not be effective. In these spaces a permanent full installation of a radio frequency (RF) ALS will be installed. (Appendix A) With a RF system a radiator is not needed but conduit may still be needed for best placement of the antenna in the ceiling.
- Appropriate acceptable cabling and hardware can be found in Appendix D and E. ALS systems and related equipment can be found in Appendix A.

- **Projector Requirements**
    - The minimum required brightness for a projector is a level of 5000 ANSI lumens and a minimum resolution of 1280 x 720. For areas of high ambient light, light levels must be measured to determine the required brightness level of a projector needed. There are other considerations to account for such using motorized shades or an ambient light rejecting projector screen. The projector screen gain will be selected in addition with the projectors lumen output to reach the desired brightness level. The contrast ratio must meet a minimum of 15:1 or a higher lumen projector will be required. A laser based projector is preferred in general classrooms. In classrooms where color replication is critical, a lamp based projector maybe acceptable. All projectors will have an HDBaseT port for video and control.
    - Acceptable projector models can be found in Appendix B.

    - The control system will be programmed to turn off all projectors at eleven p.m. Central Standard Time.
    - The projector must be located an appropriate distance from projector screen based on the projector screen size and approximately 50% of the lens throw ratio.

- When possible, the projector must be placed exactly level with the top of the screen as well as be centered on the screen.

- **Classroom Calculations**

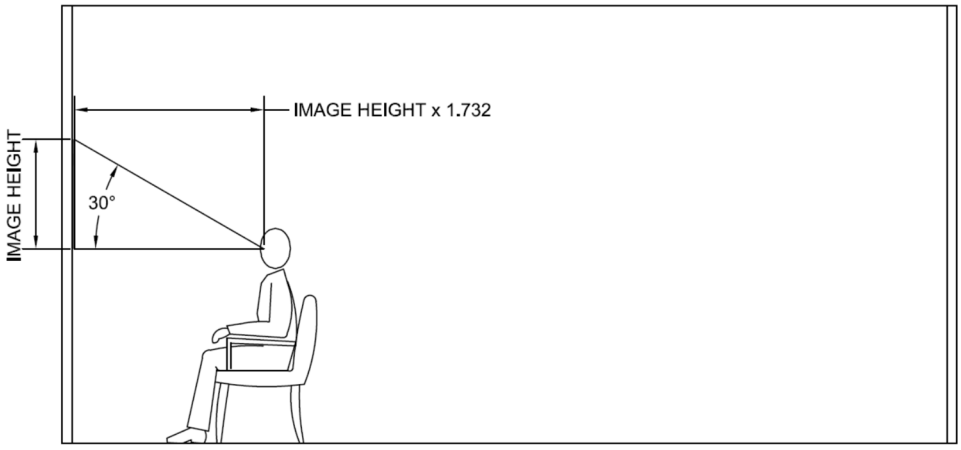
Distance to farthest viewer	**Required ceiling height**
<25’	9’
30’	10’
36’	11’
48’	13’

DISCAS standard based on 16:9 Aspect Ratio for 2D ONLY

- AVIXA V202.01:2016 Formerly ANSI/INFOCOMM V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems

Closest viewer

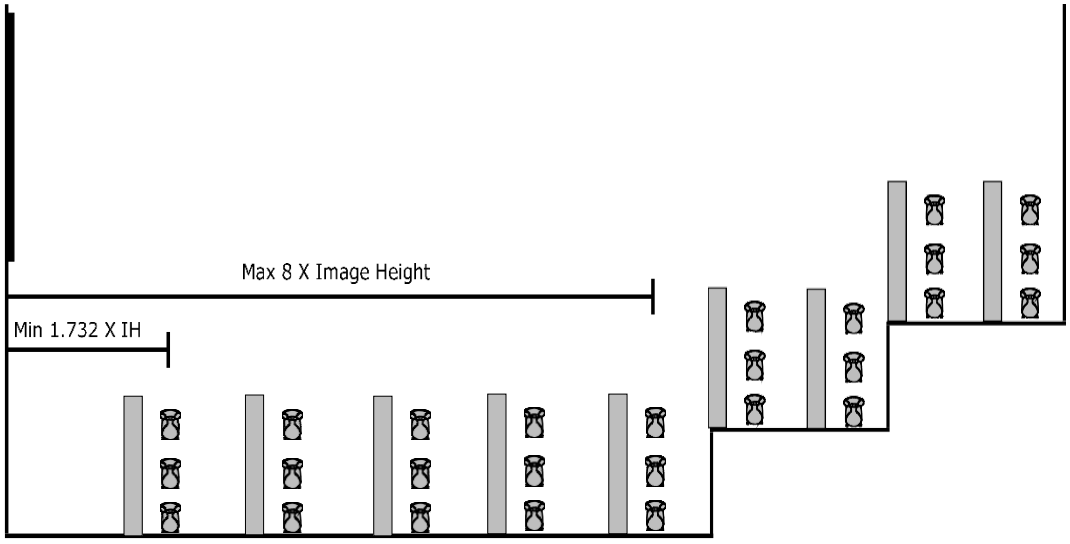
- The minimum distance for the closest viewer is determined by the Image height multiplied by 1.732.



CLOSEST VIEWER CALCULATION FOR BDM
NO SCALE
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

Distance from back row to the screen	**Image Height**
30’	5’
36’	6’
42’	7’
48’	8’
54’	9’
60’	10’

- **Tiered Seating**
    - To determine when tiered seating is required, multiply the image height of the projector screen or display by eight. If the depth of the room is greater than this, you will need tiered seating beyond that distance.



Max Viewing Distance

- 24pt font converted to pixels is 31.8 px
- 32px / the screen resolution 1080p = 2.96%
- % Element Height = 3.00%

Max Viewing Distance(MVD) for Basic Decision Making = Image Height X (200 X %Element Height)

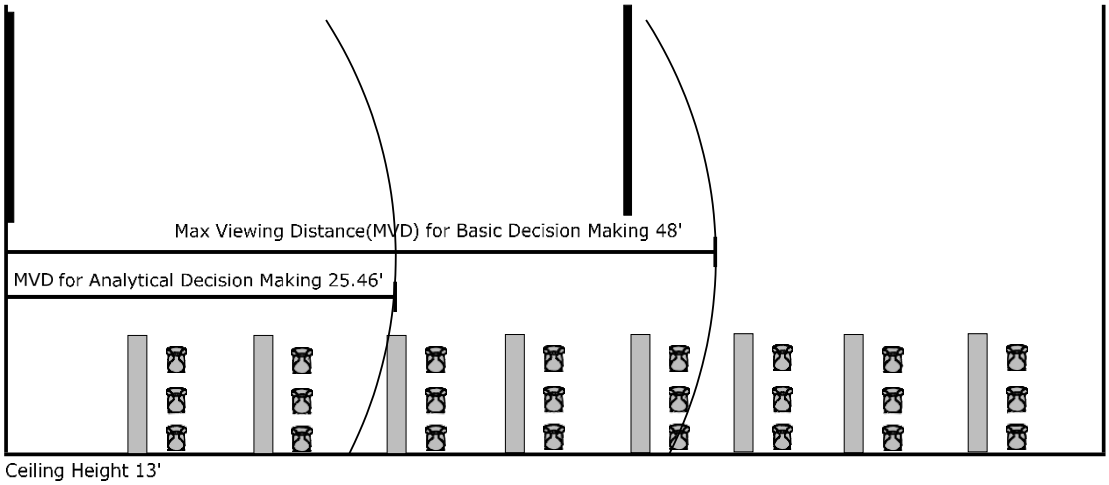
30'(MVD) = 5' X (200 X 3.00%)
36'(MVD) = 6' X (200 X 3.00%)
42'(MVD) = 7' X (200 X 3.00%)
48'(MVD) = 8' X (200 X 3.00%)
54'(MVD) = 9' X (200 X 3.00%)
60'(MVD) = 10' X (200 X 3.00%)

Classroom minimum 3.00% Element Height

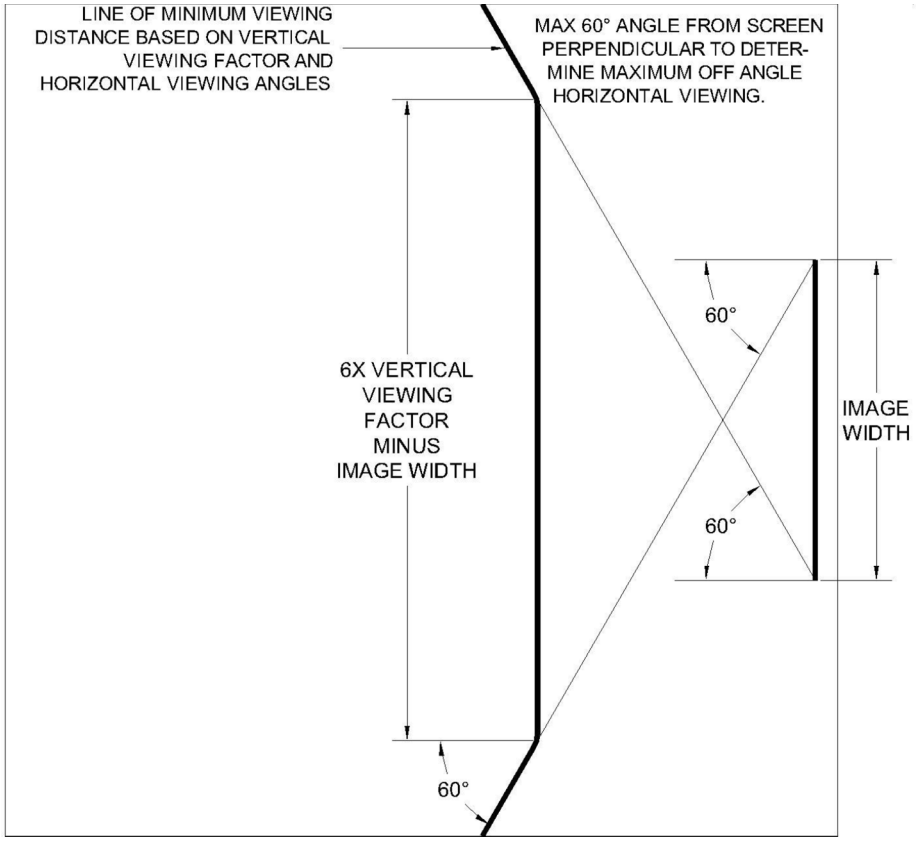
24pt font minimum at a 1080p resolution
16pt font minimum at a 720p resolution
49pt font minimum at a 4k (2160p) resolution

Max Viewing Distance for Analytical Decision Making = (Image Height X 3438) / Vertical Pixels

15.92’(MVD) = (5’ X 3438) / 1080
19.1’(MVD) = (6’ X 3438) / 1080
22.28’(MVD) = (7’ X 3438) / 1080
25.46’(MVD) = (8’ X 3438) / 1080
28.65’(MVD) = (9’ X 3438) / 1080
31.83’(MVD) = (10’ X 3438) / 1080



The maximum horizontal viewing angle shall be 60° angle from the edge inward of the screen.



- **Lighting Types and Control Systems**
  - Four foot LED lamps with a temperature of 3500 Kelvin and a minimum CRI of 75 is the campus standard for general instructional spaces; however, in areas where better color viewing is required, CRI of 85 is recommended.
  - Light fixtures should be selected to minimize the collection of bugs.
  - All classrooms will have motion detectors/occupancy sensors. Lights should be programmed to turn on when one enters the room and off after 30 minutes of no movement in the room. A manual light switch at the entry door(s) will be available and not affect the functioning of the motion detectors/occupancy sensors.
  - All Master Classrooms to have dimmable fixtures and lighting zones. Lay-in 2’ x 4’, pendant type, or recessed can lights may be used. Zoning of lights (or classroom scenes) should be accomplished by using the specified control and interface as per the appendix; the particular model depends on the number of zones to be controlled. It is imperative the front of the room near the screen be able to darken via zoning and dimming, and a separate can light over the instructor’s work area on its

own fader be installed. Each classroom will require individual programming of the lighting control system.

- **Electrical Requirements**
  - In order to prevent 60 cycle hum in the sound system and on the video screen, the instructor's computer(s), AV rack (inside the instructor station), and projector must be on the same phase of power in a quadraplex electrical outlet located at the AV rack location. The projector requires a duplex connection in the ceiling and has a power consumption of 400 watts; the computers and AV rack draw about 17 amps on average.
    For rooms with larger PA systems, an additional 20-amp circuit is required. A licensed electrician is needed to make the high voltage connections to the low voltage controller for the electric screen.
  - All equipment and/or hardware connections, whether below or above the ceiling, must be installed to meet or exceed all applicable fire and life safety codes.

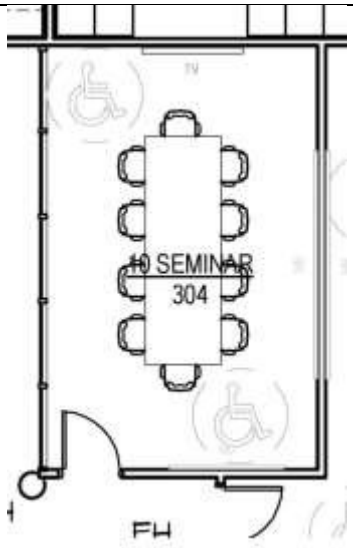
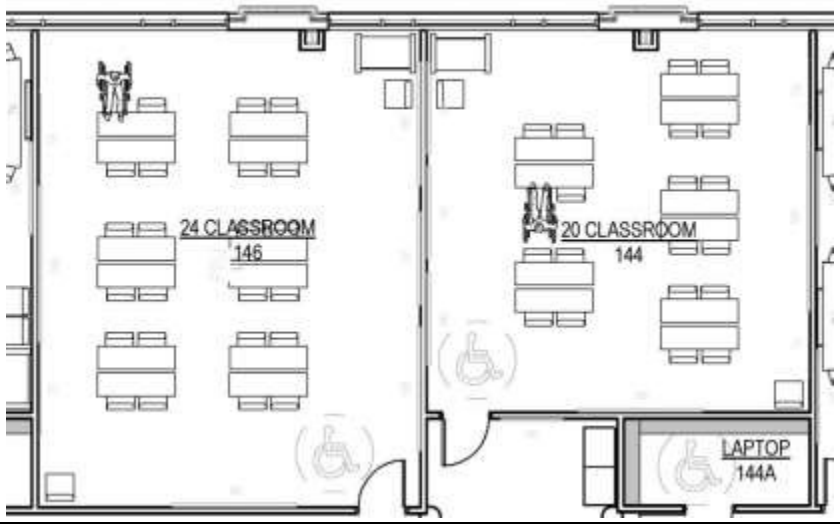
- **Data Requirements: Wired and Wireless**
  - For a standard Master Classroom, there should always be at least four network jacks (RJ-45) located at the teacher station. Additional lines for printers or student computers need to have jacks available to each location that are no more than 25' from the jack to the device.
  - Acceptable jacks and cabling found in Appendix D

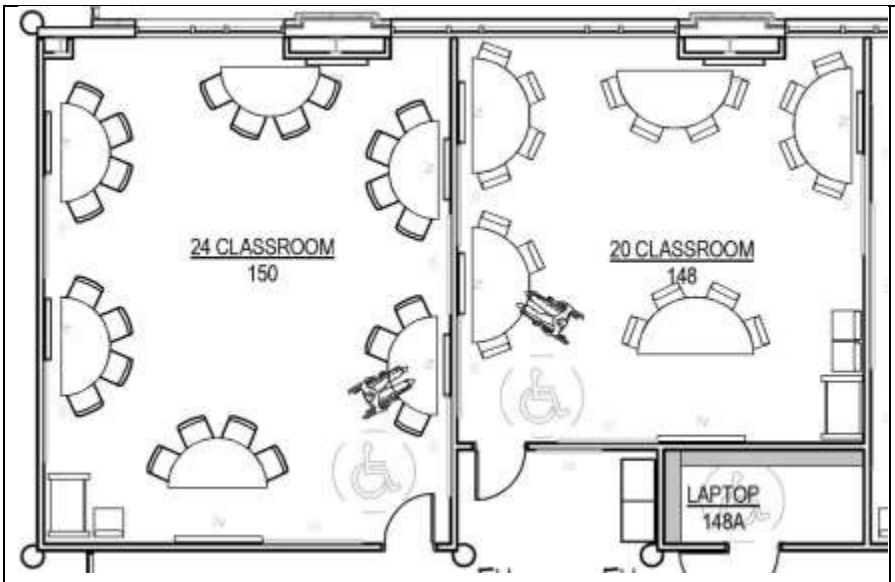
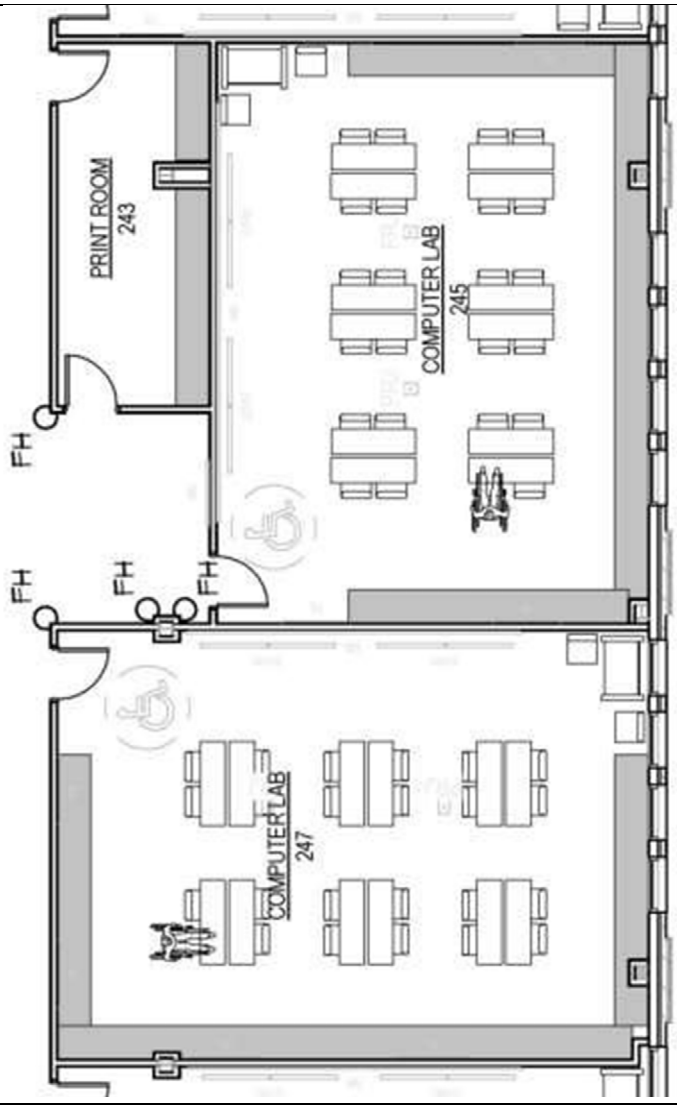
- **Conduits for AV Equipment**
  - A 1 1/4" minimum rigid conduit with a 4 x 4 junction box is needed for the cables from the instructor's station. Actual conduit size and routing must be reviewed and approved by MTSU during design.
  - A 3/4" conduit will be needed for all electric projector screens, from the low voltage screen controller to the AV rack location. A single gang electric box is required at the end of the conduit for the three-button switch.
  - All cables above the ceiling should be plenum rated.
  - Cable runs shall maintain a minimum distance of six (6) inches from fluorescent lights, motors, and other sources of EMI radiation.
  - Acceptable cabling can be found in Appendix D

- **ADA and ANSI 117.1**
  - The Americans with Disabilities Act Accessibility Guidelines (ADAAG) and ANSI 117.1 clearly define what is required of the University in our classrooms. The MTSU Director of ADA compliance is the campus contact for ADA related issues.

- **Room Control Programming**
  - Room control programming will adhere to the campus standard layout and be tailored to each room configuration.
  - Campus standard layout templates will be provided by MTSU

ITD. Classroom configuration examples-

	Seminar
	Traditional

	Collaborative
	Computer Lab

Appendix A – Audio Equipment

Reference	Brand	Model	Description of Parts
A.1	Bi-Amp	TesiraFORTE VT4	Digital Signal Processor for microphones
A.2	QSC	Core 110f	Audio Digital Signal Processor
A.3	QSC	Amp	Amplifier
A.4	QSC	Acoustic Coverage	In-Ceiling Speaker
A.5	QSC	Acoustic Design	8" In-Ceiling Speaker
A.6	Crestron	SAROSICI6TWT	Saros® Integrator 6.5” In-Ceiling speaker
A.7	Extron	42-168-03	8" 2X2 In-Ceiling Speaker SF 228T
A.8	Shure	GLXD14/85-Z2	Lavalier Wireless Microphone
A.9	Shure	ULXD	Handheld Microphone
A.10	Listen	LA140GY	IR Radiator
A.11	Blackmagic	Web Presenter	Audio to USB

Appendix B – Video Equipment

Reference	Brand	Model	Description of Parts
B.1	Extron	60-1615-02	IN1808 Control processor and amp
B.2	Extron	60-1238-85	IN1608xi Control processor and amp
B.3	Extron	60-1368-12	DTP CrossPoint 84 IPCP SA Switcher
B.4	Panasonic	PT-VMZ50	LCD Laser Projector
B.5	Sony	VPLFHZ61W	Full Color 3LCD Laser Projector
B.6	Vaddio	999-8210-000	AV bridge
B.7	Vaddio	999-9990-000W	ConferenceSHOT 10 Camera USB
B.8	NEC	C981-AVT2	98" ultra HD display
B.9	Viewsonic	IFP8650	86" Interactive Flat Panel
B.10	ELMO	1364 PX-30	Document Camera
B.11	HP	E230t	Touch screen monitor
B.12	Aver	CAM 520	PTZ camera with RS-232

Appendix C – Control Equipment

Reference	Brand	Model	Description of Parts
C.1	AMX	MT-1002	10" Touchpanel
C.2	Extron	60-1601-02	10" Touchpanel
C.3	Extron	60-1417-01	IP Link Pro Control Processor

Appendix D – Cables

Reference	Brand	Model	Description of Parts
D.1	AMX	AMXFG55232	HPX-AV102-HDMI-R
D.2	AMX	AMXFG56101	HPX-P200-PC-US Power
D.3	AMX	AMXFG55234	HPX-N102-ETH-R Cat6 Ethernet
D.4	AMX	AMXFG55312	HPX-N102-USB
D.5	Shure	SBC10-MicroB	USB wall charger for microphone
D.6	Vaddio	440-1005-023	USB 3.0 Type A to Type B Active Cable - 20m
D.7	Systimax	CPC331201F020	20 Ft GigaSPEED XL GS8E
D.8	Systimax	CPC331201F005	CAT6 5' Patch Cables - Black
D.9	Systimax	CPC331201F003	CAT6 3' Patch Cables - Black
D.10	Crestron	HDTx101CE	HDMI TX/RX
D.11	Trin	234001WH	Network coupler - RJ-45 (F) to RJ-45 (F) - shielded
D.12	Liberty	DLAR7005	HDMI adapter ring
D.13	Kramer	C–MHM/MHM–6	Flexible High–Speed HDMI Cable
D.14	Kramer	C–MHM/MHM–3	Flexible High–Speed HDMI Cable
D.15	C2G	28103	3 Meter USB cable A-B Cable
D.16	Extron	26-518-01	RS-232 cable

Appendix E – Hardware

Reference	Brand	Model	Description of Parts
E.1	Extron	60-1233-01	Power Injector
E.2	Extron	70-1138-02	Swivel Mount
E.3	Chief	K1D120BXRH	lectern mount for monitor
E.4	AMX	AMXFG56002BL	HydraPort 9
E.5	AMX	AMXFG55803	HPX-B200
E.6	Chief	CMS445	SUPENDED CEILING 2X2 KIT with power
E.7	Chief	RPMA285	White projector mount
E.8	Chief	CMS012W	12" Pipe
E.9	Raco	Model 420	2 in. Deep Gangable Switch Box
E.10	Vaddio	999-2225-022	IN-Wall Enclosure for Vaddio
E.11	DaLite	94214LSR	110" (54"x96") Tensioned Contour Electrol projection Screen
E.12	Listen	LA342	mounting bracket
E.13	Microsoft	PY9-00001	Wireless keyboard & mouse
E.14	Chief	PRX-SMP-15X10	SLIDING MOUNTING PLATE
E.15	MiddleAtlantic	PD915RPL	Rackmount Power Distribution
E.16	Viewsonic	VPC14-WP	PC Module
E.17	Spectrum	Link	Link lectern
E.18	Spectrum	Director	Large lectern
E.19	MiddleAtlantic	MIDUD2	2 Space (3 1/2”) Utility Drawer, Black Powder Coat Finish
E.20	MiddleAtlantic	MIDFI2	2 Space (3 1/2") Customizable Foam Insert
E.21	MiddleAtlantic	MIDU2V	2 Space (3 1/2") Vented Rackshelf for Computer
E.22	Lutron	QSE-CI-NWK-E	Sivoia QS lighting and Shade control
E.23	Viewsonic	WMK-047-2	Wall mount
E.24	Balance Box	40090	Adjustable wall mount
E.25	Chief	K1D120BXRH	lectern mount for E230T touch screen

Appendix F – Standard Classroom Configurations

F.1 Medium - Large Standard Classroom		
Appendix Reference	Device	Description of Equipment
E.18	Large Lectern	Instructor's station
B.1 - B.3	A/V Switcher	Audio/Video switcher
C.1 - C.2	Touchpanel	Interactive touchpanel for classroom control
E.1	Power Injector	Network power injector for POE
E.2	Swivel Mount	Swivel mount for touchpanel control
E.4	Modular A/V connections	Audio/Video connection ports for the lectern
A.4 - A.7	Speakers	In-ceiling speakers for audio distribution
A.1 - A.3	DSP and/or Amplifier	Audio amplification and processing
B.8 - B.9	Video display (wall display)	Wall display provided based on room and requirements
B.4 - B.5	Video display (projector)	Projector provided based on room and requirements
E.11	Projection Screen	Projection screen provided based on room and requirements
E.23 - E.24	Display mount	Ceiling mount or wall mount provided based on chosen display
A.8 - A.9	Microphone	Lavalier wireless or handheld microphone
B.7, B.12	Video camera (optional)	USB camera for conferencing or lecture capture
E.10	Camera mount (optional)	Enclosure mount for USB camera
A.10	ALS IR radiator	Infrastructure to support addition of ALS system
E.22	Lighting and/or Shade control	Controls for automatic lighting and shades
B.10	Document Camera	Document camera
N/A	Classroom PC	Windows or Apple PC provided for classroom instruction

F.2 Small Standard Classroom		
Appendix Reference	Device	Description of Equipment
E.17	Small Lectern	Instructor's station
B.1 - B.3	A/V Switcher	Audio/Video switcher
C.1 - C.2	Touchpanel	Interactive touchpanel for classroom control
E.1	Power Injector	Network power injector for POE
E.2	Swivel Mount	Swivel mount for touchpanel control
E.4	Modular A/V connections	Audio/Video connection ports for the lectern
A.4 - A.7	Speakers	In-ceiling speakers for audio distribution
A.1 - A.3	Amplifier	Audio amplification and processing
B.8 - B.9	Video display (wall display)	Wall display provided based on room and requirements
B.4 - B.5	Video display (projector)	Projector provided based on room and requirements
E.11	Projection Screen	Projection screen provided based on room and requirements
E.23 - E.24	Display mount	Ceiling mount or wall mount provided based on chosen display
A.10	ALS IR radiator	Infrastructure to support addition of ALS system
B.10	Document Camera	Document camera
N/A	Classroom PC	Windows or Apple PC provided for classroom instruction