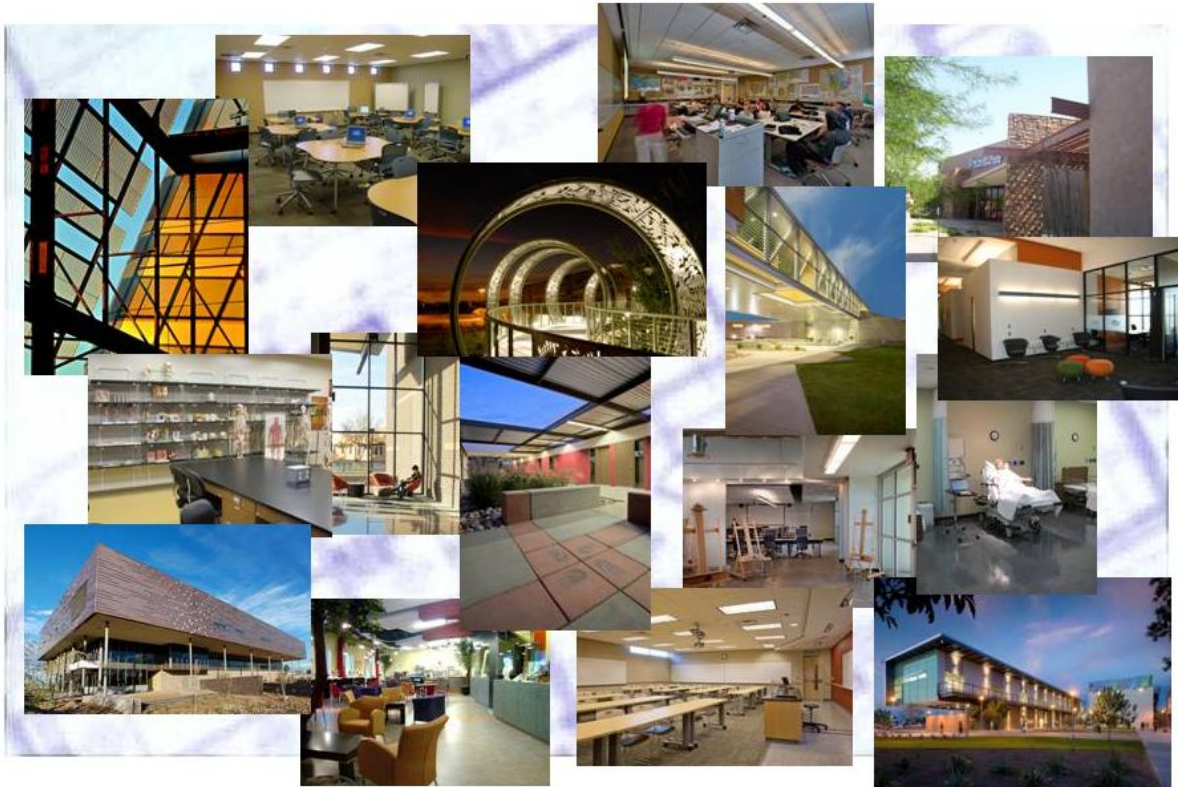




**MARICOPA
COMMUNITY
COLLEGES®**



CAPITAL DEVELOPMENT PROJECTS MANUAL

Part II: FORMAL and INFORMAL LEARNING SPACE DESIGN GUIDELINES

Revisions:
2/07- minor update
9-28-10- significant rework and update

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Definitions

General Purpose Instructional Spaces

General Purpose Instructional Spaces

(20 to 32 Students; occasionally up to 42 students)

Computer Based Instructional Spaces

(24-32 Students- for permanent computer installations at student stations)

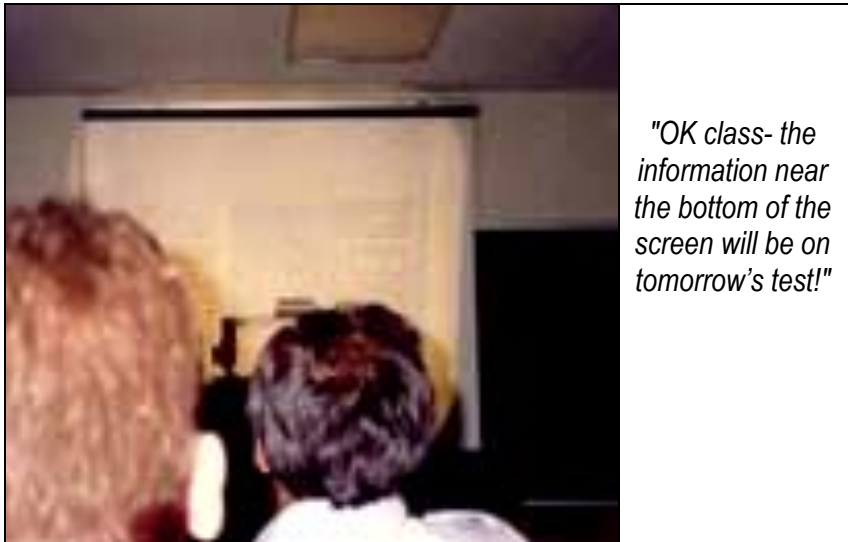
Tiered/Case Study Instructional Spaces

(32 to 100 students)

“Traditional” Lecture Hall and Conference Tiered Spaces

(50 to 200 students)

Sources and Credits



"OK class- the information near the bottom of the screen will be on tomorrow's test!"

<http://www.classroomdesignforum.org>⁵

Part II- Formal and Informal Learning Space Design Guidelines

"Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves."

--Arthur W. Chickering and Zelda F. Gamson, "Seven Principles for Good Practice,"

Active Learning is a process where learners are actively engaged in the education process, rather than passively absorbing lectures. It involves reading, writing, discussion, and engagement in solving problems, analysis, synthesis, and evaluation. Active learning engages a greater range of students in effective learning, has a positive affect on the attitude of students toward themselves and peers in the process, and builds student-to-student and student-to-instructor social communities.

Instructional space must complement instruction activities In order to support active learning. Students have three fundamental rights in their learning environment¹:

- **Students should be able to see anything that is presented visually**
- **Students should be able to hear anything that is presented audibly, free from noise and distortion**
- **Students should be comfortable in their learning environment, including air flow, room temperature and proper furniture**

The University of Maryland's design guide stated,

"Well-designed instructional space does not happen by chance; classrooms are the responsibility of everyone. While offices, conference rooms, laboratories or other specialized areas have their own advocacy group or responsible department, classrooms are learning and instructional resources that belong to the institution⁶."

Because community colleges generally lack the research and publishing missions of major universities, successful delivery of instruction is our measure of success.

The purpose of this guideline is to provide design professionals with information to plan and design learning and instructional space. The District's is not to limit the creative individuality of the architect. The guidelines and requirements presented in this document are based upon the District's and other institutions' experience that provide the fewest problems in use, operation and maintenance of instructional space.

These guidelines are intended to be a minimum standard, which may be exceeded at the user's or college's requests, or where the use and design warrant it.

This is a constantly evolving document reflecting the constantly evolving environment for and approach to instruction and learning.

1.0 Responsibility for complying with standards, laws and program

Design professionals are responsible for meeting the requirements of the facility's program, education specification, Maricopa Community College Design Guidelines, life-safety and building code requirements, and accessibility code requirements (including Title II Regulation (28 CFR Part 35 for State and local government entities) of the American With Disabilities Act (ADA) and Uniform Federal Accessibility Standards (UFAS)).

Telecommunication and infrastructure standards prepared by each college's Information and Instructional technologies groups are applicable to meeting the minimum requirements in all areas.

Any proposed deviations from these guidelines or observed conflicts between these guidelines and the facility program shall be brought to the attention of the District's Project Manager for approval or resolution.

2.0 Informal Learning and Social Space

Instruction and learning no longer stops at the walls of formal classrooms; it continues at nearly all other times and locations that students or faculty gather. In the *Social Life of Information*, John Seely Brown and Paul Duguid state: "As much learning happens outside the classroom as inside"¹³. Because Maricopa's colleges are non-residential, making them "sticky" is important. We must create places and reasons to break the student's car-to-class-to-car model by providing a variety of indoor and outdoor spaces that fit a wide variety of social and learning styles.

Circulation areas serving classrooms should contain seating and informal social areas. This seating creates an atmosphere of unhurried scholarship, social interaction and informal teaching situations outside the classroom. Corridors and connectors become learning streets, with activities on and between destinations, not just paths between endpoints.

Successful outdoor and indoor informal spaces attributes include:

- Proximity to and integration with main corridors, pedestrian paths and building entries
- The ability to "see and be seen" from the seating.



- Typically, a more active environment, but also include some quiet retreat/study spaces for students wanting a more calm, quiet or peaceful study setting. We are designing spaces for students from high school to retirement age, having a wide variety of social and study space preferences.

- Seasonal shade in outdoor areas allowing full or filtered sun during the cooler spring, winter and fall.



- Larger, more active spaces placed away from classroom areas to contain the noise. Limited seating, quiet study and waiting areas directly outside classrooms are useful.
- Nearby food or drinks.
- Separate areas for smokers must be located at least 25' away from buildings, fresh air make-up locations, main circulation paths and other seating areas, but including arrangement and amenities to other seating
- A variety of seating arrangements, including picnic tables outdoors, two or four person light movable tables with loose chairs for group meetings and learning both indoors and outdoors. Indoors, we can use upholstered chairs and couches with durable fabrics for social settings. Include seating and accessibility for physically challenged and wheelchairs. Generally avoid cast concrete benches that will be too hot to sit in the summer and don't allow movable arrangements to suit multiple needs.



- Inviting colors and finishes, with floor covering or ceiling plane differences to define the area



- Bulletin boards for general information posting and small whiteboards to facilitate student or faculty discussion and interaction.
- Wireless internet with plenty of easily reachable power outlets for computers and cell phones. Preferred are wall outlets mounted at +36" to + 48" for easy access.



If floor outlets are used, use outlets that are even with the floor with flip up covers rather than harder to reach and use floor recessed boxes.

- Wall mounted flat screen monitors for general college information and announcement. Flat screens in some areas may be provided with the capability to allow computer displays for group work to be displayed.
- A variety of lighting arrangements to complement the setting, with proper lighting for reading and use of computers

- The proper levels and balance of light, temperate and acoustics to make it a comfortable, attracting space

Emory University's Guideline emphasized *"Make these areas a specific planned space, rather than an afterthought. Value the space"*.

3.0 Formal Instructional Space

Where possible, instructional spaces should be located in multipurpose buildings that also include faculty offices, in order to facilitate student access to classrooms and academic services, enhance safety and security, and heighten stewardship of classrooms. Although a single department may have first priority to schedule and use the rooms, instructional spaces belong to the college.

3.1 Instructional Space Location

- A. Provide interior corridor entry for all rooms. Avoid entrances to instructional space directly from the outdoors in order to enhance after hours security, reduce soiling of rooms, reduce exterior noise coming into instructional spaces and allow proper air balance and conditioning of spaces.
- B. In single story buildings, place instructional spaces closest to main entry doors due to high traffic volumes. In multiple story buildings, place as many instructional spaces as possible at grade level, then next on floors directly above or below grade, again as close as possible to the main stairways and elevator cores.
- C. Locate instructional spaces to avoid heavy student traffic passing through non-instructional areas.
- D. Isolate classrooms from internal noise sources such as restrooms, dining facilities, mechanical and equipment rooms, vending areas and elevators; and away from external noise sources such as loading docks, parking lots, driveways and streets. Wherever possible, avoid common walls between instructional space and high noise sources like restrooms, elevator (shafts and equipment rooms), electrical and mechanical rooms. If common walls cannot be avoided, these walls must be very high acoustic rated in order to isolate and contain the noise source.
- E. Size corridors serving classrooms and labs for one and one-half to twice the code required loads and width due to heavy numbers of students leaving and entering at the same time, along with students waiting or talking. If classrooms must be located on upper floors, increase the widths of the stairs as well as their doors to accommodate larger than code minimum traffic flows at class change over. (Take into account area of refuge requirements on stair landings in order to keep these areas outside of necessary exit paths/flows)
- F. Include student waiting/meeting/social spaces along circulation paths. Design and locate these areas to reduce noise and contain activity levels generated from class areas.
- G. Provide restrooms on each floor along the main travel path between primary entry doors and vertical circulation cores to the instructional areas. Provide one easily found and accessible unisex/family restroom within the main restroom core on each floor.
- H. Multiple floor buildings **shall** have at least two elevators, one of which is oversized/freight to allow movement of furniture, equipment, etc.

3.2 Instructional Space Design

3.2.1 General Requirements

- A. Instructional space is designed for the department and college general use, never for an individual instructor's preference or teaching style.

- B. Design classrooms to allow different seating arrangements. Coordinate floor boxes for power, where requested, providing additional boxes as needed to cover all arrangements. (NOTE: confirm whether data will be wireless or be provided in the floor boxes. ALL instructor station locations get both power and data/A-V connections in the floor boxes).
- C. Structural columns must not occur within the seating area or obscure sightlines to the instructor and projected images.
- D. Ceiling heights are a function of proper architectural room proportion, acoustic properties, and projection screen heights/image size/viewing angles. In new construction, provide adequate ceiling height (a minimum of 9'-6" and as suggested below for larger areas) based on the height of a projected image.
- E. Locate entrances at the rear of the room or in the side walls towards the back of the room to lessen the disruption of students entering and exiting while class is in session. Provide recessed vestibules for out-swinging doors to avoid conflicts with corridor circulation paths.
- F. Provide a narrow window in the door or sidelight at the latch side to prevent accidents when doors are opened and increase security. Each door should have a door stop, sound stripping and a "Classroom function" lockset where panic hardware is not required. At the college's option, provide card access and the coordinated electric latch (not lockset) hardware for the room. Confirm lockdown requirements or special hardware with College Safety.
- G. Instructor consoles shall be located so as not to obscure the students' sight line to the projection screen(s) and markerboard(s). Provide a minimum of 8' (with 10' preferable) from the front wall to the first row of student seating for the instructor desk/station and circulation. Additional distance may be required to meet projection screen viewing angles. Allow and design a second location at the opposite end of the front instructional area.
- H. Small exterior windows are encouraged in classrooms to provide controlled natural lighting. Design and arrange windows toward the rear end of the sidewalls to prevent light spill on projection screens and markerboards. Exterior windows should have an STC > 50. Provide window shade systems or blinds to darken the room, including sidelights at doors (windows in doors generally do not require black out ability). Provide electrically operated shades in larger tiered rooms. **Blinds and window coverings are part of the General Contractor's package and are not provided through college FF&E.**
- I. Accent colors on walls are desirable.
- J. Movable walls generally should not be used in classrooms because of the difficulty in maintaining adequate sound separation. If the user program requires an operable wall for space versatility, provide a movable panel operable wall instead of an accordion partition. Specify an STC that equals or exceeds the classroom wall rating. Include a continuous acoustical rated wall closure between the door track head and roof/floor deck above to maintain full acoustic separation above the operable partition.
- K. Locate the main set of light switches, technical controls, A/V controls, wall phone, data and power outlets near the primary instructor station at the front of the instructional space. Provide power data, and A-V connection in both wall outlets behind the primary and secondary instructor station as well as a floor box under the primary instructor desk. Provide one switch for general/partial lighting at the each entry door; the entire lighting control need not be duplicated at the doors. Coordinate switch locations for lighting, projection screens and electric blinds to assure that the switched are not located behind the screens and become inaccessible when screens are down.
- L. The front wall and ceiling must be clear of anything that will conflict with projection screens, marker boards or tack boards. Coordinate, check **AND THEN RECHECK AGAIN** locations of lights (especially cable hung lights), projection screen switches, temperature sensors, thermostats, or fire

alarm strobe/annunciators to assure that these do not fall within marker boards and tack boards. Coordinate light, projector and electric blinds switched so that they are not behind projection screens. Do not place emergency lights that remain on in front of projections screens, and do place air supply grilles that blow on and ripple projection screens. Place any clock on the back wall of the classroom.

3.2.2 Room Configuration and Design

Good room configuration simultaneously addresses seating, views of the instructor, whiteboards and projection screen(s), acoustics, traffic flow and spatial proportions.

- ☛ **When specific seat counts are provided in the user program, that number must be placed in the room, within the required layout and sight lines, even if the room size must be increased beyond the program size. Do not squeeze the required seat count into too small a room, a badly configured room, or reduce the front instructional area or aisles to achieve the required seat count.**

In general, classrooms with seating capacities above 40 work better with a tiered floor or raised instructor platform to improve sight lines.

Rooms should be designed from the inside outward, in this order. Provide a room plan, elevation and front-to-back section of the room to design and test each of the following in order:

1. Confirm whether the room will be used as a traditional single front instructional zone or multi-front learning studio and, for larger rooms, whether the room will be a flat floor or tiered/sloped floor arrangement.
2. Confirm the seat count and type of furniture to be used.
3. Determine the preferred seating and aisle arrangement (single center aisle, aisle each side, sides plus center aisle). Multiple options during early design are helpful to allow visualization and fit testing vs. program space.
4. Show the minimum 8' depth of the front instructor zone
5. Determine the number, general location and orientation of projection screen(s) (*front-centered, front but off center, front corner plus verify single or multiple screen preference*)
6. Draw horizontal and vertical "viewing angles" from each screen to assure that all seats fall within this optimum horizontal area and vertical viewing angle, especially seats in the front rows.
7. Determine the overall preliminary room width and depth, testing against preferred proportions
8. With Instruction Technology, select a projection screen size, based upon seating configuration, minimum/maximum distances from students and image proportion (*4:3 or 16:9*)
9. Set the ceiling height, based upon minimum ceiling height, required image height and minimum 48" image height above the floor. If suspended or direct/indirect light fixtures are used, the ceiling height must be increased, or lights must be moved, to avoid conflicts between the lights and projected image.
10. Reconfirm that all of the above works together and properly, including an acceptable room proportion, and re-adjust anything as needed.

In larger tiered rooms and auditoriums, the use of non-parallel wall surfaces are recommended to enhance acoustics.

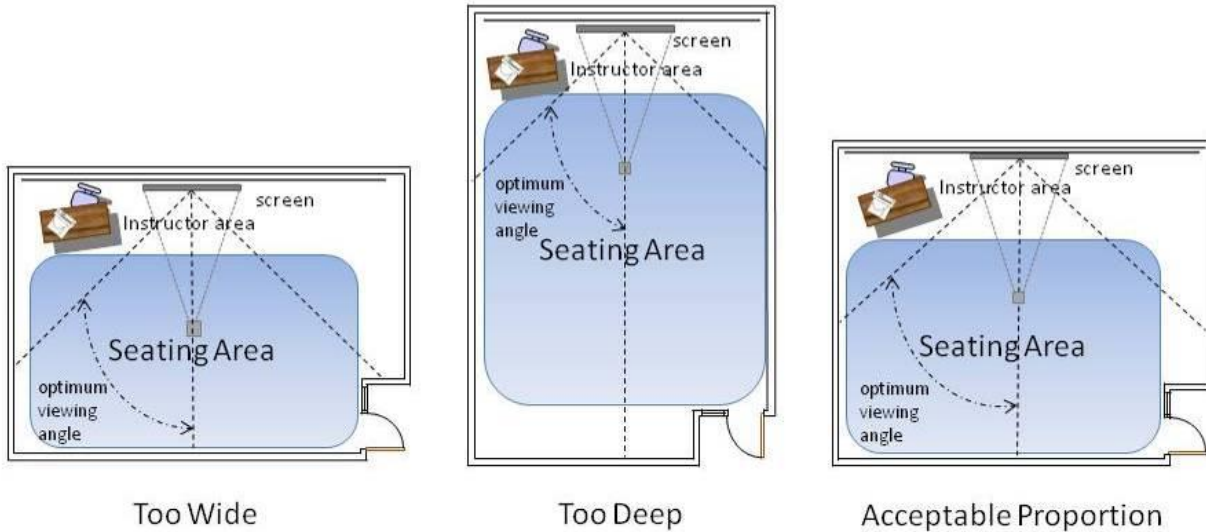
3.2.2.1 Room Proportions

Room proportions impact seating capacity, sight lines and the ability of students and instructors to interact with each other. In more traditional, single/front instructional zone configuration, the preferred average classroom width-to-depth ratio ranges from to **4:3 to 3:2**. Learning Studios, which do not use a traditional single front wall instructor zone, should be roughly square.

Odd shaped or oddly proportioned classrooms should be avoided. Classrooms that are too wide have poor sightlines (often requiring multiple projection screens), dedicate too much space to the instructional zone and make it harder for instructors to maintain easy eye contact with the entire class. Classrooms that are

too deep make it challenging for students in rear rows to interact with instructors and other students, to hear what is said, and to see the front of the room. Instructor areas may be too narrow to contain the projector screens, markerboards and instructor station without conflicts or unwanted overlapping.

Classroom and Lecture Hall Proportions

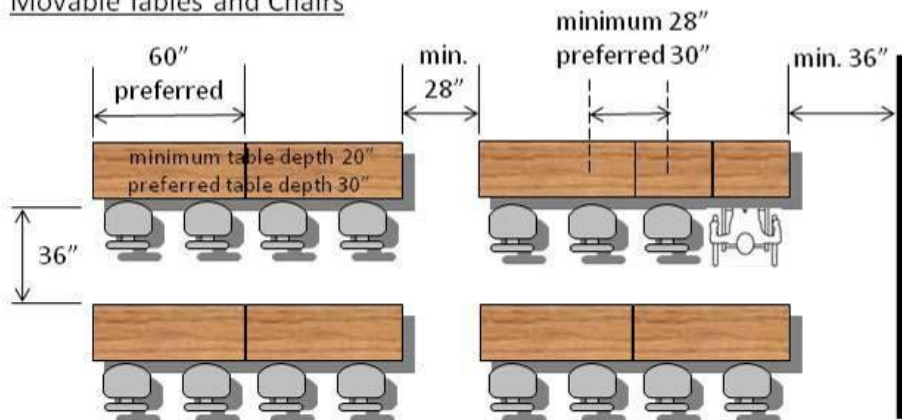


Concept diagram originated by "Design Guidance: Learning Environments", University of Cincinnati

3.2.2.2 Aisle and seating configuration

Primary aisles should be 36" wide, including all access to wheelchair paths and seats. Secondary paths should be a minimum of 28" wide. Configurations providing both a center aisle and side aisles are preferred but where space is limited, a single center aisle configuration generally is preferable to aide aisles with uninterrupted rows of seats. Seating for physically challenged users and wheelchairs should be dispersed in the instructional space when more than one location is required. Minimum handicapped seating space shall be 30" wide by 48" deep. Ramps to platforms and tiers must not have slopes steeper than 1:20.

Movable Tables and Chairs



Concept diagram originated by "Design Guidance: Learning Environments", University of Cincinnati

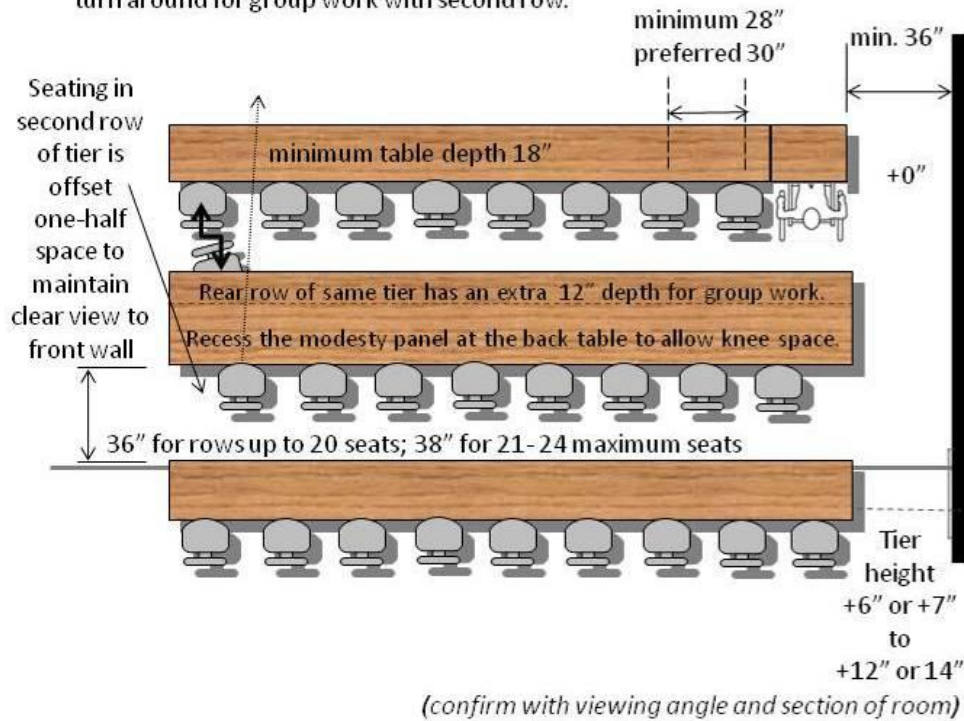
The "Maricopa Tier"

In tiered classrooms, Maricopa's latest design places two rows of tiers on each level, with the back row having an extended depth table top. This arrangement allows students in the front row of the tier to turn around and participate in group work with the second row. Seats in the rows are loose chairs with wheels.

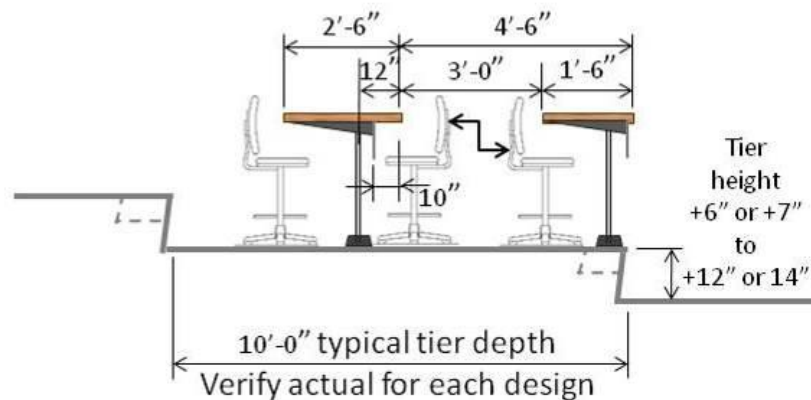
Offset seating positions to allow unobstructed viewing lines from each row to the instructor, writing surfaces and projection screens.

Continuous Work Surface with Movable Chairs in Tiered Rooms

Two rows of tables on the same tier level. Forward row can turn around for group work with second row.



Section through typical Tier

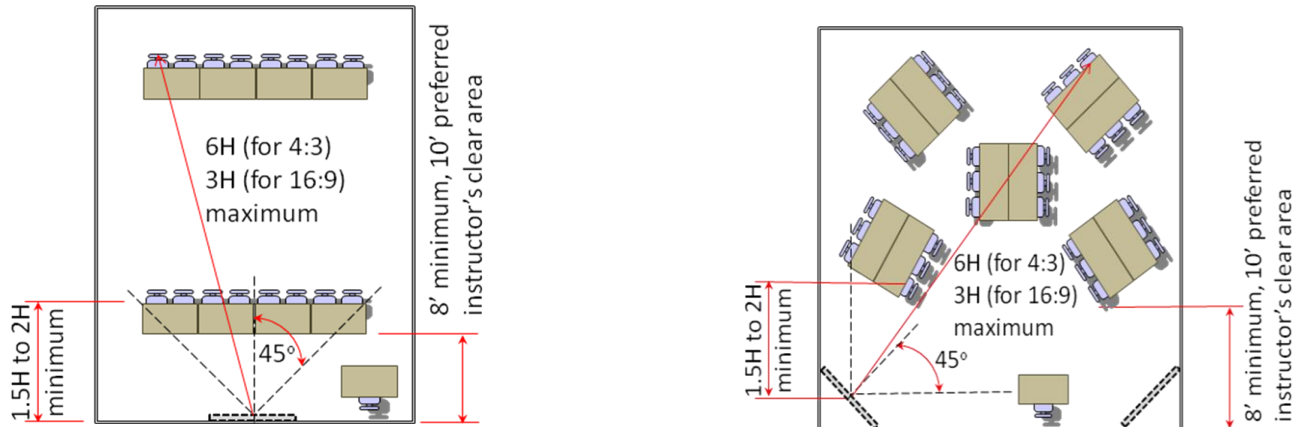


3.2.2.3 Optimal viewing of projection screens

If lines are drawn out at 45 degrees from the outer edges of the screen, they form a cone that consists of optimum viewing positions with a minimal amount of optical distortion. Seating outside of this cone is not desirable.

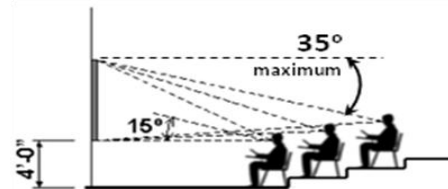
Based upon the image height (**H**), the minimum distance from the screen to the first row should be at least **1.5H and preferably 2H**. Based upon screen height (**H**), the distance from the farthest screen edge to the

most distant viewer should be no more than **6H maximum for a 4:3 projector screen image and 3H for a 16:9 image**. Screens should be Standard Format (4:3) unless otherwise specified for a given room. (sample calculation for a classroom with a 9'-6" ceiling and the bottom of the screen at 36" above the floor: The screen image will be 6' tall. For a standard video (4:3 screen format) a 6' high by 8' wide screen, the last row of seats should be no more than 36' from the screen. For a wide-screen format of 16:9, a 6' high screen would place the last row of chairs should be a maximum of 18' back from the screen.)



Charts and graphs should use a 4 times ratio to calculate the maximum distance of the last row of seats. A room with a 6' screen should have the last row of seats no more than 24' back.

Projection screen height/tiered floor levels should be set so that head tilt is limited to **15 degrees maximum** above horizontal to the center of the projection screen and **35 degrees maximum downward** from the screen top.



Determine the optimum screen size based on room dimensions, planned audience seating size, use, required image ratio and screen arrangement. Verify these items with the college both during design during shop drawing reviews as a last check.

The height of the projected image is determined by taking the distance of the farthest student from the projection screen and dividing it by 6. The ceiling height at the front of the room should allow for the image height plus 4'. This may require additional screen "drop" for ceiling hung screens.

Any screens 120" and over should be electric return with tab-tension and low voltage modules for connection to third party controllers. A very nice initial screen sizing tool (when matching a particular video projector) is at <http://www.projectorcentral.com/projection-calculator-pro.cfm>.

3.2.2.4 Ceiling Height

Ceiling height should first be set based on the required height of the projected image **plus 48"** from the bottom of the image to the floor. (For example, in a typical general-purpose classroom in which the farthest student sits 30' from the projection screen, the height of the projected image must $1/6 H$ for 4:3 image, which is 5 feet. Add 48" to the floor and mounting for the screen above the image, making the minimum ceiling height at the front of the room 9'-6" feet.)

Ceiling heights also are a function of architectural proportion, acoustics and screen height. Recommended minimum heights are:

0-32 people	9'-6" (9'-0" as the minimum in remodeled areas only)
32-50 people	10'-0"
51-75 people	a function of sloped or tiered floors, generally 12'-0" at the front of the room and no less than 8'-6" at the rear
76-200 people	a function of sloped or tiered floors, generally 13'-0" to 15'-0" at the front of the room and no less than 9'-0" at the rear

3.2.2.5 Finishes

Classroom finishes should enhance acoustics, using the proper balance of reflective and absorptive surfaces, as well as meet requirements for custodial, durability and long-term maintenance. Floors should be non-slip and easy to maintain. Carpeting (carpet tile where budgets allow) is preferred. If a sink is present, provide a four to six foot deep strip of VCT the entire length of the counter/sink. A few colleges prefer VCT in classrooms due to the presence of food and drink. In these locations, additional acoustic adjustments on other surfaces must be made.

In tiered lecture halls or auditoriums, carpet should be used at the front instructional area. Sealed concrete or VCT should be used at aisles, or other areas of concentrated foot traffic. The front faces of the tiers and entire horizontal surface should be carpeted. Provide a contrasting color or textured nosing, or different color VCT, at stair treads.

Walls should have durable, non-glare finishes. Paints should be semi-gloss for walls, gloss/acrylic for doors, frames and other surfaces subject to hand prints. Hard ceilings may be gloss or semi-gloss paint. Soft materials, such as acoustic panels, should be mounted as high as possible to avoid accidental or user damage. Chair rails or wall protective features may be provided in rooms where moveable chairs may hit walls. Rails should be made of materials that hide or aesthetically accept gouges and marks.

Recommended minimum light reflectance for instructional areas:

Ceiling	80-90%
Walls	50-60%
Floors:	30-50%

Instructional space ceilings generally are lay-in acoustical tile to provide proper acoustics and lighting reflections. Hard ceilings may be used in larger rooms when recommended by the acoustical consultant. **Provide finished ceilings in all formal instructional areas to help achieve proper acoustic specifications; fully exposed metal or concrete roof/floor decks above instructional space are unacceptable.** See Designing a Favorable Listening Environment below.

Provide 48" high corner guards at all outside corners in the corridor, including at recessed entries to classrooms and labs.

3.2.3 Room Acoustics

Instructional space acoustics affect how well the listeners can understand verbal communication and thus the success of their educational experience. **Poor acoustics, sound quality or noise is the most common complaint in instructional spaces.**

3.2.3.1 Acoustic measurements

The criteria used to measure and create acoustically functional spaces include:

- **Sound Transmission Class (STC)** is a rating that measures the amount of airborne sound blocked from transmitting through a partition.
- **Noise Criteria (NC)** is a measure of background noise within a space. Background noise is a major concern in instructional facilities. Factors that must be addressed to achieve satisfactory NC performance typically include light fixtures, mechanical and plumbing systems, and the

construction detailing of the room's envelope in order to reduce noise infiltration from external sources.

- In multiple story buildings, **Impact Insulation Class (IIC)** is a rating of the floor-ceiling assembly to block impact/structure borne noise from transmitting to the space below it. A floor-ceiling assembly with a low IIC rating will allow noise into the room below.

Additional attributes used to define a favorable listening environment include:

- **Reverberation Time (RT)** affects the intelligibility of speech. Longer RT's increase sound echo in the room and lowers the SNR by overlapping the original signal with reflections that muddy or blur the sound of subsequent words or sounds. The proper reverberation time is a critical factor in improving intelligibility in the classroom.
- **Signal-to-noise ratio (SNR)** measures the intelligibility of spoken information by comparing the loudness of the sender's voice (signal) to the background-sound level (noise) at a particular location (receiver's ear). Even with proper reverberation, excessive background noise levels seriously degrade intelligibility. SNR can be improved by providing balanced early sound reflections (e.g., wall shaping and finishes), reducing speaker-to-listener distance and minimizing excessive reverberation time.
- **Speaker-to-listener distance (SLD)**. As the distance between speaker and listener increases, the loudness of the signal decreases as does the signal-to-noise ratio.

3.2.3.2 Acoustic requirements for Instructional Areas

A. Sound Transmission Class ratings:

1. For instructional spaces adjacent to offices **minimum 45 STC** or conference rooms: **minimum 50 STC**
2. For instructional spaces adjacent to another instructional space, corridor or to the outdoors: **minimum 50 STC**
3. For instructional spaces adjacent to common use and public use areas such as lobbies, and restrooms: **minimum 53 STC. AVOID common walls between restrooms with plumbing fixtures/piping and instructional areas** due to water flow noise in pipes, flushing noise, etc.
4. For instructional spaces adjacent to music or other performance space, cafeteria, gymnasium, elevator shafts and other equipment rooms, mechanical rooms and electrical where larger transformers are present: **minimum 60 STC**
5. Classroom doors should be rated as **STC-30** or more, and music room or other high noise area doors as **STC-40** or more. Entry doors across a corridor should be staggered to minimize noise transmission (see the sketch below).

B. Noise Criteria one-hour steady-state ratings when measuring ambient sound level at all points throughout the space:

1. Classrooms: **NC 25 to 30**, with a goal of **no more than 35 dB background noise level**
2. Auditorium/Lecture Hall: **NC 25 or less**
3. Studio/Distance learning room, both receiving or originating the information: **NC 20 - NC 25**

C. Impact Insulation Class ratings for floor-ceiling assemblies above instructional spaces should be at least **IIC-45** and preferably **IIC-50** (measured without carpeting on the floor).

In new construction, high floor impact uses like gymnasias or dance studios should not be located above instructional spaces.

D. Reverberation Time in unoccupied rooms:

1. Classrooms up to 10,000 ft³: **RT60 of 0.4 to 0.5 seconds** at mid-speech frequencies of 250, 500 & 1000 Hertz.
2. Classrooms between 10,000 and 20,000 ft³: **RT60 up to 0.7 seconds**
3. Tiered lecture halls (100 to 200 seats) and larger conference rooms that also may be used for instruction: *suggested RT60 of 0.60 to 1.00*
4. Large auditoriums used predominantly for instruction with lecture and audio/visual systems (more than 200 seats): *suggested RT60 of 0.85 to 1.20 seconds*

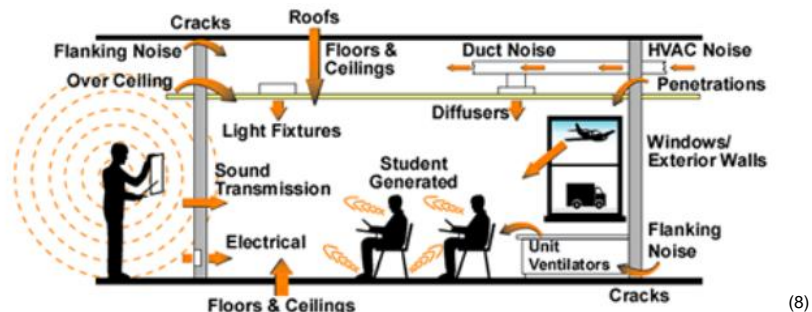
For large tiered lecture rooms (more than 40 seats) and auditoriums, the final reverberation times and room configuration **must be** recommended by an acoustician for the specific primary and secondary uses (many rooms are multi-use such as small music recital or drama presentation, etc.).

A number of web sites provide simple tools for initial calculation of a room's reverberation time including M^cSquared System Design Group (*speech samples, from no reverberation, 0.6, 0.8, 1.3, 2.0, 5.0 seconds RT*) at <http://www.mcsquared.com/reverb.htm> and Armstrong Ceilings, (*both speech and music samples at 0.5, 1.0, 1.5, 2.0, 2.5, 3.0 and 5.0 seconds RT*) at www.armstrong.com/reverbtool

- E. **Signal-to-noise ratio** should be **at least 15** for normal speech without amplification, assuming a background noise level of no greater than 35 dB.

3.2.3.3 Sources of noise in Instructional Spaces

The space's design determines background noise levels and reverberation time. A critical goal is to keep outside noise from being audible inside the classroom. Noise from passing vehicles, internal building and hallway noise significantly detract from the learning experience.



Many factors determine the background noise level in a room which then impact speech intelligibility:

- building location and the resulting noise originating from adjacent areas like parking lots or streets
- the room's placement relative to or noise generated from other adjacent interior spaces and uses
- the size and shape of the room
- the surface treatments and finishes
- the floor, wall and ceiling construction
- noise generated within the room from audio/visual equipment or building systems

Identify noisy areas (mechanical and electrical rooms with equipment or transformers, gyms, cafeterias or music areas) early in design and use buffer areas (corridors, storage rooms, etc.) to separate these areas from critical instructional and noise sensitive areas. Many instructional areas use audio equipment that also produce high sound levels that can be transmitted to adjacent classrooms.

HVAC are the predominant, but not the sole source, of background sound in the classroom. Locate roof top mechanical equipment and air handlers away from instructional spaces. Avoid placing mechanical equipment, including VAV and fan boxes, within the instructional areas even above ceilings. Instead, place mechanical equipment and major ductwork over hallways and run the secondary ducts into the classrooms to reduce noise as well as making equipment maintenance less disruptive to instruction.

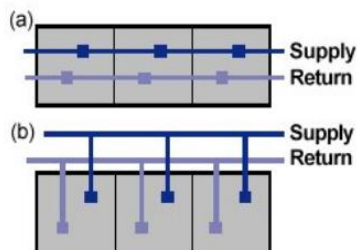


FIGURE 5. Duct Arrangements
 (a) bad duct arrangement - sound travels through the duct work from room to room, instead (b) good duct arrangement - sound has a longer path to travel through lined duct between adjacent rooms.

(4)

Where project budgets allow, provide a fully ducted return air system, including adequate sound insulation (duct liner) and/or silencers to reduce duct borne air handler noise. If budgets are not adequate, provide sound insulated sheet metal ducted “U” or “Z” return air boots through the full height sound rated walls to reduce noise transfer between air return plenum areas. **Holes cut in the full height walls and left open to provide air return paths are not acceptable in any Maricopa facility.**

Other building utilities and services also may emit constant or intermittent sounds to the classroom. The sound level from these sources should not fluctuate significantly nor create an annoying buzzes, rattles, whine, hiss, or whistle. Even “sound rated” transformers, when enclosed in small electrical rooms, produce enough sound to interfere with adjacent rooms.

3.2.3.4 Designing favorable listening environments

To achieve the desired noise reduction, select construction materials and assemblies with appropriate **Sound Transmission Class (STC)** ratings for the slab, roof, interior and exterior walls including doors and windows.

All walls surrounding instructional areas must be sound rated and extend from the floor to the roof/floor deck above. Specify that all gaps, edges and penetrations of the sound rated partition are properly sealed, including ends that abut other assemblies such as window wall mullions. Extending walls slightly above ceilings and adding sound insulation over the ceiling at the perimeter of the room is inadequate to prevent passage of noise.

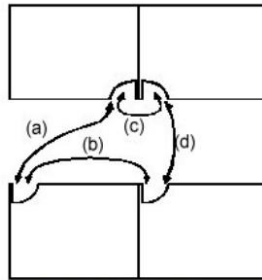
Classrooms with all or nearly all hard reflective surfaces such as exposed structural decks above coupled with VCT or concrete floors create poor listening environments. Instructional space with no ceiling or partial ceilings generally cannot provide proper acoustics due to reverberation and mechanical noise entering the room. Perforated metal deck with acoustic inserts is inadequate for sound control.

Construction Documents Requirement: The design team must include adequate specifications and detailing on the construction documents to achieve the required acoustic results. Do not leave it to General Notes or the contractor “means and methods”.

In lecture halls and auditoriums, early reflections help improve speech intelligibility, but late reflections and excessive reverberation degrade intelligibility. The front wall and ceilings may be more reflective to aid sound in reaching everyone. Absorptive material on the back and sidewalls helps reduce reverberation time and unwanted reflections. Splayed side walls help to eliminate flutter echoes.

3.2.3.5 Door locations and sound paths in corridors

At corridors within instruction areas, locate doors into rooms next to and opposite each other as far apart as possible:



Paths (a) and (b) represent good layouts because the sound has a longer path to travel from one room to the next, paths (c) and (d) represent bad layouts because the distance between is short. (4)

4.0 Audio-Visual Systems

Computers and audio/visual systems are standard in all instructional areas. The technology and the architectural design must be complementary. The design team shall confirm the technology and audio/visual needs with college's Information Technologies and Instruction Technologies groups for each project.

Projection screen configuration must provide proper sight lines and viewing distance from screens. Screens and equipment should be mounted so that projected images are not key-stoned, blocked by suspended light fixtures, etc. Any equipment permanently installed in classrooms must be as secured to prevent both theft and damage.

Each instructional area will have a ceiling mounted video projector. Some larger rooms will have two projectors and screens to provide optimum viewing or meet specific instructional needs. Learning studios may have three or four projectors and screens. The projector should be located approximately **2½ - 3 times** the projected video image height from the screen, but this may vary with the projector type, model or room configuration. **Confirm exact location (both distance from the screen and whether to mount on the centerline of the screen) with college's technology staff.** Audio-visual equipment may be placed in the instructor podium, in a separate cabinet next to the instructor desk or in a separate cabinet located at the wall near the instructor station.

Confirm with the college if the screen is to be centered on the front instructional wall, offset from center front to allow use of the marker board simultaneously while the screen is down, or located in one of the front corners of the room. Also confirm the number of screens and projectors.

Projection screens are part of the General Contractor's package and are not provided through college FF&E. Video projectors are provided through college technology budgets and contracts.

A. Projection screens

1. Screen sizes 10 feet and larger (height or width) should be electrically operated. Provide low voltage screen controls so that it can be tied into the audio-visual system controls. Locate the screen control switch next to the lighting controls at the front of the instructional area, making sure these none of these are behind the lowered screen. Switches shall be sustained operations in the up or down position, lowering or raising the screen to the limiting switch positions. Momentary screen control switches are not acceptable.

2. All new classrooms should be designed to provide, at a minimum, front wall space for 9 (units high) x16 (units wide) format projection screens. Confirm the screen format with the college.
 3. Projection screens mounted in front of the marker board must clear the board's marker (chalk) tray when lowered. Typically, allow 6"-8" clear from the face of the marker board to the back of the screen.
 4. Screens can be ceiling hung or surface mounted. Do not use screens recessed into the ceiling except in high end or formal meeting/presentation spaces. Lay-in ceiling systems shall not be fastened to recessed screen housings, to allow the unit to be dropped easily for service.
 5. Provide black masking borders on front projection screens to enhance the apparent brightness of an image on a screen.
- B. Ceiling-mounted projectors or wall-mounted projection screens should not conflict with the lighting fixtures or access to lighting fixtures for changing lamps.
 - C. Where video projectors are suspended from the ceiling, a motorized lift shall be provided where the distance from the floor to the underside of the projector exceeds 14'.
 - D. Monitors shall be sized for the maximum viewing distance: Provide 1 inch of diagonal measurements for each 1 foot of viewing distance.
 - E. Lecture halls and classrooms with 40 or more should be considered for voice and audio amplification systems, particularly in areas serving older or senior populations. Lecture halls and classrooms with 100 or more occupants must have voice and audio amplification systems. Consider assisted listening systems in these larger areas.
 - F. Projection rooms may be utilized in spaces with 100 or more occupants where projection is used.
 - G. Projection rooms should be 48 sq. ft. minimum, with a 4'-6" minimum dimension in either direction. Provide lighting and sound controls that duplicate the controls in the instructional zone.

5.0 Mechanical Systems

Size ducts, diffusers and air returns large enough to achieve a "library quiet" environment. ASHRAE minimum requirements generally are not low enough for instructional space.

Equipment mounted adjacent to, above or below instructional space shall be isolated to prevent transmission of vibration into occupied spaces. Main, large supply and return lines should not be routed over instructional areas. Where this cannot be avoided, provide additional sound insulation or additional duct size to reduce the amount of air movement noise introduced into the instructional area. HVAC systems and equipment shall be designed and placed to reduce, and preferably eliminate, need to enter instructional spaces for maintenance. Placing VAV boxes and similar equipment outside instructional areas also eliminates their background noise in these rooms.

Do not place or aim diffusers or returns where they will be blowing on or close enough to the projection screens to cause movement or rippling of the screen, or if they cannot be properly placed, provide a three-way throw in the supply register to direct air away from screens.

5.1 HVAC Requirements

- A. Each instructional space shall be its own cooling/heating zone with its own temperature controls.

- B. HVAC controls system also will tie into the occupancy sensors for the lighting system through an additional set of sensor contacts to allow more rapid response when the room becomes unoccupied.
- C. System components (fans, ductwork and diffusers) shall be selected to meet the following sound criteria (*which are lower than ANSI/ASA S12.60 criteria*):
 1. New Classrooms: **NC 20 to NC 25**
 2. Renovations: **NC 25 to NC 30**
 3. Diffusers must have a rating of **10dB lower than the room NC** rating at rated flow in areas with lower NC requirements.

Also see design suggestions and additional requirements in the **ACOUSTICS** section.

6.0 Electrical Requirements

Avoid locating equipment rooms that contain electrical equipment that produce high levels of vibration or noise adjacent to instructional areas or offices. Even “low noise” transformers produce unacceptable decibel levels when located within small rooms with hard floor/walls/ceilings. *Also see design suggestions and requirements in the **ACOUSTICS** section.*

6.1 Lighting

Light fixtures and lamps should be selected for energy efficiency, low heat generation, easy maintenance and cleaning, and to meet specific instructional needs. Flexible lighting capabilities have become essential. Classroom lighting should permit a range of levels from dark to bright, as well an intermediate level to permit note taking while projection equipment is in use. For nearly all smaller instructional areas, multiple light switches are adequate. Complicated or expensive dimming systems with specialized touch panels should be reserved only for larger lecture halls or auditoriums. If dimming systems are used, they should provide a series of simple pre-sets for instructors.

6.1.1 General Lighting Requirements

- A. Overall even ambient lighting level should be **50 foot-candles** ± 15 foot-candles in order to provide adequate light levels and meet current energy codes. Even illumination is defined as ± 10 foot-candles from mean.
- B. When lighting is dimmed or partially switched for note taking during presentations, seating areas require **5-10 foot-candles** minimum. +10 foot-candles only is acceptable.
- C. Lighting levels from task lighting to any viewable surface in the room should not be **less than one-third and not more than five times** the lighting level at the task area, with a maximum three-to-one ratio for the student viewing area to the front instructional zone of the room.
- D. The front wall marker board shall be illuminated to **30 foot-candles** minimum average (measured vertically). This will meet the requirement of not less than one-third to a maximum of five times the task surface contrast level, assuming a 50 foot-candles task lighting level at the desktop.
- E. In instructional spaces set up for primary use as computer labs, provide lighting fixtures with both an upward and downward light component or lay-in fixtures with internal reflectors to eliminate hot spots on computer screens. In all other general-purpose and smaller tiered classrooms, including those with occasional computer use, lay-in fluorescent light fixtures with parabolic lenses or recessed direct/indirect lens for glare reduction are acceptable. If combination suspended light fixtures are used, they must be coordinated with the video projector so as not block the video projector image.
- F. All instructional rooms must be provided with emergency lighting, whether or not required by code. Emergency lights must be located towards the rear of the room so that the light does not spill onto

the projection screens when the remaining room lights are dimmed. Where the specific use of the classroom requires complete blackout capability, emergency light fixtures in classrooms may have a bypass provided by switchable emergency battery ballasts with an unswitched reference wire from the circuit. Nightlights are not required in instructional areas.

6.1.2 Lighting Levels and Controls

Provide ceiling or wall mounted occupancy sensors in all rooms. Sensors should turn off all lights when no activity is sensed for fifteen minutes. (This also allows a five year ballast warranty). Sensors should turn on lights when activity occurs in the room or upon entry into the room. Use multiple sensors when room size or configuration is larger than the sensor range. Place and aim the sensor(s) towards the door.

For general instructional space lighting, the overall objectives are to provide separate lighting zones for the front instructional area and the remaining seating area. This allows a dark front zone at the projection screen while students still have enough light to take notes. Provide the following for lighting controls in general purpose classrooms and smaller tiered lecture rooms, per the sketch on the next page:

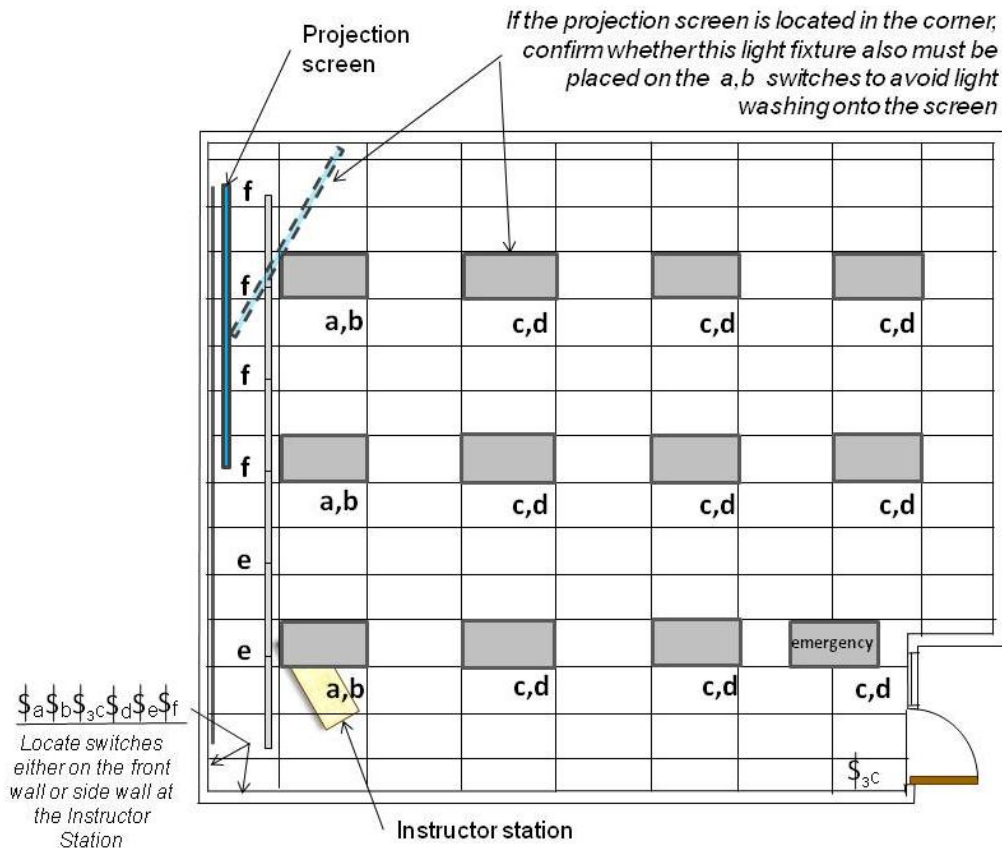
- Provide one three-way light switch for general room lighting at the entry door to the instructional space, with a complementary three-way switch and balance of the remaining light switches at the front of the room, behind the primary instructor location. The lights that are controlled at the entry door should provide sufficient light level to allow a user to walk safely through the classroom to reach the remainder of the front lighting controls.
- Through zoning the light fixtures as described below, illuminate the front instructional wall and projection screen separately from the balance of the seating area. This allows both use of the projector and note taking in the balance of the room without lights washing out projected images.
- If additional supplemental marker board and instructor zone lighting is provided, add separate switches to control these fixtures. Switching should be zoned so that the lighting showing on the projection screen can be turned off separately from the lighting that remains on the instructor and unobstructed marker boards. This means that this front, supplemental zone needs at least two switches. Lighting needs to be aimed or shielded so that the lights that remain on do not wash onto the projection screen.

Light switches separately control the middle and outer tubes (assume a three tube fluorescent lay-in fixture) of all light fixtures, providing fully off, partial lighting level (33%/67% for three tube fixtures or 50%/50% split for two tube fixtures), and fully on levels of lighting for each fixture. The **a,b** and **c,d** notations on the sketch below indicate the split switching of the tubes within a two or three tube fixture (**a** and **c** control a single tube; **b** and **d** control the balance of the tubes).

For cable or pendent hung fixtures with both an upward and downward component using a common set of tubes, the multiple lighting zones and levels of lighting still are required. Either the fixtures must be provided to allow a split switching for each tube or a dimmer system should be installed.

If more economical for the project, dimmer switches or low voltage control systems also are acceptable to meet specified illumination levels in larger rooms. All fixtures and all tubes within the fixture in a single zone can be on one variable level switch. Low voltage dimmer or control systems should be set up with very simple programmed pre-sets to reflect the different uses of the room.

The row of light fixtures closest to the front of the classroom is controlled by two switches, and the balance of the light fixtures in the room are controlled by a second pair of switches. One of this second set of switches is a three-way switch paired with another three-way switch located at the door; these switches should control the higher level of general room lighting. If the projection screen is angled in the corner of the room, an additional fixture closest to the screen in the second row/seating zone generally needs to be switched with the front row zone to be able to prevent light wash onto the screen.



•The college, architect and electrical engineer need to confirm the primary instructional wall and location of the projection screen assure the correct lighting fixture controls and switching splits. Each project also may evaluate whether multiple switches or lower cost dimming switches and ballasts are more economical to provide this variable lighting arrangement.

A. General-purpose, tiered classrooms and smaller computer labs have two primary lighting zones with variable illumination levels and two optional zones:

Zone 1, fixtures (A,B): Instructor's area of the room including the markerboard general illumination and the projection screen(s)

Zone 2, fixtures (C,D): The remaining student area of the room, including emergency lighting generally located near the door.

Optional Zone 3, fixtures (E,F): Supplemental lighting of the markerboards. Typically, these lights are provided so that the instructor can use the remaining, visible markerboard while the projection screen is down and the projector is on. The arrangement and switching of this set of lights must be carefully developed so that the lights used to illuminate the remaining markerboard do not wash onto the projection screen. This lighting split can be accomplished with either a single row of fixtures that is split somewhere in the center of the room or through a two circuit track light that allows individual lights to be moved and aimed, then switched depending upon which of the two circuits in the track are tapped.

B. Auditorium, large classrooms or tiered classrooms have three control lighting zones and two optional zones in auditoriums:

Zone 1, fixtures (A,B): Instructor's area of the room including the white board general illumination and the projection screen(s)

Zone 2, fixtures (C,D): The remaining student seating area of the room. A large room/auditorium may require multiple student area zones and may require different

illumination levels. Emergency lighting will be in multiple locations within the room, but placed so as not to shine on the projections screens.

Zone 3, fixtures (E,F): REQUIRED supplemental lighting of the markerboards to assist legibility from distances and view of the instructor while the projection system is being used. Assure uniform and adequate lighting the entire length and height of the boards. Select lighting to ensure that the lamps in the fixtures will not be directly visible from the student seating area. Similar to their use in smaller classrooms, the arrangement and switching of this set of lights must be carefully developed so that the lights used to illuminate the remaining whiteboard do not wash onto the projection screen.

Optional Zone 4: Highlighting to illuminate the instructor while showing A/V systems are in operation and the rest of the room in fully or partially darkened. Control this zone by separate switching.

Optional Zone 5: Highlighting of a sign language interpreter for visually impaired. Confirm the need and location for this zone with the college. Control this zone by separate switching.

Lecture halls and auditoriums generally provide integrated lighting and audio-visual control systems. Coordinate lighting design and controls with college Instructional Technology.

6.1.3 Additional lighting locations

Separate lighting should be installed on teaching lecterns in large instructional spaces to allow instructors to refer to any notes they may need while the room is dark. This lighting should be contained within the teaching station so as not to distract students from lectures or presentations.

Projection booths should have their own switched lighting to allow work and assistance within that room with minimal disruption to the lecture. The projection booth also should have a duplicate set of lighting controls for the seating and instructional areas.

6.2 Classroom Convenience Power, Communications and Audio/Visual Pathways and Power

6.2.1 General Power Requirements

All audio, video, and control electrical circuits should provide clean power circuit legs from a transformer free of high inductive loads. There should be no elevators or other large motors such as a compressor or blower, on the side of the power transformer that feeds the media equipment, classroom or lecture hall circuits.

Power poles shall not be used within instructional spaces in new construction. In remodeling projects, power poles may be used only when no other solution is viable and only after review and specific approval by the project manager and college.

In computer classrooms, power and data along the perimeter walls may be provided by two- compartment surface mounted wire raceway instead of a series of individual electrical and data jacks. Confirm the spacing of power outlets along the raceway. For data access to raceways, provide a 2" empty conduit at each end of the raceway on a single wall, and not farther apart than 20' centers. The raceway will stub into accessible ceiling space and then drop behind the raceway, allowing data wiring to enter the raceway through a 4" X 4" mud ring behind the correct raceway compartment. Confirm with the college whether the raceway is to be placed above desk top level or at normal outlet level.

In both regular and computer classrooms, power in the center of the room is provided through floor boxes. Confirm with college Information Technology whether data connections will be hard wire or wireless. If hardwire, provide this connection in the same floor box as the power (but with adequate and proper separation of outlets from data jacks, separation of wiring within the box, etc.) Provide a separate 1¼" empty conduit for data from each floor box, stubbed up into accessible ceiling space. DO NOT "DAISY CHAIN" data conduit between floor boxes. Provide and arrange floor boxes to allow multiple desk/seating arrangements within the room.

6.2.2 General Communications and Audio/Visual Pathways Requirements

All 90-degree elbows shall be "communication sweeps", and there shall be no more than three such sweeps (or more than 270° in offsets) between junction boxes. All conduit for audio/visual systems shall be 2" minimum, all conduit for data shall be 1¼" minimum and all conduit used solely for a voice/phone drop shall be ¾" minimum. The open conduit ends shall be fitted with a plastic bushing ring at the projector location.

Where lay-in ceilings or other easily accessible plenum space is provided, data and low voltage communications conduit may "daylight" into the accessible plenum area and need not run the entire route to the termination point. Confirm exact locations, clips/mounting rings for data and A/V jack terminations in wall or floor boxes, conduit and box size with College's technology staff. Cable tray in accessible ceiling areas, and 4" conduits over inaccessible or hard ceilings, shall be provided along major hallways and other routes holding significant amount of cabling or wire.

See the District's **Support Space Guidelines** at <http://www.maricopa.edu/facilitiesplanning/>, "For Campus and Community" pull down menu, for conduit/pathways requirements outside of instructional rooms.

6.2.3 Specific Requirements for Power, Communications and Audio-Visual Systems in General Classrooms

The college's Instructional Technology group generally is responsible for the design, specification, purchase and installation of audio-visual and technology equipment. The design team's responsibility is to work with the college to confirm location and placement of equipment and then design the proper power, termination boxes and cabling pathways for wiring. Conduit and box sizes, number and location shown below are basic recommendations and must be reviewed and confirmed with Information Technologies in Instructional Technologies for each installation during both design and construction documents phases.

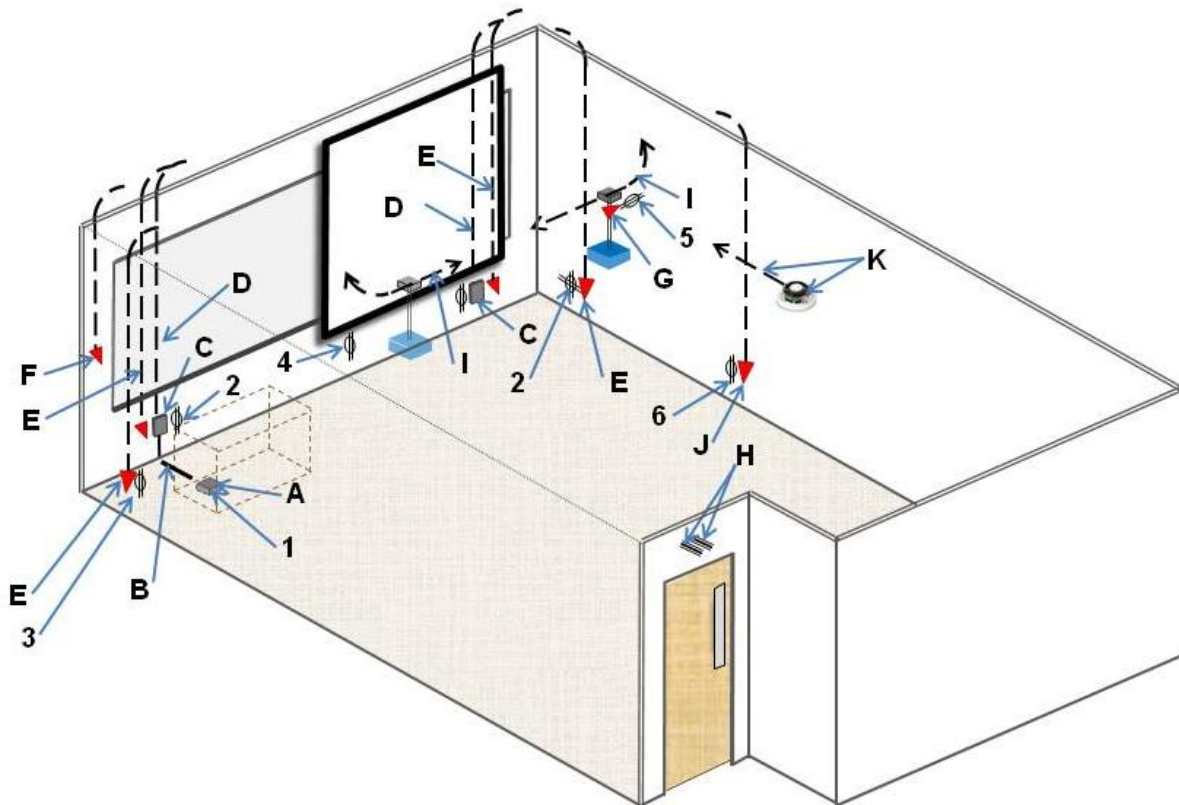
Each general purpose classroom and small(er) tiered lecture hall is set up with a primary instructor station to one side of the front instructional zone, with a second position located at the other side of the front zone. Generally, but not always, the projection screen is located on the side of the room opposite the primary instructor station. Also see **General Classroom Characteristics** for other coordination issues.

The following power, communications and data conduit/box information is a basic minimum. All conduit counts, sizes and locations should be confirmed for each project with the college's Information Technologies and Instructional Technologies groups. The following requirements may be altered only when specifically approved by these groups.

6.2.3.1 Power

The item number below refers to the following room diagram:

1. One fourplex outlet within the multi-service floor box served by a 1" conduit.
2. One duplex receptacle located next to each 6 X 6 box. One fourplex outlet located on the side wall at the secondary instructor station
3. One duplex outlet located on the side wall at the primary instructor station
4. One duplex outlet located at the center of the front wall
5. One duplex outlet mounted flush in the ceiling for each video projector. Mount this outlet 6" from the data/A-V outlet and within 12" of the projector support. CONFIRM if the college requires a fourplex outlet in this location. CONFIRM if the college requires this power outlet to have a switch located with the lighting controls at the instructor station. Clearly label the switch's function. The receptacle shall be on the same phase, and if possible, the same circuit, as the power for the balance of the A/V equipment in the room. This outlet may be mounted using a flexible "whip" conduit to allow the outlet to be moved as technology changes or the projector mount is adjusted.
6. One general purpose duplex outlet around the perimeter of instructional spaces at not more than 12-foot intervals. Provide at least one convenience outlet per wall. CONFIRM if the college requires additional outlets along the side or rear walls for additional computer locations.



6.2.3.2 Communications and audio/visual pathways

- A. Recessed multi-service floor box and mounting plates for data, network, coax and other audio-visual system plugs, jacks or receptacles. CONFIRM specific requirements with Instructional Technology for each location. Power wiring and outlets to be properly separated and routed away from low voltage and fiber systems. The large capacity, multi-service floor box is similar to Wiremold #RFB9.
- B. Three 2" conduits for audio-visual, one 1¼" conduit for data between the 6 X 6 wall box and multi-service box.
- C. 6" x 6" box (see note below) with finished cover behind the primary and secondary instructor location, mounted at normal outlet height, used as a pull through/junction box for data and audio-visual system wiring. A college also may use this box cover for mounting data and audio-visual system jacks. CONFIRM with Instructional Technology the size and use of this box; the alternate size may be to match a four, five or six gang wall plate configuration.
- D. Three 1¼" conduits stubbed to above ceiling for data and two 2" conduits stubbed to above the ceiling for audio-visual connection to the video projector. CONFIRM conduit size and counts with Instructional Technology. CONFIRM with Instructional Technology whether one of the 1¼" conduits should be extended all the way to the cable tray or main cabling pathway outside of this room for the primary data feed into the room. Also see Note I below.
- E. One data jack in a 4" X 4" gang box with 2" riser stubbed to above ceiling next to each of the 6 X 6 boxes and at the sidewalls at primary and secondary instructor locations.
- F. One telephone jack for a wall mounted phone with ¾" riser stubbed to above ceiling. Occasionally, this phone is located on the instructor desk- CONFIRM with Instructional Technology the final location of this phone. If the phone is located on the instructor desk, extend the ¾" conduit to the multi-service floor box.
- G. Network and audio-visual connections at each video projector location. CONFIRM with Instructional Technology the number of connections and boxes required. Mount boxes flush in the ceiling, 6" from the power outlet and within 12" of the projector.
- H. One 4" empty conduit with bushings on each end for cable passage through full height classroom walls. Provide an additional 4" conduit where there is heavy computer use in the room. Locate

the conduit on the pathway leading directly to the cable tray or main cabling pathway. Data and audio-visual vendors will seal this conduit after installing wiring.

- I. Where partial open ceilings are present or when requested by Instructional Technology, complete the 2" conduit system between the 6 X 6 wall boxes and the video projector location(s) so that all cabling is contained with conduit. Complete a full loop between boxes and projectors when more than one projector is present.
- J. Where requested by the college or Instructional Technology, additional data jacks with 1¼" riser stubbed to above ceiling at side or rear walls. CONFIRM counts and locations, and then whether providing two- compartment surface mounted wire raceway for both power and data will be more efficient.
- K. Ceiling speakers by the college's audio-visual system vendor. Where requested by the college or Instructional Technology and where lay-in style accessible ceiling is not present, provide j-boxes with blank cover plates (finish to match ceiling color), mounted flush with the ceiling, at each speaker location. Connect all boxes with ½" conduit, then looped to the projector a/v box.

NOTE: Some colleges prefer A/V equipment to be located within the instructor's podium, some prefer a separate free-standing cabinet/console, while others prefer to have the equipment located in a separate cabinet located behind or adjacent to the primary instructor location, or as part of the room's normal casework. If the equipment is located in a separate cabinet, confirm the location and coordinate it with the (C) wall box above. Located one box at the equipment cabinet and enlarge it to the 8" X 8". The box should be located as directed by Instructional Technology to be either within the cabinet or just above the equipment storage cabinet (with cables dropped through the top of the cabinet via an access hole and grommet).

7.0 Instructional Area Security

In addition to keyed *Classroom* function lever latch sets and closers where required, card access system at the selected main entry door of a building or to a specific room may be requested by the college. When provided, also provide door security contacts to be wired to the security system, including all other doors accessing the room. Additional CCTV and wall and/or ceiling mounted motion sensors in the room may be provided for rooms with highly valuable or dangerous equipment, materials, etc.

8.0 Instructional Space Furnishings and Equipment

Furnishings should be durable, appropriate in style and character to the learning delivery, and complement the building design. Student seating should be able to accommodate a variety of body sizes including heavy or pregnant individuals, and increased presence of older students. All furnishings should be able to withstand heavy use and abuse for a long life, and have ergonomic design to provide proper seating position, wrist support, writing height, etc. Colleges typically are responsible for the selection and purchase of all furniture for their projects.

For more flexible classrooms, stacking or folding/rolling chairs, drop leaf tables, portable small marker boards or writing pads provide the ability to reconfigure the room to multiple uses within the same class session.

8.1 Furniture

8.1.1 General selection and configuration

Classroom seating for both students and faculty should be comfortable and capable of accommodating the 5% to 95% ergonomic range of individuals. Where seating type differentiates between left and right handed users, left-handed seating should comprise 10% of all chairs in a classroom.

Accommodate wheelchair users according to the following ratios:

- 4 - 32 student stations: **1 seat**
- 33 - 50 student stations: **2 seats**
- 51 - 100 student stations: **3 seats**
- 100 - 150 student stations: **4 seats**
- >150 student stations: **1% to 2% of the total seats**, depending upon the historic rate of physically challenged users for the particular college

The location of wheelchair stations or areas should be planned so that a variety of positions within the seating area are provided as an integral part of any seating plan. These locations should be located to provide sight lines comparable to those for all viewing areas. They must adjoin an accessible route that also serves as a means of egress in case of emergency. At fixed tables, allow space next to locations for physically for an assistant or companion challenged.

Determine whether students will use only a notebook or use additional materials, such as calculators, laptop computers, multiple books, etc., when sizing the desktop, table station (width and depth) or tablet arm size.

8.1.2 Seating

A. Movable student seating for either fixed or movable tables:

1. Either upholstered, thermoplastics or polypropylene shells. No arms are required but may be included at the college's option. Articulating backrests often are preferred for additional user comfort.
2. Sled type bases are acceptable. Include stainless steel glides where chairs will be placed on VCT. Chairs with castors require a five-star type base. Adjustable height and tilt features are optional.
3. In science labs with 36" or standing height benches and tables, provide adjustable stool seating with foot ring/foot rest and backrest, without armrests. Provide bases with glides; **DO NOT USE** casters or wheels for stools at lab counter seating.

B. Fixed Seating and Tablet Arms at fixed auditorium type chairs

1. Provide a minimum writing surface area of 212 square inches, up to 280 square inches where laptop computer use will be prevalent.
2. Theater type lecture hall seats shall not be less than 20" in width with preference to 22". At least 90% of the seats should have a minimum seat width of 21 inches. Keep all seating not less than 39" and preferably 44" seat back to seat back to allow passage of students when writing surfaces are being used.
3. When used on tiered floors, seating should be secured to the riser face for ease of floor cleaning.
4. Specify a rattle-free tablet arm mechanism and reinforced supports to prevent breaking of the tablet arm when sat upon.
5. The left-handed arms shall be arranged along the left aisle (as viewed from the seating area) Provide at least 15% of chairs for left handed users.
6. Confirm with the college whether power and data connections must be provided at each/some chair locations.

C. Instructor Seating

1. Provide an appropriate height chair including seat back and wheel/caster base at the teaching/control instructor station for the instructor.
2. Coordinate the finish detail of the instructor's chair with the other room furniture.

8.1.3 Desks and Tables

A. While not used very often at Maricopa, moveable sled desk seating shall have:

1. Tablet desks with a minimum writing surface area of 375 square inches, 450 to 475 square inches preferred (a full chair width writing surface).
2. Book storage below seat.
3. Swivel or self-leveling guides, or sled type base.
4. Thermoplastics or polypropylene seat shells
5. A mix of chairs for both left and right handed students
6. Size the chair and clearance to the attached desk to allow for large, heavy or pregnant students.

B. Movable Tables

1. Provide a minimum station width of 30 inches per student without interference from table legs or supports. Where computers are used, provide a minimum width of 36 inches per station. Students often work in groups and require adequate width per station.
2. Supports can be either four-legged/corners or a cantilevered two leg design. All tables should be sturdy, resistant to wear and able to support heavier students leaning/sitting on the desk top. Folding or stacking tables should have wheels to allow rapid reconfiguration or storage.
3. The work surface height of tables shall be 29" - 30" where no computers are present or 26" to 30" with computers, unless a separate keyboard tray is provided under the table top. Provide an adjusting height table or higher table for wheelchair users.
4. Moveable seminar type tables shall provide a minimum depth of 20 inches where no computers are used, and 24 inches where computers are used.

C. Fixed Tables

Fixed tables are part of the General Contractor's package and are not to be provided through FF&E.

1. DO NOT use attached or swivel-mount seating in conjunction with fixed tables; all seating is loose, movable chairs.
2. Provide seating widths without interference from table legs or supports.
3. Where group work is anticipated, two rows of tables will be located on a single tier, allowing the students at the forward table to turn around and work in groups with the students at the rear table. Provide additional depth at the rear table to allow knee space at the front edge. (see recommended details and design in this Guide)
4. Normal table depth to be a minimum of 18" front to back (with an additional 12" added for group work situations). Provide front modesty panels, except at wheelchair positions where the panel may prevent a wheelchair user from getting close enough to the writing surface.
5. Supports can be either support posts or cantilevered leg design. All tables should be sturdy, resistant to wear and able to support heavy students leaning/sitting on the desk top. The work surface height of tables shall be 29" - 30" except at ADA stations where additional clearance may be required. Provide heavy PVC resilient "T-spline", not laminate or wood veneer, on the edge of the work surface for durability.
6. Fixed continuous tables shall have power and also may have data capability specified at student stations. (Confirm data connectivity needs with the college and whether these services will be hard wired or wireless.) Supply and coordinate power (and data) wire routing and management under the table surface, and hard connections from floor boxes. Conduit and cable shall be run within or attached to support legs, not "free-air" that is subject to damage from impact, kicking, foot resting, etc.

D. Tabletop lecterns or full size podiums shall provide a surface of 24"w x 18"d minimum.

E. The instructor station or desk comes in many configurations and sizes, with a variety of features. These will vary from as simple as a normal desk with computer, to free standing lectern/stations to nearly unmovable podiums containing audio-visual equipment. Confirm with each college their preference. Locate the instructor station a minimum of 3'-6" clear distance between the front wall and the rear face to allow seating and circulation behind the station. Most colleges have a preferred station model that will accommodate audio-visual equipment, data and power connections, storage, and work surface. Instructor stations should be located at the side of the room, not in the center.

8.2 Markerboards and Tackable Surfaces

Provide marker boards on the front instructional wall, both sidewalls of general-purpose classrooms and tiered lecture rooms, and on **all four walls** of learning studios. Marker boards should cover as much of the instructional wall as possible. Chalkboard use is rare but occasionally occurs by special request. Movable or

sliding multiple boards may be appropriate in some instructional spaces, especially in larger tiered and lecture rooms. Some colleges have opted for Wall Talker "Erase-rite" wall covering, a vinyl wall covering material used for both a marker surface as well as projection screen surface.

Fixed marker boards and tack boards are part of the General Contractor's package and are not to be provided through FF&E.

- A. Markerboards shall be white.
- B. At the front wall of the instructional space, the minimum area of marker board should be 4' by 16'. In some academic areas, two 4' by 12' marker boards may be requested on the main instructional wall. Place a 4' by 12' marker board centered on each sidewall of classrooms and tiered space. In learning studios, provide a 4' X 12' markerboard on the rear wall as well. The bottom of the board shall be 3'-0" above floor.

Where Wall Talker or similar vinyl wall surfacing products are used, (a) provide a finished, Level 5 smooth, flat wall surface (no texture) behind the vinyl material (b) select the proper finish on the vinyl for both marker use and projection image reflectivity (c) provide metal trim along all edges and a standard marker/eraser tray at the lower edge and (d) properly configure the vinyl material for both marker board use and projected image size.

If the height of the applied material is wider than the roll width, install rolls with horizontal seams to minimize gaps or bumps within the primary writing areas.

If the material also is used for an oversize projected image, consider an inverted T configuration to accommodate the taller projected image:



- C. Marker boards with permanent gridlines, music staves, graphing coordinates or other markings may be appropriate when a classroom either will be used 100% for the specialized academic area OR is provided with enough plain marker board area to allow other general purpose instruction.
- D. Provide a continuous chalk tray, top map/tack rail with end caps plus one movable map hook for each 24" of board length rounded up to an even number. Provide one flag holder per room.
- E. A 48" by 48" tack board may be placed adjacent to the classroom entry. Additional tack boards may be placed at the ends of the white boards to allow pin up space for group work.
- F. At the user department's request, a tack board (confirm size with users) inside a lockable display case can be provided directly outside of a classroom or lab, or in adjacent social/study areas to post grades, test answers, messages, etc.
- G. For multiple layer/sliding boards, provide a solid sill so that the second and third boards slide upward. The writing surfaces should be from 36" AFF to 84" AFF. Clearances above the board should be large enough to allow the secondary boards to fully clear the primary writing area. When horizontal sliding units are used, no movable panel or remaining space should be less than 6' wide. In both vertical and horizontal units, provide rubber stops to prevent moving units

from crushing or shearing fingers between the moving boards or between moving boards and frames/sills.

H.. Smaller, portable white boards and/or paper pads may be provided in classrooms where small group work, brain storming, project development, etc. takes place regularly. These are standard in learning studios and are part of the FF&E package.



10.0 SAMPLE INSTRUCTIONAL SPACE DESIGN AND REQUIREMENTS

Definitions

- A. General-purpose Instructional Spaces:** A formal instructional space, typically up to 32 students (occasionally up to 40 to 45 students for two classes or larger sections) that supports a variety of academic disciplines, uses and seating arrangements. The general-purpose classroom is the most common, basic instructional unit. Laptop computers and data connection ability (wireless or hard wired data jacks) are common in general purpose rooms. Maricopa uses either a more traditional single front classroom or a multiple front learning lab configuration.

This classroom type also can be used for computer classrooms/small computer labs, **Computer-based Instructional Space**, either with additional size or smaller number of student stations in the same floor area, and for distance learning. These rooms use computers for nearly all instruction and have enhanced data/video projection capabilities and data connectivity. User-friendly laptop connection or a permanent computer is installed at all student seats and the instructor location(s).

In both types of instructional spaces, a DVD player and/or other input device, and capabilities for other add-on audio/visual equipment are provided at the instructor station or adjacent A/V cabinet, feeding the overhead projector(s). Projection screens and at least one video projector is standard within all Maricopa instructional spaces.

- B. Tiered/Case Study Instructional Spaces:** A tiered space with a capacity of approximately 40 to 100 students. Once classrooms reach about 40 student capacity, views of the marker boards, projection screens and instructor, as well as eye contact between students and the instructor, become more difficult due to the size of the room and the number of heads in the way. There are examples of flat floor classrooms at 40 to 50 student seating, but at this capacity level, strongly consider elevation changes in the room to improve sight lines and discussion between students. Placing two rows of desks on the same tier, as shown earlier in this guide, allows group work between students. Audio-visual equipment is similar to the general-purpose classroom, often adding an audio system. Tables are tiers generally are fixed and may be configured as a more open type crescent seating form or more closed “U” shape, depending upon the amount of student to student interaction and eye contact is desired.
- C. “Traditional” Tiered Lecture Hall and Conference/Training Tiered Spaces:** A more formal, tiered teaching space with a capacity of 100 to 200 students that is most suitable for traditional lecture format, multi-media presentations, training/conferences, performances, basic distance learning and demonstrations, or where instructional presentation is primarily a dialogue or monologue between the instructor and student. The level of technology and audio-visual equipment shall be confirmed with the college on a room by room basis but typically is upgraded to allow distance learning (receiving and origination) and more advanced types of presentation.
- D. Auditorium:** A tiered or sloped floor teaching space with a capacity that generally exceeds 200 students and is most suitable for traditional lectures, multi-media presentations, receiving or originating distance learning and demonstrations. Typically, auditoriums are multi-use (and at the community college level, rarely having their primary use for instruction) and may have a variety of needs in addition to those required for basic instruction. Room shapes vary from rectangular to semi-fan shaped to create better viewing lines to projections screens and improved acoustical properties. The level of technology necessary shall be confirmed with the college. *Because community colleges generally prefer limited class sizes, no guidelines for instructional use are provided for auditorium spaces. Specific needs will be developed on a case-by-case basis.*

The following requirements are **IN ADDITION** to the General Guidelines above.

10.1 GENERAL PURPOSE INSTRUCTIONAL SPACES (20 to 32 Students; occasionally up to 42 students)

USE

This room is used for typical section size classes in general instruction. Class section size can vary by discipline up to 32, 36 or 40 students. Confirm counts, uses and needs with the primary user department and college during programming. In order to maintain schedule flexibility and college, rather than department, ownership of instructional space, general purpose classrooms should NOT be designed to limit their use to a single discipline or course.

The flexibility allows these spaces to be used for many types and sizes of courses. One- or two-person tables with loose chairs (or occasionally sled desks) are used so that students can easily move furniture for various purposes and activities during the class session. Furniture type and configuration must be considered early in the design process. Class sections with fewer than 24 students can use the larger, 24 to 30 seat general-purpose classroom rather than providing smaller less useful seminar rooms.

Learning Studios

A recent evolution of the traditional general purpose space is the “**Learning Studio**”, sometimes called a “Collaborative Classroom” at other institutions (*all instructional space at Maricopa is considered collaborative!*). Building on designs and research by Dartmouth College, Stanford University, Project Kaleidoscope, and North Carolina State’s SCALE-UP project, the District’s Estrella Mountain Community College pioneered our version to explore more effective approaches to the traditional classroom learning environment. The studios provide faculty and learners an opportunity to experiment with flexibility in space, furnishings, and technology.



Before



Typical Learning Studios



The **Learning Studio** is nearly square, allowing multiple instructional zones, projectors and screens but no single “front” of the room. The studio requires slightly more square foot/student than a conventional general purpose classroom. Seating can be a wide variety of arrangements and types, including informal soft seating. Tables with fold down tops and rolling/“nesting” chairs are common, allowing the room to change configuration and seating capacity rapidly.



Whiteboards are provided on all four walls, often including a Smart Board. More video projectors and screens are used, often one on each wall or in each corner. Upgraded audio-visual systems and computer connectivity are common. Nesting/rolling tables with folding leaves or tilt-tops commonly are used to allow rapid reconfiguration and storing tables against side walls. Portable small white boards and paper pads are used to encourage small group work and brain storming.



Room Area and Affiliated Spaces

Classroom Area

Regular classrooms: recommended minimum of 23 NSF/Student, to a maximum of 27 to 29 NSF/Student, with minimum capacity of 24 students, 32 students preferred for minimum size, generally yielding **750 to 850 square feet** for the typical classroom.

Learning Studios: recommended minimum of 32 NSF/Student, to a maximum of 36 NSF/Student, with capacity of 24 students to 32 students preferred for minimum size, generally yielding **925 to 950 square feet** for the studio classroom.

While larger than code occupancy requirements, rooms in the 21 sf to 23 NSF/student size result in crowded conditions, inadequate circulation, too little room at the front of the classroom for the instructor station or poor viewing angles of the projection screen. The 750 sf to 850 sf size allows better seating arrangements and circulation, as well as the ability to use different types of furniture, re-arrange the furniture for smaller break out groups during classes, etc. The largest "learning studio" size allows a larger variety of furniture sizes and types primarily aimed at group activities. Smaller class sections can use a larger room if needed.

Vocational or occupational content programs that have needs for larger pieces of equipment, demonstrations, role playing, etc., need larger classrooms, often in the 27 NSF/student to 35 sf/student size, with some as high as 50 sf to 60 sf/student per student, depending upon the exact needs and instruction that will occur.

Examples of existing facilities for comparison are:



36 seats at 20 NSF/student
(too tight for 36 seats at 720sf)



30 seats at 22 NSF/student
(still pretty tight at 660 sf)



32 seats at 24 NSF/student
(785 sf; 675 sf for 28 seats)



36 seats at 25 NSF/student
(900 sf)



35 seats at 26 NSF/student
(910 sf)



32 seats at 27 NSF/students
(864 sf)



29 seats at 27 NSF/student
(778 sf)



35 seats at 35 NSF/student
(1210 sf)

Learning Studios



32 seats at 29 NSF/student
(930 sf)



24 seats at 33 NSF/student
(795 sf)



32 seats at 29 NSF/student
(930 sf)

Storage

Provide each classroom with either a full height storage cabinet (in FF&E if free standing) or small built in counter with lower cabinets; upper wall cabinets or a sink may be added by college request. All doors must be lockable. Some colleges also request a backpack cubby near the door.

Elements Needed

A/V and Information Technology

Must including projection screen(s) a part of the design and construction team's basic work. Additional permanently installed audio-visual equipment, such as an instructor and student computers, video projector(s), DVD player or document camera at the instructor console, may be included.

Many classrooms have lap top computers, some at one per table, many with one computer per student. Computers may be secured to tables and left in place or stored on portable charging cart to allow movement between rooms.

Flexibility and ability to accommodate growth in technology in the future, particularly in terms of networking is an important part of room design. Room design must accommodate for increased use of wireless technology. Flexibility and potential growth for technology are important design elements. If budgets allow, provide recessed data and power floor boxes in several locations around the room to accommodate computer connections.

10.2 COMPUTER BASED INSTRUCTIONAL SPACES

(24-32 Students with permanent computer installations at each student station)

Use

Computer classrooms are distinguished from other open computer labs and learning assistance centers that are open use or one-on-one assistance/tutoring that have different space, orientation and features. With the growing use of lap top computers in regular classrooms, fewer and fewer computer based classrooms are being provided in Maricopa facilities.

Computer based classrooms need more desk top space and consequently, more total space for the same number of seats than a regular classroom. Computer classrooms generally have regular computer consoles, detached monitors and keyboards as opposed to lap top computers used in most regular classrooms. Additional space is needed for printers and adjustment of student sight lines over/around/through desk top monitors.

Multiple seat tables or desks are commonly used, with the processors set either on top of or below the table top, depending upon college preference. If set below the desktop, provide carriers or slings so that processors don't sit on the floor and can be moved easily for service and access. If the desk top is not at proper hand elevation for good ergonomics, a movable keyboard tray should be provided.

If the instruction is predominantly computer based, lap top computers or monitors recessed into/set below the desk top and seen through a glass panel generally provide poor ergonomics.

Room Area and Affiliated Spaces

Classroom Area

Recommended minimum of 28 NSF/Student, maximum of 35 NSF/Student, with minimum capacity of 24 students, yielding **850 square feet** minimum for the typical computer classroom. For lower seating capacities, use the upper end of the space per student range. The slightly larger classroom allows better set up and circulation, especially allowing the instructor to reach each student, as well as room for ancillary equipment such as printers. Printers may be located at ends of table rows, separate tables or on the counter of the storage unit.

Examples of existing facilities for comparison are:



24 seats at 27 NSF/student
(too tight at 650sf)



30 seats at 28 NSF/student
(840sf, note the high ceilings;
8" raised instructor platform)



36 seats at 34 NSF/student
(1210 sf)



20 seats at 35 NSF/student
(700 sf, could add more stations)

Architectural features, proportions and configuration

Configuration, doors, finishes and ceiling heights per the General Guidelines, often with a wider 3:2 ratio oriented to the instructional area at the front of the room. Provide a flat floor with low static carpeting. Low rise raised floor has been used in some computer classrooms but the justification for this is reduced as more data is delivered through wireless systems. Power connections still must be provided for each computer, generally through a combination of floor boxes or wiremould along perimeter walls. If lowrise raised flooring systems are used, they should be recessed onto a depressed slab to eliminate the need for steps or ramps into the classroom area.

Higher ceilings (10 feet minimum) often are required to allow the use of direct/indirect light fixtures and better viewing angles for the projection screen above/between the monitors. Where rooms have intense and constant computer use or monitor screens sit on top of the table, an optional room configuration is to provide taller ceilings (to 12 feet) with the projection screens mounted above the marker board, and providing a one step up raised instructor platform to improve sight lines to the screens and instructors. Design the room to allow an ADA compliant ramp to be added for the platform should the need arise.

Elements Needed

Furniture

Student station size should allow adequate space to the side of the monitor for notebooks, workspace etc. Tables should include cable management trays or channels, adjustable keyboard/mouse tray to achieve proper ergonomics, and hanging/rolling CPU holders to keep the CPU's off the floor. Allow one computer per student station along with room next to this primary seat for a second seat allowing some group/cooperative work. Some colleges have used desks that allow monitors to be recessed below the table top, but this often leads to neck and eye strain due to constant movement. Colleges also may use a desk type that allows the flat screen monitor to drop into a slot at the rear of the desk and store when not needed.

Where printers are located in the body of the classroom, provide longer tables at the aisle or smaller individual tables.

Storage

Provide each classroom with either a full height storage cabinet (in FF&E if free standing) or small built in counter with lower cabinets; upper wall cabinets or a sink may be added by college request. All doors must be lockable. Some colleges also request a backpack cubby near the door.

A/V and Information Technology

Same as general-purpose classroom, including the flexibility and ability to accommodate growth in technology in the future. In nearly all computer labs, hard wire data connection to each computer is required vs, wireless. Confirm this choice with college Information Technology.

Acoustics

Design room acoustics for optimal speech intelligibility as well as to account for increased equipment hum and fan noise.

HVAC Systems

Take into consideration greater power and cooling needs from the computers, monitors and printers, with growing loads for each new generation of computers and other ancillary equipment. Provide additional cooling capacity for the room for these future loads.

Lighting

Using combined direct and indirect lighting, or alternate fixture design, to provide adequate lighting on work surfaces with low/no glare on computer screens.

Electrical/Communications

Provide one duplex outlet per computer plus standard duplex receptacles other walls. Some colleges prefer a plug strip to distribute power under computer tables- if so, provide higher amperage floor/wall outlets for the plug strip. Provide and size circuits, electrical panels, etc. for growing power loads with each new generation of computers and other ancillary equipment. Provide additional blanked circuit capacity in the electrical panel serving the room.

See the District's Support Space Design Guideline for information on cable tray/baskets, conduit from floor boxes, etc. under **Facilities Requirements: DATA/AUDIO-VISUAL/SECURITY/LOW VOLTAGE WIRING CONDUIT and CABLE TRAY** at

<http://www.maricopa.edu/facilitiesplanning/campcomm/index.htm>

Where under-floor duct power and data distribution systems are used, provide adequate separation of data and power pathways, including separation at crossover points. Where low-rise raised floor is provided, consult with the college's Information Technology to obtain the proper floor box specifications for power and data. All power and data floor boxes should be installed at the end of a minimum six-foot long flexible conduit to allow quick relocation of floor panels without needing to rewire or bring in an electrician. Under floor data wiring will be run exposed in low profile wire management systems.

10.3 TIERED/CASE STUDY INSTRUCTIONAL SPACES **(32 to 100 students)**

Use

The tiered/case study Instructional space is a variation of the general-purpose classroom intended for larger section sizes and/or requiring better viewing sight lines. The use of the tiers for student seating provides better visibility of the instructional walls and instructor and better interaction between students than flat floor or straight desk row arrangements.

Tiered seating "horseshoe" configuration may vary from a broad, open "C" to a narrower "U", depending upon the typical student-to-student, and student-to-instructor interaction expected by the discipline. In tiered

spaces, furniture typically is fixed tables and movable chairs, with each student station being provided with a computer data connection (if wireless is not used) and power. The trade off of using tiers is that the flexibility of changing furniture configuration or orientation is lost versus a flat floor. Consequently, some colleges or courses may elect to stay with flat floor classrooms for up to 40 to 48 students.

Recent designs provide better support for small group work by providing riser tiers deep enough for two rows of tables, and providing the rear table on the tiered with an extended front edge work surface. Students in the front row of the tier can turn around to work in groups with the students in the second row and be at the same level. An important design consideration in this proposal is the sight lines to the marker boards and instructors and may require laterally off-setting seats so that students are not looking through the heads of the students in the same level row ahead of them.

A second design, pictured below in the Examples, is the use of straight risers with movable tables and chairs. Some limited rearranging of furniture for group work is possible.

Room Area and Affiliated Spaces

Classroom Area

Recommended minimum of 24 NSF/Student, maximum of 30 NSF/Student, typically with minimum capacity of 40 to 48 students, yielding **1,000 to 1,150 square feet**. If the room requires a large demonstration table or instructor's area, such as in a science lecture (example at the right below), the room may require more space for the larger instructor/demonstration table. Seating capacities for classrooms from 50 to 100 seats can be achieved in tiered rooms, using curved configurations, **27 NSF/Student to 30 NSF/Student** yielding various total sizes depending upon the seat count and whether an extended front work surface/"Maricopa Tier" design is used.

Examples of existing facilities for comparison are:



32 seats at 27 NSF/student
(875 sf)
(straight tiers w/ movable tables)



40 seats at 25 NSF/student
(1,000 sf)



48 seats at 24 NSF/student
(1,152 sf)



48 seats at 23 NSF/student*
(1,115 sf)
(not a "Maricopa Tier" design)



48 seats at 29 NSF/student
(1,421 sf)



50 seats at 27 NSF/student
(1,340 sf)



66 seats at 30 NSF/student*
(2,000 sf)



72 seats at 21 NSF/student
(1480 sf)
(modified "Maricopa Tier" design with two rows per tier, no front edge extension at rear row)



100 seats at 28 NSF/student*
(2,760 sf)

**These designs were done as retrofits into existing buildings, so the NSF/Student may not be entirely representative of a location where the layout doesn't have to work around existing columns, etc.*

A separate A/V equipment room generally is not needed. An optional 100 to 300 square foot combined room may be provided at larger tiered rooms to provide storage to support multiple course or discipline use of the room.

Architectural features, proportions and configuration

Configuration may range from nearly square to the 3:2 proportion of general-purpose classrooms, depending upon the seat/table/riser configuration. Side aisles plus a center aisle(s) are preferred for easier circulation and instructor observation during exams. Ceiling heights generally will be higher and vary to accommodate the tiers, acoustics and view lines. Floors most likely are stepped. *(note: In the 48 and 49 seat Examples above, the floor is flat but with the seating positions carefully designed to avoid blocking view lines to the instructional wall. These also could be done as tiered rooms in the same area and configuration, but would have to deal with grade changes at entries and exits).* Doors in tiered rooms may occur at either the back or the room or toward the front of the sidewall of the room, depending upon whether the instructor area is at the main floor level or the top row of seating is at main floor level. The most common design is to enter the room at the instructional zone/front level and then step on seating tiers to allow wheelchair access to both student seating areas and the instructor area.

Elements Needed

Furniture

Fixed tables are typical and provide the greatest safety. Two person movable tables with chairs also may be used at the college's option with shallow/low height tiers. Tables of either kind should have integrated power and data jacks unless wireless is used with wire management capability. Wheelchair accessible station(s) must be provided. The instructor station may be either a movable 30-inch by 48-inch desk or larger fixed podium integrating the audio-visual equipment. A standing height or tabletop lectern also may be provided.

Storage

If a separate storage room is not provided, include either a full height storage cabinet or small counter with cabinets for storage. All doors must be lockable.

A/V and Information Technology

Carefully locate, coordinate and integrate the main power and data feeds for the student stations at supports of the fixed tables. Do not allow unenclosed flex cable from the floor to the table top- it will be damaged or knocked loose by chairs or students. Room design must accommodate for wireless technology for students and hard wired connections for the instructor. Larger rooms may have multiple video projectors and screens, and a supplemental audio system for the A/V system.

Markerboards and Tackable Surfaces

Two twelve foot by four foot markerboards at the front instructional wall at a minimum. Many of the tiered rooms are including sliding or rising segments to provide more writing surface, or full wall "Wall Talker" material at the front wall. Provide at least one 4' X 10' whiteboards at each sidewall for group work. Include a tackable board adjacent to the main door.

10.4 "TRADITIONAL" LECTURE HALL and CONFERENCE TIERED SPACES **(50 to 200 students or larger)**

Use

This is a traditional lecture room layout that is not used any more in a purely instructional setting, where a smaller tiered or cooperative learning model is prevalent. This type of room configuration generally has an equally important use for performances or presentations, distance learning or conference seminars. A sloped or tiered floor is required to achieve good sightlines from all seats.

Older style rooms generally are a deeper than wider rectangular shape, with all seats and rows parallel to the front wall. Seats either are theater type with folding tablet arm writing surfaces or hard shell seats with fixed tablet arm writing surfaces. Newer large tiered spaces have become state-of-the-art rooms that also serve as training and conference centers for the college. These rooms have an upscale appearance and are intended for use both by regular college classes, public meetings and professional training sessions. These rooms typically are more fan-shaped in plan, with broad, curved tiers furnished with fixed tables, movable chairs, computer access at each seat and upgraded audio-visual systems. Their configuration and appearance create an environment more conducive to demonstrations, dialogue, distance learning (both originating and receiving), upscale presentations and multi-purpose/small performance uses. Last, another recent version, intended primarily for fine arts or speaking presentations, are set up with stepped curved tiers and theater seating with tablet arm writing surfaces. Large performing venues, like the District's performing arts centers, rarely are used for lecture instruction and are excluded from this Guideline.

Room Area and Affiliated Spaces

Seating/Instructional/Presentation Area

Recommended minimum of 10 NSF/Student (for larger halls with traditional auditorium type seating) **to 25 NSF/Student** (for moderate size halls intended for case study, professional training, etc.), both exclusive of any additional wing space off the lectern area or a projection room. Room size is highly dependent upon the proposed uses, configuration and function, as shown in the examples below. Rooms of this type most often are used for seating capacities exceeding 50 students. The smaller tiered, case study classroom described in 10.3 above better serves capacities up to 50 students, and are more conducive to an active learning and instruction.

Examples of existing facilities for comparison are:



165 seats at
9 NSF/seat
(1,440 sf)



70 seats at 16 NSF/seat
(1,085 sf)



50 seats at 16 NSF/seat
(772 sf plus
75 sf projection room)
(theater seats w/ tablet arms)



100 seats at 14 NSF/seat
(1,345 sf)



100 seats at 24 NSF/seat
(2,375 sf plus
75 sf A/V control room)

Number of Accessible Seating Spaces: 51 - 100 student stations: **3 seats**
100 - 150 student stations: **4 seats**
>150 student stations: **1% to 2% of the total seats**

At larger seating capacities, provide a variety of seating locations for the physically challenged users, including adjacent space for learning assistants or companion.

Lectern and instructor area: Confirm that adequate space, circulation and room for/in/and around the lectern is provided, particularly in smaller halls. Often, these areas also are used for larger scale instructional demonstrations, performances, etc.

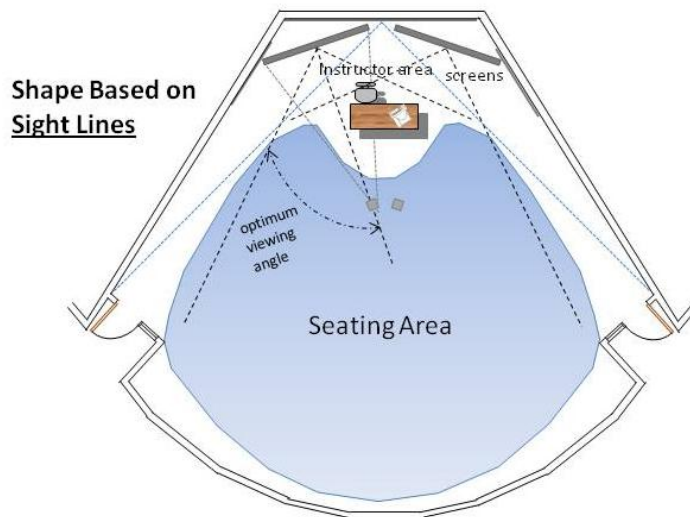
Affiliated Spaces:

- Vestibules are strongly recommended at main entries to larger halls in order to reduce noise and light from coming into the room, and prevent audio systems sound from leaving the room.
- Separate Audio/Visual equipment or control room: Optional, but recommended, where upgraded audio-visual systems or distance learning is provided. Start with 50 sf to 100 sf for programming and confirm with actual equipment and rack layout. Doors into control rooms may either enter through the instructional area if separate staff is intended to operate the equipment, or enter

through the instructional area if the faculty will be responsible for set up or operation of limited equipment.

- c. Adjacent breakout rooms and supplemental areas: If the tiered room is intended to serve as a conference center or training room, additional supporting spaces that also serve general college needs may be provided. Located immediately adjacent to the tiered room, these can include:
- small 4-6 person break-out/discussion rooms (+/- 100sf) that serve as small conference rooms, group study or small computer labs when not in use for break-out
 - kitchenette for coffee, set-ups or food prep
 - study and informal social areas set up with movable tables and chairs for breaks and eating. Spaces set up with movable tables and chairs serving as meeting break space as well as student social space and informal instructional spaces, particularly if vending machines are included in the area. Include bulletin boards at main access points or near vending machines, and even a small white board in the area.
 - larger circulation areas outside of the hall to allow for pre- and post-function activities, registration, etc.

Architectural features, proportions and configuration



Good sight lines, acoustics and the need for dialogue rather than lecture in modern larger lecture halls generally produces a tiered floor with a modified fan-shaped plan versus the more traditional deeper rectangular space. Student seating should be arranged no more than 45 degrees off the center axis of the room to provide good viewing angles from all seats (see **Viewing Based Seating Location Guidelines** within the Audio-Visual Systems section for optimum configurations and distances).

In no case should a student be required to view a projected image from a line-of-sight angle more acute than 30 degrees to the projection screen or lecture position.

Concept diagram originated by "Design Guidance: Learning Environments",
University of Cincinnati

Suggested depth of the room should be no greater than 1.5 times the width of the room, measured at the centerline of the seating area. Floor and view slope should be designed to achieve optimal viewing angles to board surfaces and audio-visual display. Placement of aisles should be sufficient such that an instructor may walk around in the seating area to proctor a test (i.e., can easily see each and every seat), but may be either "Continental style" or broken with internal aisles. Either stairs or sloped aisles may be used, though stairs are most typically found due to the required slope.

Doors in tiered rooms may occur at either the back or toward the front of the sidewall of the room, depending upon whether the instructor area is at the main floor level or the top row of seating is at main floor level. Student access from the rear of the room is preferred to minimize interruption by late arrivals. If possible, provide a separate entry to the instructor/stage area of the room if normal entries are located in the rear. If the instructor presentation area is located below the hallway/entry level, it also may be useful provide a wide ramp and extra wide door to the stage/lectern area to allow equipment and other large items to be brought in for training and lectures.

Ceilings in smaller lecture halls should be at least 15 feet high at the front of the room and at least 9 feet high at the rear, above the rear tiered level to allow proper viewing of projected images and improved acoustics. Consider that in larger lecture halls, it may be desirable to place the bottom of the projected image at the top of the marker board (7' AFF) so that the instructor will not walk in front of the projected image; however, the elevated viewing angle of those seated in the front/lowest rows also must be proper. In this example, our guideline recommends that the height of the projected image be 1/6th the distance of the

farthest student from the projection screen. Thus, if the farthest student is 60 feet from the projection screen, the height of the projected image is 10 feet and makes the ceiling height at the front of the room at least 17 feet.

Since lecture halls generally do not have windows, extra care must be given to the use of interior finishes, colors, and décor to provide visual interest to the room. The use of sidewall dimming fixtures and aisle lighting also may be considered.

Other finishes are per the General Guidelines.

2.2.4.4 Elements Needed:

A. Furniture

Fixed tables are typical where the room's use is predominantly for instruction or training, but this arrangement requires more square feet per seat than theater style seating. Tables also are preferred when the instructional topic requires the use of textbooks along with notebooks, computers or calculators. Tables should have integrated power and data jacks with wire management capability, along with wireless capability for data. Loose chairs with wheels, comfortable seating and articulating back typically is used; arms are optional, but if used, a small number of chairs must be provided with arm adjustment to allow for larger individuals.

Where rooms are used for a variety of uses, including performance, **and** student needs are limited to notebooks and calculators, theater style or hard shell seats, with fixed or movable over-size tablet arms may be used. The college should confirm seating and desk type for each application.

The instructor station may be a movable 30-inch by 48-inch desk or, more often, a larger podium/unit with stool type seat for the instructor. An additional portable standing height or tabletop lectern also may be provided. Placement the instructor desk, podium or console should be a minimum of 8' from front wall for the width of the front wall, and not conflict with student seating sightlines to the marker board(s) and projection screens.

B. Storage: Separate larger general storage rooms often are added immediately outside the room. A smaller storage room serving instructional needs may be off the side of the lecture area.

C. A/V and Information Technology: Carefully locate, coordinate and integrate the main power and data feeds for the student stations at supports of the fixed tables. The power wiring harness shall be enclosed in a wire trough below the countertop with a metal divider to separate power from data cables. Room design must accommodate for increased use of wireless technology.

Provide two electric projection screens with recessed mounting into the ceiling. Locate switches for the screens on the wall closest to the instructor console, if the screens are not operated through the A/V system controls. Use of two fixed, aluminum framed, vinyl screens, located above the white boards also may be considered. Multiple video projectors and significantly upgraded audio, visual and lighting and assisted listening systems are typical in these spaces. Early consideration and planning for these systems is critical to the room design and infrastructure.

Additional services that may be relevant to the room's use include facsimile, phone or computer in a side stage area for communication in distance learning, compressed gas or special power in floor boxes in the stage area for equipment use/demonstration, etc.

Consider providing locations for recording cameras, whether initially installed or not, at the rear and sides of the room, above the instructor positions, facing the instructor position, etc.

10.4.1.1 Considerations

10.4.1.2 Acoustics

Acoustics are one of the most important features in good lecture hall design, and the use of specialized acoustical consultants for this area is required for either new rooms or modifications to existing lecture rooms. Design room acoustics for optimal speech intelligibility, taking into consideration any secondary uses of the room. All surfaces in the room should be studied, shaped, and tested integrally with the design of the floor plan so that amplified voice systems will augment, not replace, the natural voice volume.

The ceiling, side and back walls are critical elements in assuring that the sound in the room is distributed evenly and at appropriate loudness and reverberation times to all portions of the seating area. A sloped or stepped ceiling should act as a sound mirror, reflecting sound downward to blend with the sound from the speaker system. The ceiling usually is combination of hard, reflective surfaces and softer, acoustically absorbent materials. If the ceiling has too much sound absorbent material, the loudness will diminish at the back of the room. To enhance the instructor's voice projection, the ceiling typically is hard-surfaced nearest the instructor, and tilted at an angle from the ceiling to the front wall, similar to the ceiling of an orchestra shell.

10.4.1.3 Markerboards and Tackable Surfaces: Two twelve to sixteen foot by four foot marker boards at the front instructional wall, per the General Guidelines. Where additional board space is requested, add vertical or horizontal sliding boards. One tackable board per the Guideline adjacent to the main door

10.4.1.4 HVAC Systems: Per the General Guidelines. Also provide adequate cooling to high heat load projection and equipment rooms, also allowing for larger future equipment loads

10.4.1.5 Lighting: Three to four zones, per the General Guidelines. Provide a minimum of three dimming zones - Zone 1 for the front two rows of light fixtures above the seating area, Zone 2 for the middle two rows of light fixtures and Zone 3 for the remaining light fixtures. Locate dimming controls on the wall closest to the instructor console or combine with the A/V control panel. A fourth lighting zone, with special lighting to illuminate white boards, maps or charts may be required. Such lighting shall be zoned separately. For larger rooms, consider adding aisle lighting.

10.4.1.6 Electrical/Communications: Per the General Guidelines. In addition to outlets for the seating system, provide general room perimeter outlets.

Sources and Credits

Many colleges and universities produce *Instructional Space design guidelines*. Higher education institutions often use these web posted guides to compare/confirm other institutions' requirements to create their "best practices" approach. We've cited sources below where we have borrowed significant amounts of information or diagrams, generally with that institution's approval. We also acknowledge many other guides that we've found and have used for comparisons, borrowed concepts and wording, such as those produced by Arizona State University, Emory University, Florida State University, Penn State, University of Cincinnati, University of Maryland and University of Minnesota. There are others and we thank everyone for being able to read and compare information with their institutions. As we have borrowed and learned from others, feel free to use information from our Guide as it suits your needs.

We also follow the on-going learning space research and produced by Educause (<http://www.educause.edu/>) and their *Learning Space Design* resources at <http://www.educause.edu/Resources/Browse/Learning+Space+Design/17436>).

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