Montana State University Classroom Design Guide

Approved by UFPB November 11, 2011

Acknowledgments

The Montana State University Classroom Committee, along with members of the campus community, dedicated many hours to create and publish this design guide.

Other members of the campus community including faculty, staff and the student body have contributed their collective knowledge to the progressive design of our technology-rich learning spaces.   To all of these individuals we express our deepest appreciation.

We would like to especially thank the College Classroom Working Group at Emory University for their permission to reproduce portions of their 2008 Design Guide.

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I. Introduction

This design guide is intended to provide information and a framework for the design, remodeling, construction and maintenance of classrooms and instructional spaces at Montana State University. It compiles the knowledge and experience of those responsible for day to day campus operations as well as those who plan for the future. Research on the latest trends in teaching in higher education was reviewed as well as design guidelines from other colleges and universities. We expect this document to continue to be refined as we learn more, grow in experience, and receive more input from those who use the spaces.

The planning and writing of this design guide was carried out by representatives from the Classroom Committee, a subcommittee of the University Facilities Planning Board of Montana State University, with input from the University's Campus Planning Design & Construction (CPDC) department, the office of Facilities Services (FS), Registrar's office, office of the Provost, MSU Information Technology Center, as well as faculty and student representatives.

Overarching principles that are intended to guide the design of instructional space include:

- a space that fully supports the learning process, including access to information, understanding, transfer and assessment
- a space that facilitates collaboration and teamwork for large and small groups
- spaces that easily support multiple teaching and learning styles
- all spaces easily facilitate engagement between the instructor and the student

It is intended that the concepts and recommendations of the Design Guide be incorporated into the design of MSU's instructional spaces. This Guide, and any added appendices, shall be followed for all University projects unless due process is used for waivers or modifications. There may be particular project circumstances that, in the judgment of a consultant or MSU staff, warrant alternatives to this Guide. Such recommendations are welcome and will be conscientiously considered and brought to the attention of the Classroom Committee. However, unless the Classroom Committee gives special exception for alternatives prior to design implementation, the consultant or staff must comply with the Design Guide as stated in this publication.

A note on the Americans with Disabilities Act

Montana State University adheres to the Americans with Disabilities Act (ADA) in all of its construction and renovation projects. The Classroom Committee works closely with MSU's FPDC and Disability, Re-entry and Veteran Services to recommend accessibility design and upgrades to all instruction spaces. All remodeling and new construction of instructional space at MSU must, at minimum, meet all requirements of the currently adopted Americans with Disabilities Act Architectural Guidelines (ADAAG).

II. Planning Considerations

1. **Classroom Locations**
   Whenever possible, locate classrooms on an entrance level and as close to main traffic entry doors as possible.   The next choice for location would be near major stairs and elevators on levels immediately above and below ground level, in order to isolate class change noise and high traffic functions from office and lab functions.   If not on ground level, the width of stairs, depth of stair landings, and width of doors leading to stairwells must also be considered to give students enough room to transition from one space to another.   Classroom locations must be accessible according to the Americans with Disabilities Act.

   Classrooms should be separated from noise generating areas such as mechanical rooms, elevators, vending, and restrooms.

2. **Hallways/Corridors**
   Hallways should be designed as an essential, thoughtful aspect of the building, not only as paths of egress, but for intentional social interaction. Although the corridors are used to move students throughout the building and generally can be noisy, major consideration in planning and design of these spaces is integral to a successful project.   Building codes are not the only criteria to consider.

   Hallways should be designed, and are valuable opportunities, to contain seating and small group gathering spaces to accommodate students waiting for classes or gathering to continue classroom discussions.   Such spaces can be equipped with whiteboards to facilitate discussion and interaction.   These seating/gathering spaces must be carefully designed so as to not create a disturbance for adjacent classrooms in use.

   Lower portions of hallway walls should be finished with a durable surface.   Floors should provide a non-skid surface and should include some type of design, pattern or color that lends interest to the space.   Hallways should improve acoustics for surrounding learning spaces and create visual interest.   If possible, doors should not open out directly into the hallway.

3. **Informal Interaction Spaces**
   Other spaces outside of the classroom are further opportunities to create informal interaction for faculty and students. Small alcove spaces are well suited for conversations between two to four people.   Larger spaces provide for interaction between groups of six or more.   These spaces may include amenities such as:
   - Whiteboarding areas
   - Network for wireless service or data drop
   - Power located for convenient access
   - Proper lighting for reading and use of computers
   - Privacy should be designed into some areas, while others should be designed for social interaction, offering a place for individuals to "be seen".
   - Provide soft seating, occasional tables, change of materials, accent colors, lamps and plants to make it a specific space, rather than an afterthought.   Value the space.

4. **Extended Learning Spaces**

Extended learning spaces serve to expand the available square footage for active learning in both new building construction and renovations through creative use of hallways, niches, lobby space and areas near building columns/support. These spaces differ from informal, interaction space by allowing for more structured collaborative project-based work and group learning to occur.   Spaces like these are increasing in numbers across campus, and are in high demand by students.   Successful prototypes include the EPS lobby, atrium spaces in Chemistry Biochemistry Building, lobby areas in Gaines Hall, and the Animal Bioscience Building. These spaces may include amenities such as:

- Inviting color and differences in floor coverings can be used to define the areas
- Flexible chairs and tables are on wheels, so students and faculty can move the furniture to best facilitate their activity.
- A small table (on wheels) to hold a laptop with paperwork, or a wireless keyboard and mouse
- A wall or pole mounted plasma (or LCD display) offers real estate for display of project-based work or for group learning before and after class
- Outlets for data and power

The visibility and high traffic in collaborative spaces make these spaces popular with building occupants, and an important element in new construction or renovation programming.

5. **Rest Rooms/Drinking Fountains**

Restrooms should be located near the classrooms for convenience.   Under no circumstances should there be a common wall or ceiling between any classroom and restroom.   Drinking fountains should be located on each floor and should comply with ADA guidelines and International Plumbing Code

6. **Signage – Wayfinding/Room signage**

Building signage should be designed such that the user is directed to classrooms from the major entrances and circulation areas of the building, including elevator lobbies and stairwell landings.   All signage must comply with current Signage Standards (see MSU Design Guidelines)

7. **Bulletin Boards**

Display boards should be installed near a large grouping of classrooms, each classroom does not require its own.   Thoughtful design should be developed for the boards, their location, and the way in which they integrate into the larger hallway layout and design, both visually and spatially.

8. **Vending**

Even with the advent of cafes throughout campus, it is still necessary to install small vending spaces in each classroom building.   The spaces should be accessible but not arranged so that the faces of the machines are visible from public space.   One beverage and one snack machine is usually appropriate for each vending area.

III. Classroom Types

Different pedagogical techniques require different types of learning spaces. We have defined six basic classroom types. The greatest number of current spaces fit in the "classroom" or "seminar" categories. Although we have created these definitions to be as mutually exclusive as possible, there is some overlap. A seminar may, for example, be taught in a classroom space with the chairs moved into a circle. These definitions designate the most efficient use of a space, but do not necessarily tell us what a space is being used for at a given point in time.

1. **Classroom Loose Seating**

    These are our most common learning spaces. Because they have moveable furniture, these spaces are very flexible. Furniture can be configured for lecture, seminar, group work, or anything else the instructor might require. Spaces often require more daily maintenance attention, as instructors do not always return furniture to its original location at the end of class. These rooms can be generally described as having:

    - 20 to 50 seats
    - Flat floors (not tiered or sloped)
    - Tablet arm chairs or movable tables and chairs in rows. Unless determined otherwise, chairs and tables are to be furnished with casters.
    - Distance from the front of the room to the first row of seats shall be determined by using the recommendations and formulas contained in Item 3, Section V (The shell).
    - 10 square feet for an instructor station.

2. **Classroom Seminar**

    Seminar rooms generally accommodate smaller numbers of students seated in either a circular or rectangular format. Characteristics of these spaces include:

    - 8 to 25 seats
    - Face-to-face seating arrangement
    - Instructor sometimes sits with students
    - Movable tables and chairs on casters

3. **Classroom Conference**

Classroom Conference rooms sometimes serve as seminar rooms, particularly at the level of academic departments.   However, they are often more formal than Classroom Seminar rooms, and have the following characteristics:

- 8 to 25 seats
- One large conference table or several tables configured together into one large seating area
- Chairs on casters
- Instructor sits at table with students
- Normally need to account for the peripherals in the room: bookcases, displays, credenza tables for food when designing space.
- Space used as teaching and meeting space

4. **Classroom Collaborative**

Collaborative space designs are becoming more popular.   Collaborative learning spaces offer unique opportunities to experiment with seating and with new audio visual technologies. They are characterized by having:

- 8 to 25 seats
- Require more space per person
- Expanded instructor space to use interactive display
- Seating may be larger than standard specifications and should be easily reconfigured.
- Comfortable and movable chairs and tables. Unless determined otherwise, chairs and tables are to be furnished with casters.

5. **Classroom Fixed Seating:**

Fixed seating classrooms have a well-defined "front" or main lecture area in the front of the

room.   Students tend to be more distant from the instructor due to the increased room size. Rooms are usually tiered or sloped to insure proper sightlines for both students and instructors.

- 40 or more seats
- Normally a sloped or tiered space
- Fixed table and seats or fixed table and moveable chairs or fixed tablet chairs
- Distance from the front of the room to the first row of seats shall be determined by using the recommendations and formulas contained in Item 3, Section V (The shell).

6. **Auditorium:**
The Auditorium is a space for large classes, meetings, presentations, and performances. Auditorium facilities may include assembly halls, exhibit halls, auditoriums, and theaters. As such, they tend to have wide spans and are multiple-story high in order to accommodate seating, sightline, and acoustical requirements.   Raised stage floors and special lighting equipment are often required as well.   Design features and characteristics that differentiate Auditorium space types from other gathering spaces include:
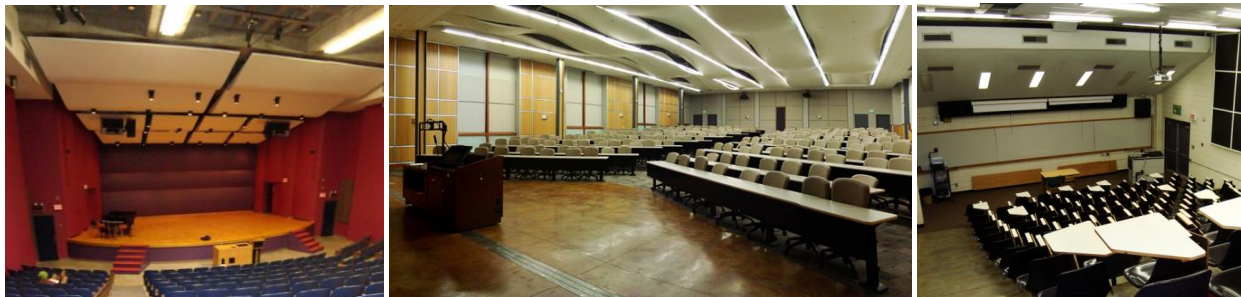
- 100 or more seats
- Sloped or tiered space
- Fixed seating usually with tablet arm or fixed seating with fixed tables (see VI, Seating, Furniture and Equipment)
- Increased distance between faculty and students Distance from the front of the room to the first row of seats shall be determined by using the recommendations and formulas contained in Item 3, Section V (The shell)
- Special acoustic design including wall treatments or coverings
- Because of large size -automated room controls include lighting, shades, drapes and AV equipment
- Sound reinforcement for instructors and speakers.

IV. Room Sizes by Type

All teaching spaces need to be large enough to comfortably accommodate the number of students planned, type of teaching, use of audiovisual equipment and anticipated furniture.   The following are standards which should be used in the Programming phase of a project.   The following space guidelines should be used to estimate the total usable floor space of classrooms.

Square Feet per Station*	Maximum Capacity	Room Type	Anticipated Furnishings
27 to 33	20	Classroom Seminar	Movable Tables and Chairs
28 to 30	12-18	Classroom Conference	One Large Table and Chairs
17 to 28	45	Classroom Loose Seating	Tablet Arm Chairs
22 to 25	45	Classroom Loose Seating	Movable Tables and Chairs
25 to 27	45	Classroom Fixed Seating	Fixed Table and Moveable Chairs
18 to 22	200	Auditorium	Fixed Seats with Tablet Arm
25 to 30	200	Auditorium	Fixed Table with Movable Chairs

*Instructor space is included in "Square Feet per Station"

- The shape of the room, size and types of furnishings proposed, and other special design features may increase or decrease the amount of space required per student.
- Room proportions have an impact on the seating capacity, sight lines and ability for student and instructor to interact with one another.
- Avoid spaces which are too wide.   They make it difficult for instructor to make eye contact.   Wide spaces also have poor sightlines --especially in front rows.   Wider spaces dedicate too much space to the instructor.
- Avoid spaces that are too deep.   Deep spaces make it challenging for students in the last rows to communicate, hear and see the front of the room.   Also, instructor space may be too narrow for screens and boards.
- Avoid creating seminar & conference rooms with long narrow tables that make it difficult for everyone to see each other.   Long rooms typically make it difficult to see the projection screen and writing on boards.   Rooms which are almost square or have a shape based on viewing angles are best.
- Non-traditional layouts and extra presentation screens will require more square footage per student.

V. The Shell

Classrooms should be developed from the "inside out". The conventional method of designing the room first, then filling it, usually leads to an inefficient layout, poor sightlines and reduced seating capacity. The following items should be considered when creating new and renovated classrooms:

- Determine the Classroom Type, seating capacity and confirm teaching style.
- Determine the technology requirements, number of projection screens and whiteboards required based on the seating capacity, type of room and teaching style. Always assume that technology will change, do not tie a classroom configuration to one technological standard.
- Determine the general location, size and orientation of projection screens, whiteboards, and seating space. Screen size should be determined using the formula in item 3 of this section.
- Determine the distance from the front of the room to the first row of chairs (see item 3 in this section).
- Ensure the instructor area meets the minimum dimensions required. Generally this requires space for a podium and/or instructor table/chair.
- Consider viewing angles from each screen and ensure that all student seating falls within the viewing area.
- Determine the width and depth based on the proposed seating space guidelines. In general, rectangular classrooms should have a width to length ratio somewhere in the range of 3:4, with the instructional end on the narrower dimension.
- Determine the location and size of aisles.
- All of these elements determine the ultimate room configuration.

1. Lighting/Electrical

Proper lighting is an important, albeit complicated, element of any teaching space. Lighting needs are dependent on factors such as room size and shape, whiteboard size, AV configuration, ceiling height, and windows.

Daylighting

Students perform best in classrooms that feature uniform, diffused daylight. Ideally, daylight levels should be ample enough to reduce the initial number of fixtures in classrooms and enable electric lights to be turned off during the day, even on overcast days. Determining those optimal levels of light requires a meticulous review of building orientation and appropriate window configuration, and a recognition that classrooms receive less light for evening use than in the daytime.
Classrooms having natural daylight are to have blinds or other daylight control as well, so that light levels can be adequately controlled for electronic media presentations.

The following are general guidelines for lighting specifications:

- Either hard switches or a lighting control panel should be located near each entrance to the

room, with another near the instructor's podium.   If the room is equipped with lighting scene controls a campus standard Extron control for lighting scenes should be incorporated into, or near, the podium.

- Where dimming and/or scene control switching is used, Lutron dimming and control systems are preferred due to ease of interface with Extron audio visual control systems.
- Per code, at least two lighting levels, or dimmable lighting, must be incorporated into the switching for room lighting.
- Hard switches for dimmable lights should have sliders to control dimming
- Dimmable lights should be equipped with a quiet 1% dimming ballast
- Classroom lighting is to have override control with combination motion/sound sensors. Sensors are to shut off all lights approximately 15 minutes after no room activity is sensed.   Sensors are to automatically and immediately turn on main room lights when activity or noise is sensed.   Sensors are to be remote units mounted high on walls or on ceilings, not as part of wall switches.
- In rooms with a significant daylighting component, daylight sensors should be used to provide override control of artificial light sources within the daylight zone of the room.
- At computer lab classrooms lighting is to be designed so as to minimize glare and reflection on computer screens.

Lighting levels:

- Uniform light level in student seating area, at desk height, is to be 40 fc, including maintenance factor. Required lighting levels are to coincide with any LEED requirements for a project.
- Lighting level in new classrooms is to be measured prior to Substantial Completion at a minimum of 6 locations in the room (12 locations in classrooms with 50 or more seats), uniformly spaced, and if the above standard is not achieved at all locations then additional lighting will be installed at no additional cost to MSU.
- Switching is to be provided to reduce light level in the area of projection screens.   Light level at projection screen is to be 10 fc.

Additional general electrical guidelines:

- All controls for moveable screens and whiteboards, tech controls, and telephones are to be located at or near the instructor's podium.
- In general classrooms, provide minimum 3 convenience outlets on front (instructor) wall. If there is no built-in podium then provide two data outlets at instructor's podium location. Provide convenience outlets at minimum 12 feet on center on side walls, and a minimum of 2 outlets on sidewalls. Provide minimum 3 convenience outlets on rear wall.
- Provide power and data outlets at ceiling-mounted projector location, whether a projector is specified to be installed or not.
- At tiered classrooms with fixed desks provide power to each tier whether desks are to be wired or not.
- At computer lab classrooms MSU ITC department is to approve all power and data provisions and layouts.
- At alcoves and study areas, including those at classroom corridors, provide convenience

outlets at no more than 12 feet on center.

- Special electrical/data/communication installations such as those for interactive video conferencing must be identified early in a project and coordinated with all parties.
- If an audio amplification system is installed, either in the room enclosure or at the instructor's podium, then a campus standard assistive listening system is to be installed.
- In large classrooms and auditoriums an equipment rack is to be installed.   The equipment rack is to be installed in a closet easily accessible from the podium location or in a wall recess near the podium location.   Closely coordinate rack requirements with MSU ITC department.   Conduit runs between the rack and podium must be coordinated and approved by ITC.

Lighting zones

As a rule, all classroom spaces will have lighting organized into a number of zones.   These zones can be combined and switched to create a number of different lighting scenarios.

In spaces where cost concerns prohibit dimming, light fixtures should be wired for inboard/outboard switching.   Where rectangular fluorescent or LED fixtures are used they should be oriented parallel to the teaching wall where the instructor typically stands.

There are four possible lighting zones in most classrooms:

Zone 1 – Main classroom lighting (student seating area)   **Zone 2** – White board   **Zone 3** – Projection area   **Zone 4** – Instructor Workstation

- **Zone 1** – Main Classroom Area: This zone services students and allows them to read and take notes in class.
- **Zone 2** – White Board: The first row of lights over the main white board area of the room should be switched separately from the rest of the room.   These lights should be far enough away from the surface to avoid having the light trapped above the board (this sometimes occurs in the case of sliding boards).   It should be close enough to allow for proper illumination of the board.   Proper illumination is defined as an average of 40 lumens across the surface of the board with no area ~~dipping~~ below 20 lumens.
- **Zone 3** – Projection area: It is important that light not shine directly on a screen during projection.   Because of this, we recommend that lights which shine directly on the screen be switched separately.
- **Zone 4** – Instructor Workstation: Light directly above the instructor workstation should be switched separately whenever possible to allow the instructor to see his/her materials while conducting a class with the rest of the lights off for projection.

Emergency Lights

Due to fire and safety codes, many classrooms must have an emergency light that stays on at all times, even when the lights are shut off.   Because this can cause interference with the clarity of the projected image on screen, every effort must be made to isolate light radiation to the back of the room away from the projection screen. Lighting for steps is to be considered in instructional space with tiered seating.

Motion/Audio Sensors

Motion/Audio sensors shut off the lights in a space after a specified period of inactivity.

This helps assure that the lights are off when the space is not in use.   When installing sensors in classrooms, care must be exercised to avoid accidental light shutdown during relatively low-motion activities such as testing.
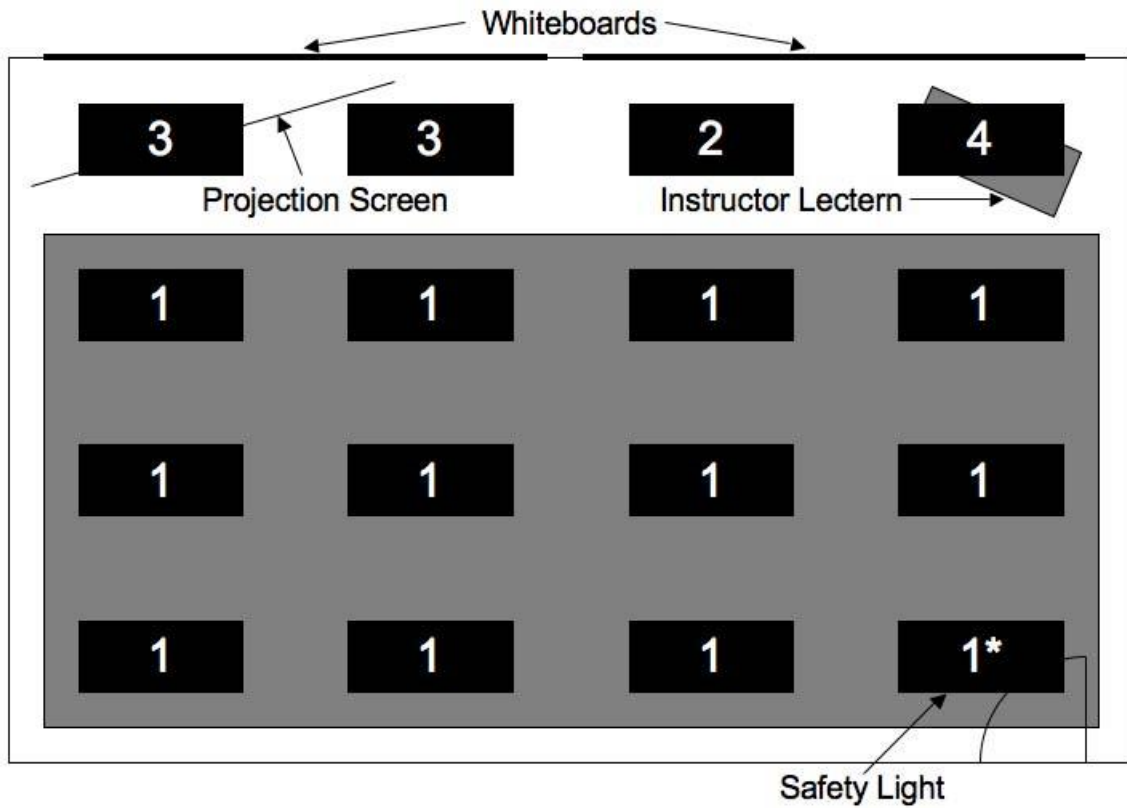
Sample 40 seat Classroom lighting diagrams

Projection Screen

Safety Light

Instructor Lectern

White Board
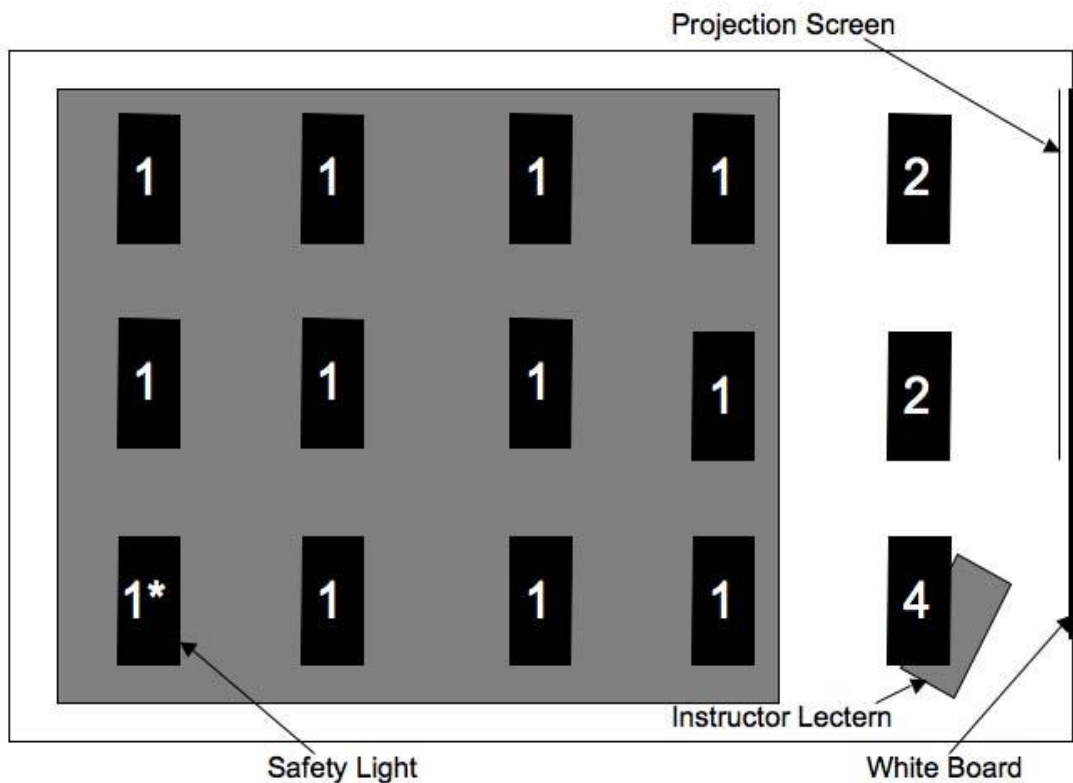
2. HVAC

Indoor air conditions:

The HVAC system shall be designed to maintain a temperature range of 68 to 78 degrees Fahrenheit year-round for buildings that include air conditioning. For all new and remodeled spaces the consultant shall discuss desired/achievable temperature ranges with ~~Owner~~ MSU's Project Manager and the University Engineer during preliminary design phase.

Typically humidity is not actively controlled for MSU's classrooms. The indoor humidity fluctuates with the outdoor humidity. MSU does not employ humidifiers or control logic to actively control humidity. The consultant should consult with the Building Committee to determine if there are specific project requirements that would require more control over the relative humidity range.

Outdoor air conditions:

The summer outdoor air conditions used to determine the cooling load should be 87 degrees F dry bulb/ 60 degrees F wet bulb (or as currently specified by ASHRAE). The winter outdoor air conditions used to determine the heating load shall be -20 degrees F dry bulb (or as currently specified by ASHRAE).

Balancing dampers:

Provide balancing dampers in the supply ductwork to serve all diffusers. The dampers shall be located a minimum of 2.5 diameters upstream of the diffuser, or as required to provide desired NC ratings (see below).

Diffuser location:

Pay specific attention to the location of the diffusers in the classroom layout. Do not locate diffusers near projection screen or whiteboard; this is to avoid conflicts with the mounting of the audio/visual equipment in the ceiling. Care should be taken to avoid creating drafts on projection screens which can cause the screen to flutter.

Location of above-ceiling mechanical equipment:

Locate above-ceiling mechanical equipment needing routine service in a location outside the classroom to allow service without disrupting the class. However conditions may dictate that the equipment be located in the classroom because no other space is available. When equipment must be installed in the classroom it should be located where it can be accessed with ladders, preferably in aisles or other areas without seating. It is very important that the above-ceiling equipment have adequate access available to service the unit. Therefore do not sacrifice access space just to get the equipment out of the classroom.

Noise:

Disruptive noise is the single most prevalent complaint made about classrooms. Careful attention must be paid to acoustics in the design of the classroom. Noise is transmitted to the classroom in many ways, including:

- Noise can be transmitted from areas adjacent to the classroom. This noise can travel though doors, lighting fixtures, return air paths, plenum spaces and return ductwork.
- Noise can be transmitted from the classroom diffusers. This noise can be air noise and radiated noise from the HVAC equipment.
- Noise can be transmitted from adjacent HVAC equipment. This is frequently caused by the location of mechanical rooms, location of fan-powered terminal units and location of ductwork mains.

The NC (Noise Criterion) ratings for general classrooms should be NC 35 or less, or approximately 35 db in normal speech frequencies. Large lecture halls shall have a rating of NC 25 or less. Individual equipment such as fans, ductwork and diffusers shall have ratings not exceeding NC 25 throughout the load range. For rooms where video conferencing systems are installed or likely to be added in the future, background noise level should ideally be NC 25 or less. This includes both noise from technical installations (air conditioning, in particular) and outdoor traffic noise etc.

Noise from adjacent areas can be mitigated in many ways, including: doorways can have sealing hardware if appropriate to achieve noise levels, lighting openings shall take into account noise transmission, return air paths shall incorporate noise traps, walls shall be constructed of sound deadening materials or insulated with sound insulation, top and bottom wall plates shall be set in sealant, walls shall extend to the structure and openings including piping, ductwork and electrical penetrations shall be sealed.

Noise from diffusers and ductwork should be mitigated by careful selection of diffusers to limit noise ratings. Ductwork should be designed to limit noise ratings. Ductwork geometry should be designed to limit noise from connected equipment.

Noise from HVAC equipment should be mitigated by layout design and by attention to construction details. Mechanical rooms should not be located so as to share a wall or floor structure with a classroom. Main ductwork runs should be located so that duct chases are

not located near a classroom and ductwork mains avoid classrooms as much as possible. This should be coordinated between Mechanical Engineer and Architect during the initial floor plan layout. If HVAC equipment and ductwork unavoidably has to be located near classroom, the consultant shall provide specific construction details to limit noise transmission. These should include ductwork stiffening, special duct hangers, separation of wall structures from support materials, design of wall for acoustic isolation, etc.

Ventilation:

Adequate outside ventilation air should be provided in accordance with current codes and ASHRAE recommendations. Large, high occupancy, rooms should have CO_2 or other demand-controlled ventilation systems.

Zoning:

When designing buildings, classrooms should be placed on air handlers that are separate from air handlers that serve laboratory and other specialized HVAC systems. Large auditoriums should have their own air handlers, which will allow these areas to be controlled to save energy.

3. **Screen sizing and distance to first row of seats recommendations:**

The minimum physical screen size will be determined by the distance from the screen to the last row of seats. The physical height dimension of the screen should be approximately equal to 1/6 the distance from the screen to the last row of seats, allowing text to be read and detail to be seen in the projected image.

Ideally, the first row of seats should be approximately two screen heights away (as determined above). The bottom of the screen should be a minimum of 4 feet above the audience floor, allowing those seated toward the rear of the audience to see the screen.

4. **Networking/ITC requirements**

AV Lectern Active Data

Each room will be equipped with at least four active network drops, grouped together at the instructor AV lectern location. More network drops may be needed for large lecture halls. The active drops should be grouped together near the instructor lectern in a location easily reached by the podium whip, preferably in the same 2-gang box. The wall box should be located so that data cables run from the wall to the lectern do not create a tripping hazard for the instructor. For a typical room, network drops are needed for the on-board computer, laptop connection, control panel and the control processor.

ITC Building Standards

MSU ITC has a Building Standards document available to anyone via their website
http://www.montana.edu/itcenter/guidelines/telecomm/#3

This document has in detail the required specifications for cable and fiber infrastructure to and within MSU buildings.   All infrastructure specifications for buildings and building distribution should be obtained from the MSU ITC Building Standards document.

5. **Doors/Room Security**

Standard Door Hardware

All doors are to include door hardware that is required by the latest revision of the International Building Code (IBC) and MSU's Design and Construction Guidelines. Classroom doors should include the following:
- Classroom function lockset
- No closers, unless required by the IBC. This will allow the door to remain open on its own for easy access into and out of classroom
- Concave wall bumpers at lever height for wall protection
- Door silencers to muffle the noise of the door closing
- Panic hardware on exit doors for classrooms of greater than 100 seats.

Card Access Door Hardware

Card access control systems may be installed on a case-by-case basis.   These doors will need the following:
- Storeroom function lockset
- Door closer
- Electric strike (to allow key over ride when needed)
- Door contacts
- Card access system
- If an ADA electrically actuated door is required, install the following:
    Electric system
    Door closer
    Push buttons on inside and outside of classroom

Doors

Doors should be located at the back of the classroom so that students entering and exiting the space will not disrupt instruction.   Exceptions to this rule would be large tiered classrooms and auditoriums that require multiple doors located at the front and rear of the space, or if two doors are required to exit the room.   Doors should adhere to the following parameters:
- Minimum of three feet wide
- Door opening force, hardware, width, thresholds and maneuvering clearance must conform to ADA standards.

- Should have a small glass window panel or glass sidelights to allow viewing into and out of the room if permitted by the IBC.
- Sidelights that are full height or begin about three feet above floor level are preferred because they function as well for wheelchair users as for people who are standing.   When sidelights are installed, blinds should be installed since there are occasions where hallway lighting can bleed into the classroom, interfering with audio/visual presentation.
- Existing classrooms with only one door near the front of the room shall be modified, if feasible, during renovation to move the door, move the instruction area or add a second door.
- When possible, doors should be recessed into the room so that the door does not swing into the hallway.   If it is necessary for the door to open into the hallway, some kind of visual identification (such as the tile pattern in floor) can be used to indicate the amount of space the door will occupy when it swings open.

6. **Windows**

Windows should be installed in every classroom where possible.   The windows should not exceed 30-40% of the exterior wall in each room and should be on the side or rear wall.   In larger rooms as well as sloped or tiered rooms, it is often desirable to install motorized shades and blinds.   Be certain to design in sufficient depth the window and wall to allow for motorized installations.

- Tinted, "Low-E" rated glass is preferred for all windows.
- Window treatment can be manual if they are easily accessible.   If windows are too high to reach and/or are too numerous, the window treatments should be motorized and capable of being controlled by the AV control system.   This will allow ease of use for instructors to control the lighting from the windows. Use of light diffusing shades on a roller is recommended, however a combination of horizontal blinds and shades can be used.   All window treatments should have a non-reflective matte finish.

7. **Flooring**

In classrooms a multi-colored or patterned carpet should be used - no solid color should be installed.   Carpet tiles are preferred for most applications. Four to six inch cove base should also be installed.   If carpet cannot be installed under seats in fixed classrooms due to maintenance, then the concrete floors should be free of cracks and defects and should be sealed. In laboratories floors are to be sealed concrete, free from cracks and defects, or a continuous resinous flooring appropriate to the use of the space..In hallways that lead to large classrooms directly from the exterior of the building, hard surface floors should be installed.

8. **Walls, Ceilings and Chair Rails**

Walls

- Walls, with batt insulation, must extend to structure above ceiling to provide sound isolation from adjacent spaces.
- Folding or moveable walls should be avoided
- Walls in Auditoriums should be designed to have a finish and/or configuration to disperse sound.
- The rear wall should have an acoustically absorbent finish, if determined that sound absorption is needed.

Ceilings

- Ceilings in classrooms, with less than 50 students, may be entirely acoustical ceiling.
- Minimum ceiling height for classrooms is 9 feet, 10 feet for classrooms of 50 or more seats and will depend on the size of screen required.   In large, sloped or tiered classrooms, the ceiling height is directly related to the distance to the last row of seats.
- The surface of the ceiling must be designed to accommodate the required acoustical properties of the room.   The ceiling may include hard surface material coupled with acoustical tile, if determined that sound reflection is required.
- Ceilings in small tiered classrooms should be at least 15 feet high at the front of the room and 9 feet high at the rear.   Larger tiered classrooms should be at least 20 feet in front and 10 feet at the rear.   An angled ceiling at the front can deliver better sound to the rear.

Chair Rails

- All classrooms with movable furniture must include chair rails on all walls to protect walls and are to match the architectural design of the room. Solid surface products are preferable for chair rails.
- Chair rails are to be wide enough to work with movable furniture of varying design and mounted at a height that will prevent damage to wall surfaces.

9. **Colors/ Finishes**

- Walls should be painted in a light color in an eggshell finish.   A darker contrasting shade of color is acceptable on the front teaching wall.   Focus walls in spaces where distance learning takes place should be light blue or grey in color.   No vinyl wall covering should be used.   Paint colors should match existing colors in adjacent rooms or should be chosen from MSU standard color palettes within the Design and Construction Guidelines
- No-VOC paints should always be used.
- Colors for furnishings and audio-visual components shall be coordinated with finish colors used in the room and in the same building.

10. **Reflectance Values**

The Illuminating Engineering Society of North America (IES) recommends the following

reflectance values for finish materials in classrooms. Coordinate floor and paint finishes to achieve reflectance values without increasing lighting.

- Ceilings: 80% or higher
- Walls: between 50% and 70%
- Floors: between 20% and 40%
- Desktops: between 24% and 45%

11. Acoustics

- Walls in the classroom should have a minimum sound transmission class (STC) of 50.
- The rear wall of any large classroom (over 75) should have an acoustically absorbent finish.
- Side walls in large lecture halls should not be parallel. Walls should be designed to disperse sound, should be a mix of reflecting and absorbing materials, and they should have a rough or textured surface. Noise levels should not exceed NC 25-30.

12. Closets

There is often a need in large classrooms for a small storage room for classroom supplies separate from audiovisual space. Room should be up to 40 square feet to store board supplies, movable lecterns and additional chairs. This space requires lighting, a lockable door, conditioned air, power and a few shelving units for small supplies and no window. It should be equipped with a storeroom function lock.

VI. Seating, Furniture and Equipment

1. General
To the greatest extent possible, furniture for instructional spaces is to be purchased from the WSCA Office Furniture term contract as established by the State Procurement Bureau (http://gsd.mt.gov/procurementservices/termcontracts/wsca_office_furniture.mcpx)

2. Student Chairs
Student seats should comfortably accommodate the tallest and smallest persons. They should provide good ergonomics and have backs that allow for articulating movement.

Recommended Seat Spacing

Moveable tables and chairs

- Moveable seats placed a minimum of 28" on center
- Tables should be 36 inches apart to allow access between rows

Continuous work surfaces with moveable chairs

- 36" apart for rows with up to 20 seats
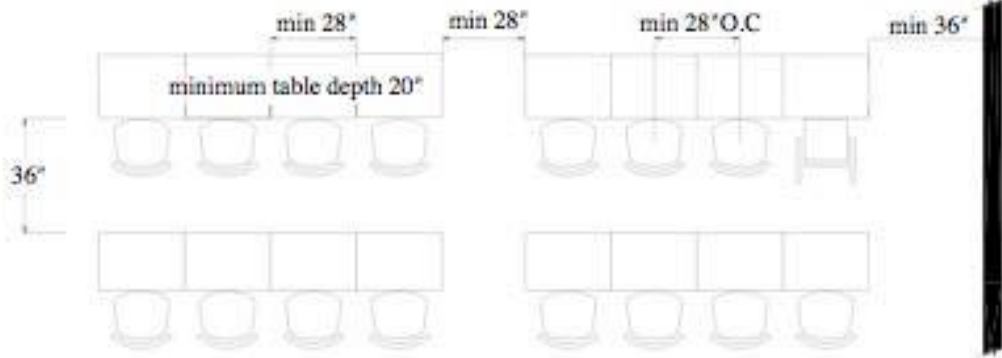
- 38" apart for rows with 21-24 seats

Large auditoriums with tablet arm seats

- Seats spaced a minimum of 24" on center
- Minimum 21" clearance between tablet arm supports
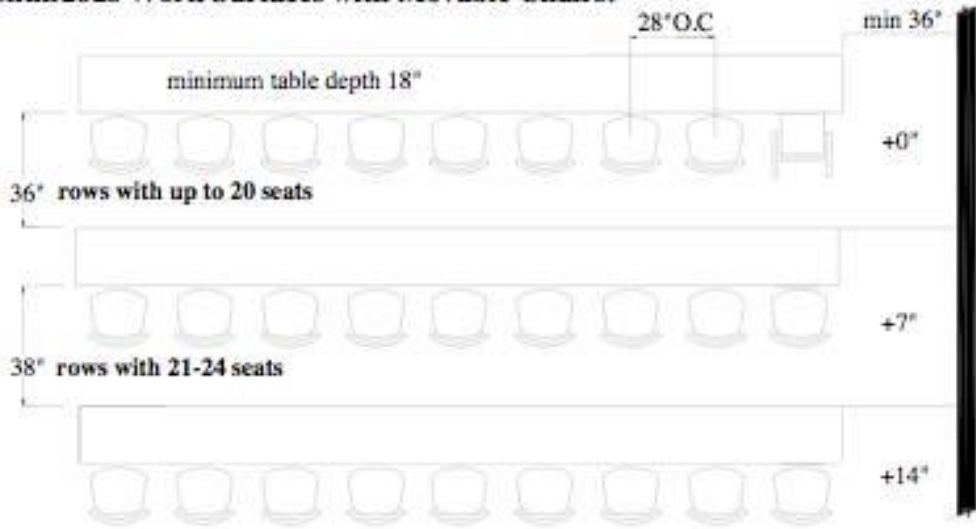- Minimum 12" clearance between tablet arms in-use and seat backs (with seats fully reclined)

Access Aisles

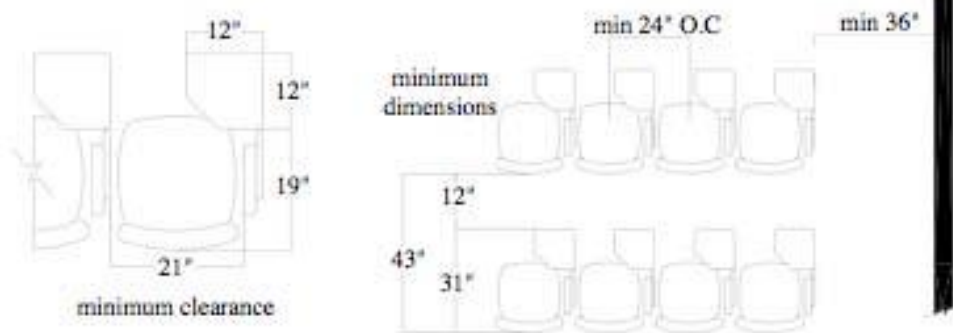Provide a minimum 36" wide aisle leading to front of room.

Movable Tables and Chairs:

Continuous Work Surfaces with Movable Chairs:

Large Auditoriums with Tablet-Arm Seats:

-from University of Cincinnati's "Design Guidance: Learning Environments", p. 27

Moveable Chairs

- Seat cushion should be a minimum of 17" wide and 18 ½" deep.
- Unless determined otherwise, chairs are to have casters.
- Depending on the application, they can either have arms or be armless
- They should be stackable to at least 5 high

Movable Tablet Arm Chairs

- Seat should be 22" wide (minimum).
- Tablet arm tablets should be at least 130 square inches.
- 20% of the seats should be left-handed.
- The back of the chair should have some flex
- Unless determined otherwise, chairs are to have casters.
- A tablet that can fold off to the side is desirable. If a tablet does not fold off to the side, it must be sturdy and durable.   Take care in selecting a product if this feature is desired.

Auditorium seating

- Seats should spaced a minimum of 24" on center
- Stagger seats to allow clear viewing
- Fixed seating should allow for comfortable seating for the person in the seat as well as the person behind the seat.   Avoid rear panels and chair heights that don't allow for proper legroom and foot space.
- Flip-up seats allow for easier passage within a row.   Self lifting upholstered seats are

preferred. Consider the spacing between rows to allow students to exit a row of seats without disrupting students in other seats. Provide oversize, flip-down tablet arms on each seat with plastic laminate or poly surface material. 20% of tablet arms should be left-handed.

- As an option to flip-up seats, single or dual swing-away seats with fixed tables may be used
- Power and data to student seats or tables are not required unless required by the project.
- Aisle end panels and modesty panels are considered optional and to be determined by project needs.
- Provide the correct size and number of accessible wheelchair spaces and dispersion of wheelchair spaces according to the latest revision of the IBC.
- For each accessible wheelchair space, provide the corresponding number of companion seats as required by the IBC.
- Provide assistive listening systems if required by the IBC.

3. **Student Tables**

Movable tables allow the class to rearrange seating into smaller groups if needed and should:
- Unless determined otherwise, tables should have casters with a locking mechanism.
- Tables are to be 18 - 20 inches deep and 28 - 30 inches wide per person and are best to seat more than one student (seating for two works well).
- Provide unobstructed knee clearance under the table that is at least 22 inches wide and at least 27 inches high. Provide a modesty panel for each table where appropriate.

4. **Conference Tables**
   Conference tables should allow eye contact between the students on both sides of the table. There should be an unobstructed view of the instructor, projection screen, and white board. Use of a boat shaped table or movable tables is desired.   Special care is required to ensure proper legroom around and near table legs.   Design seating space with adequate room for each student.

5. **Instructor Furniture**

- Typical instructor station requires minimum 10 square feet.
- If an AV lectern is installed the instructor can use that for their teaching space.   The lectern must be at least 48 inches from the front wall and 48 inches from the side wall for ADA accessibility.

- If no AV lectern is installed, provide a small sturdy table with modesty panel and a tabletop podium.
- Space should be provided if an instructor requires a table in addition to the AV lectern.

6. Special Rooms

In classrooms or labs where chemicals or art supplies are used, provide moveable chairs or stools that do not need foam pads and upholstery to provide comfort.   Use chairs with adjustable height seats and backs and back tension that adjust automatically to weight.

7. Accessible Tables

Each classroom, whether it has tablet arm chairs or moveable tables, is to be equipped with a table to allow for wheelchair access.   In areas where there are a large number of classrooms, heavier tables are desirable to discourage people from removing them from the rooms. Lightweight tables are easier to maneuver in the classroom, but are prone to being removed without permission for reasons other than an accommodation.

8. Types of Furniture to Avoid

- Pedestal seats bolted to the floor.
- Moveable student desks with seats attached.
- Pivot arm seats that do not comfortably accommodate large or small students.
- Movable tablet arm chairs with tablets that are not durable.

9. Whiteboards & Tack boards

Provide whiteboards in classrooms as follows:

- Fixed-height white boards should be mounted with the top of the chalk tray 36-inches above the floor
- Whiteboards are to have a low-gloss white porcelain enamel steel surface that is easy to clean.
- Whiteboards are to be illuminated by lights on a separate switch that do not spill over onto screens, other white boards, or the wall behind them (refer to "Lighting Zones on page 12)
- Each shall have a continuous marker tray below the marker board surface and a wall-mounted holder nearby that is large enough for six markers and an eraser.
- Provide tack board strips and clips along the top of the boards so that display materials can be hung without being damaged.
- Coordinate the location of the whiteboard with the audio-visual equipment. Allow for simultaneous use of projection screen and whiteboards (See VII. Audio-Visual Technologies, page 26)

Provide tack boards as follows:

- Outside classrooms, provide a tack board display in a central hallway or gathering area. It is desirable to position these near computer email/kiosk stations.
- Large display boards are not desired in other areas because they attract notices of events and advertisements that detract from room and building appearance.   The exception to this is in the area of departmental offices where departmental notices are frequently appropriate.

10. Clocks

Clocks should be provided in each classroom, should be large and easy to read.   The clock should be seen easily by the instructor and students and placed on either a side wall or the back wall if necessary.   Never locate the clock at the front of the classroom.   If a battery clock is selected it must be "noise free".   Clocks should be decorative in nature and appropriate for each space.

11. Trash and Recycling

All classrooms must be equipped with proper *trash/recycling* containers that are complimentary to the design of the space. Trash and paper recycling should be located near the exit door of each classroom.   Additional trash, paper recycling and plastic/aluminum recycling should be provided in lobby, vending and student common areas.   Special design consideration should be considered for location, design and use for each building.   Off-the shelf style containers may not always be appropriate.

12. Artwork

Artwork or graphics may be considered– for its aesthetic added value to the space. Inexpensive choices are best, to reduce the liability of theft.   Artwork or graphics is most appropriate if themed for specific departmental or building areas of concentration.

VII. Audio-Visual Technologies

1. General Conditions

Audio-visual systems in classrooms should be designed for the most commonly used

conventional and electronic media --whiteboards, projection screens, VHS tapes, DVDs, compact disks, document cameras, computer-generated media, audio inputs.   The following sections provide applicable guidance for each of these media.

2. **Classroom AV Tiers**
    MSU ITC has developed a system for room design and scheduling which designates a classroom in terms of room AV Tiers.   This classification (Tier 1 through Tier 3) defines the type and kind of dedicated AV equipment that exists in a classroom.   NOTE: Due to quickly changing technology and equipment, check with MSU ITC for current AV equipment and control specifications.

    <u>**Tier 1 – Basic Technology Classroom:**</u>

    - Ceiling mounted projector – WXGA resolution, 4000 lumen minimum
    - Single manual screen with controlled screen release sized to room, 16:10 format; (motorized screen optional with low voltage controller)
    - Network jack for laptop use
    - Laptop connection
        o Config 1: Wall shelf with Extron Polevault system, wall jack; Extron MLC 104 controller – network control; VCR/DVD player; audio w/ceiling speakers
        o Config 2: 30" podium furniture with above equipment plus an Extron Cable Cubby

    <u>**Tier 2 – Enhanced Basic Technology Classroom:**</u>

    - Ceiling mounted projector – WXGA resolution, 4000 lumen minimum
    - Single manual screen with controlled screen release sized to room, 16:10 format; (motorized screen optional with low voltage controller)
    - Podium furniture w/accessible rack space & no user access to cable connections
    - Dedicated networked computer
    - VCR/DVD player
    - Wireless mouse
    - Extron control system for audio visual equipment
    - Laptop connection box (Extron Cable Cubby 600)
        o VGA cable
        o Two power plug ins
        o Two USB connections
        o 3.5mm mini audio connection
        o Network connection (DHCP off second NIC in dedicated computer or wireless if available)
    - Sound w/installed speakers
    - Document camera (Wolfvision)
    - Assistive listening systems installed in classrooms with audio amplication systems
    - Wireless microphone (Revolabs w/base station charging unit)

Optional equipment:

- 17" or larger LCD annotation panel & display (Smart Technologies)

Tier 3 – Enhanced Smart Classroom:

- Dual ceiling mounted projectors, 16:10 format, brightness depends on room
- Dual electric screens or fixed screens depending on room design
  - Automated screen control if electric screens
- Podium furniture w/accessible rack space & no user access to cable connections
- Dedicated networked computer
- VCR/DVD player
- Wireless mouse
- Extron touch panel controller
- 17" or larger LCD annotation panel & display (Smart Technologies)
- Laptop connection box (Extron Cable Cubby 600)
  - VGA cable
  - Two power plug ins
  - Two USB connection for thumb drive use
  - 3.5mm mini audio connection
  - Network connection (DHCP off second NIC in dedicated computer or wireless if available)
- Sound w/installed speakers
- Lighting controls
- Wireless microphone (Revolabs w/base station charging unit)
- Document camera (Wolfvision)

Video Conferencing Option:

- This could be a Tier 2 or Tier 3 classroom that has the necessary equipment added in the room to do audio & video conferencing.

3. **Instructor Lectern**

Technology-rich classrooms should include an instructor AV Lectern designed to accommodate audio-visual systems, presentation computer and other commonly used audio-visual components and control devices.

Most "off-the-shelf" lectern furniture does not meet MSU requirements ~~our needs~~. MSU ITC has worked closely with a State millwork vendor to develop custom designs that meet our goals and standardize workstation and user interface design for each classroom. This standardization simplifies ease of use and minimizes instructor training. Refinements to custom-designed instructor workstations are made periodically. Consultants must obtain electronic copies of drawings for the appropriate current design(s) from MSU ITC.

Floor plans and cross sections that show the lectern must be included in design phase submissions.   Floor plans and sections must show the location of the following:

- Instructor AV Lectern drawn to scale
- Other portable media projectors and carts (if proposed)
- Locations of wall or floor junction boxes for power/data/audiovisual system wiring to serve the lectern

A typical instructor AV lectern is illustrated below in two styles.

Computer and Laptop Combination AV Lecterns:

Laptop Connection AV Wall Shelf or AV Podium:

A. Instructor Lectern: Key Design Features and Considerations

- Lecterns shall be oriented to allow instructors to maintain eye contact with students while using keyboards and allow students to see projected media.
- In rooms with one screen, an instructor podium located on the side opposite the doorways, marker boards across the front of the classroom, and a screen in the side opposite the podium.   The need exists to maximize available white board space when the projection screen is in use and still maintain adequate viewing angles for students.
- In large rooms with multiple screens, a lectern located opposite the doorways, near the marker board usually works well, but a more central location may be preferable in some rooms.   Tables used for instructor notes or references may also be needed.
- Lectern audio-visual components shall not block views of screens and marker boards:
  - o 42 inches above floor–maximum height of work surfaces
  - o 48 inches above floor–maximum height of monitors/task lights/other components (currently difficult to do unless we use a monitor or Sympodium recessed or mounted under the work surface).
- Lectern accessibility
  - o Provide accessible route to workstations
  - o PC keyboard/mouse/controls within easy reach of instructors
  - o Control panel for A/V system in easy reach of instructors
  - o Height of instructor's seat easily adjusted -19 to 27 inches above floor
- Lectern Security
  - o Security of lectern components will be enhanced by using exterior room door locks – either electronic or keyed.   Facilities Services will designate a lock style in order to standardize for locking/unlocking.
  - o User access to the inside of the podium will be restricted by a secure rack such that the user can't access or modify cables and equipment.   Rack to be specified by ITC.
  - o Door access shall be provided in lectern back for technician access to computer and audiovisual components for maintenance – lectern key lock (or electronic locking code) to be determined by ITC.
  - o Security cables to tether computer, computer monitor, and document camera equipment to a solid support structure within the lectern.
  - o Instructor AV lectern shall provide space for the following:
   - ▪ Instructor's references and handouts

- AV controls
- Computer monitor
- Document camera
- Cable cubby (see specification for cable cubby components)
- Laptop placement on podium surface
- Space for iClicker student response base station, wireless mouse, wireless microphone base charging station
- Small task light with shade, focused on usable lectern work surface, is an optional addition that may be considered
- Audio-visual components installed in standard racks

B. Interface (Extron)

Control systems for electronic components will have the capability of controlling all of the components identified above as well as projection screens, room lights, and shades operated by electric motors.   Contact ITC for detailed specifications.

Currently all control systems must:

- Be Extron manufactured controls
- Be programmable and capable of being re-programmed
- Interface properly with controls for AV equipment, screens, lights, and shades and other selected programmable devices
- Have a touch panel or push button controller on the instructor workstation with easy-to-read, simple menu choices or button configurations which mirror the MSU chosen standard design.   Design samples will be supplied by MSU ITC.
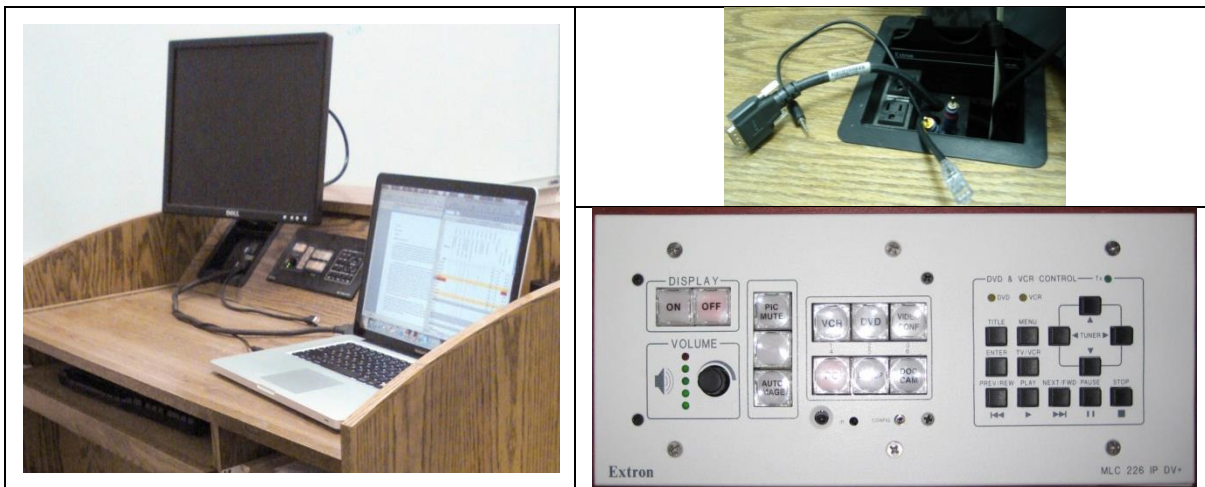
- All source codes, compiled codes, and access passwords shall be provided to the University at acceptance and become University property.
- If an AV integrator is used, integrator will provide updates to existing code and firmware during the life of the AV vendor equipment service warranty

7" Touch Panel Interface

For the components that are to be integrated into the podium, check with MSU ITC for current specifications.
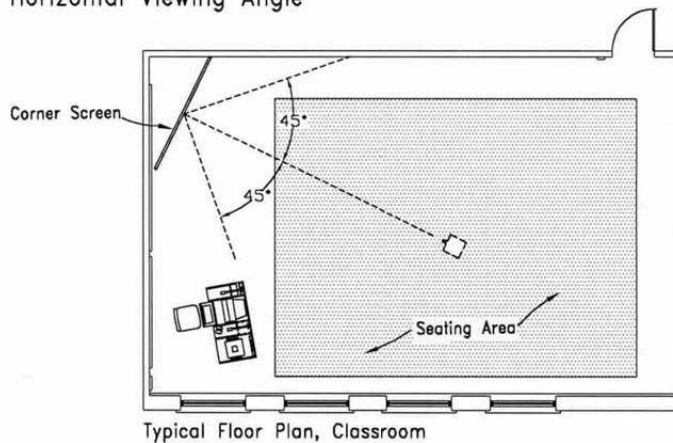
C. Viewing Angles

Provide an unobstructed view of the entire image on all screens from all seats within the viewing angles (cones of vision) described below:
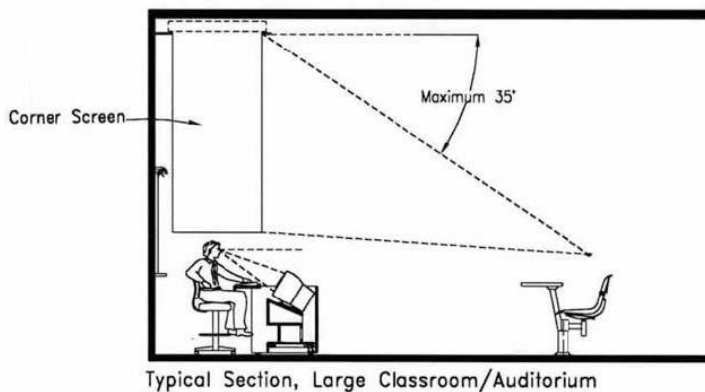
Maximum 45-degree horizontal angle from the perpendicular to the center of screens

Maximum 35-degree vertical angle from the perpendicular to the top of each screen

Horizontal Viewing Angle

Corner Screen

45°

45°

Seating Area

Typical Floor Plan, Classroom

Vertical Viewing Angle

Corner Screen

Maximum 35°

Typical Section, Large Classroom/Auditorium

D. Screen Type

• Matte white with gain of about 1.0 (30 Lamberts per square foot of screen area)
• Black border
• Electrically operated whenever possible
• Tab tensioned screens are preferred for electric screen installations
• Mounted above the suspended ceiling with opening in ceiling
• Stop point at least four feet above the floor

- Manual screens will be considered only in rooms designed primarily for interactive discussion and the project budget precludes the use of ceiling-mounted data projectors and other audiovisual components that are installed permanently.
- Manual screens should be wall-mounted above the suspended ceiling whenever possible and shall have a controlled screen release function.
- Screens mounted below the ceiling with exposed brackets are not desirable.

E. Rationale for Using Electric Screens

Screens operated by electric motors represent less than 10% of the cost of an electronic audio-visual system.   Installing them after rooms are built can be very costly if ductwork or lights must be moved and new wiring circuits added.   Most manual screens are not very flat, distort projected images, are hard to raise and lower, and can be easily damaged.   Students in rear rows cannot see the bottom half of projected images if manual screens are mounted just above the whiteboard.
Manual screens should therefore be considered only as a last resort in rooms where projected images are only needed infrequently.

F. Dual Screens

Certain teaching styles lend themselves to the use of two projected images at once.   For example, an instructor may wish to show PowerPoint presentation on one screen and create a video on another screen.   At this time, MSU has only a few examples on campus, but the technology is becoming more in demand.   This best allows for single-projection instruction while providing the option of going to dual screen.   The size of room and teaching methods for the space will determine the need for this requirement.

G. Audio Systems

Accurate sound reproduction for sound and moving image playback is important for the teaching spaces where playback is routinely done.   For spaces without permanent installations a portable sound system may suffice.
While some data/video projectors have built-in speakers the sound reproduction has proven inadequate in permanent installs.   Besides general classrooms consideration should be given to the specific amplification needs for the teaching of film studies and music with input from the respective faculties.   In larger classrooms there may be a need for voice amplification using a fixed lectern microphone and/or a wireless Revolabs microphone.   Revolabs wireless microphones are also being installed in smaller rooms to facilitate classroom lecture capture.

Standards:
- Playback sound amplification should be present when a data/video projector is designed into the room.

- Specific speaker types and locations will be determined by ceiling configuration.
- Wall mounted speakers should be mounted in front of the room where instruction usually takes place.
- Ceiling mounted speakers should be located to equally distribute the sound to within the space.
- Department faculty should be consulted about their specific needs for playback sound amplification.

VIII. Other Items
A. Emerging Technologies

In 2013, Renne Library opened the Innovative Learning Studio (ILS) as a collaborative and flexible space that can be used for a variety of group activities such as presentations, classes, group study, workshops, and training sessions. Activities that are part of course instruction have priority for the space but is open to any MSU-affiliated group on campus.

The ILS is available provided one of the following criteria is met:
- Enhancement of a teaching practice
- As part of a Center for Faculty Excellence to improve pedagogy
- Need for equipment/technology applications not available elsewhere on campus
- Need to use the room in advance of an instructional session to practice with state of the art technologies.
- The Library staff provides technical support to help integrate innovative technologies and applications into instruction methods. Faculty are encouraged to use this innovative space to integrate apps and authoring tools into their courses. Refer to MSU Library website for further information about the ILS.

B. Technology Enabled Active Learning (TEAL) Classrooms

Technology-enabled active learning is a teaching format that merges lectures, problems and problem-solving, and hands-on desktop experiments to create a rich collaborative, team-based learning experience in a specially designed instructional space. MSU has 3 TEAL classrooms and are located in Gaines Hall, Wilson Hall and the EPS Building. Mini-lectures are interspersed with desktop lessons to stimulate and encourage group problem solving and discussions.

TEAL classes feature:
- An instructional space that supports collaborative learning-students working during class in small groups with shared workstations or laptop computers
- Media-rich visualizations and simulations delivered via workstations or laptops and the internet
- Usually round tables, fixed or movable, for up to 9 students with chairs on casters
- A room that has neither front nor back, but rather a central-focused instruction position within the space

- Based on initial assessment of student success in the TEAL Classrooms, it is likely that future upgrades and renovation of instructional space on campus will incorporate concepts of active learning, in part or in whole, to engage students more deeply into their course material.

VIII. Future Additions to the Guidelines

- Emerging Technologies -Special AV Designs
- Special Needs Accommodations (Hearing impaired, sight impaired)
- Teaching Labs
- Best Practices for Working with AV Consultants and Vendors
- Process

Thank you for taking the time to review this document. Montana State University is committed to updating this document as new lessons are learned and as our classroom spaces evolve. Please help us continue improving our classroom design process. Suggestions can be made by sending an e-mail to designguidelines@montana.edu or by calling Matthew Hume at 406/994-4213.

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