

APPENDIX DD – REQUIREMENTS FOR UNIVERSITY CLASSROOMS

1. General

1.1. The University of Minnesota uses a wide range of classroom facilities to meet the needs of its teaching and learning mission. General-purpose classrooms are centrally scheduled and managed, and are designed to serve the entire campus community. General-purpose classrooms (also referred to as central classrooms) include rooms that range from small seminar classrooms to large auditoria. They include a wide range of equipment, technology and resources. General-purpose classrooms are sufficiently flexible to meet pedagogical requirements of the many departments, faculty and students who use them.

1.2. In contrast, departmental classrooms serve more specialized needs of a smaller segment of the university. Examples of departmental classrooms are studios, labs, specialized or unique teaching facilities, and computer labs dedicated and optimized to the requirements of a particular department, discipline or program. Departmental classrooms are managed and scheduled by the respective departments.

1.3. University of Minnesota classrooms are intended to be of the highest quality. They provide an environment in which the instructors' and students' chosen teaching and learning methods are fully supported by the physical space and its technological appointments.

1.4. The Office of Classroom Management (OCM) is the central point of contact, and primary point of responsibility, for all general-purpose classrooms on the Twin Cities campus. This includes defining the requirements, specifications and FF&E of general-purpose classrooms, as well as the responsibility for operating, scheduling, and coordinating the maintenance in these classrooms.

1.5. OCM is a resource that is available during all phases of project design and construction regarding general-purpose classroom issues. Given the complexity of design issues in classrooms, coordination between the A/E and OCM during the design phase is encouraged. The primary contacts within OCM are the facilities coordinator for all facilities/FF&E, room layout and furnishing-related issues and Classroom Technical Services for audio-visual, technology, acoustic or technical matters.

1.6. The standards contained in this appendix are required for all Twin Cities general-purpose classrooms. They may be specified by cognizant university officials for other classrooms or other locations as appropriate.

2. Specifications

2.1. General-purpose classroom design definitions and requirements preface:

2.1.1. Projection Capable Classroom: A classroom that has data/video projection capabilities, Internet connectivity at the instructor's station, a VCR and/or other input device, a user-friendly laptop interface/control system, and capabilities for other add-on modular features. Projection-capable classrooms use standardized control/interface systems and employ a standardized operational protocol. All general-purpose classrooms must meet this minimum standard. Contact OCM for additional technical detail on Projection Capable Classroom standards.

2.1.2. Seminar Room: A teaching space for small section classes with a capacity of approximately 20 students. The level of technology necessary shall be confirmed with OCM on a by room basis.

2.1.3. Case Study Room: A tiered teaching space with a capacity of approximately 50 students that allows for interaction between instructors and students. Each student has a computer connection to access databases. The level of technology necessary shall be confirmed with OCM on a by room basis.

2.1.4. Lecture Hall: A tiered teaching space with a capacity of 100 students to approximately 250 students that is most suitable for traditional lectures, multi-media presentations, basic distance learning and demonstrations. The level of technology necessary shall be confirmed with OCM on a by room basis.

2.1.5. Auditorium: A tiered teaching space with a capacity that exceeds 250 students that is most suitable for traditional lectures, multi-media presentations, distance learning and demonstrations. The level of technology necessary shall be confirmed with OCM on a by room basis.

2.1.6. To provide representative examples of classroom types, sections from the 1995 University of Minnesota Twin Cities Classroom Study are attached in the guidelines section of this Appendix, section 3.

2.1.7. The teaching and learning environment in classrooms involve many elements. Considerations include, but are not limited to, acoustics, lighting, HVAC, furnishings and audiovisual systems. The following sections provide requirements in these areas for general-purpose classrooms, followed by guidelines on meeting these requirements.

2.2. General Requirements

2.2.1. All general-purpose classrooms shall meet the projection-capable classroom standard.

2.2.2. Classroom Signage

2.2.2.1. Place signs at all classroom doors with room numbers in accordance with Appendix F – Signing and Graphics Standards in this publication of the Standards and Procedures for Construction.

2.2.2.2. Signage at all room doors must clearly indicate the room to be a General Purpose Classroom with the room number. The signage also must meet code and ADA criteria.

2.2.2.3. Emergency signage must be placed in classrooms that illustrate university policies and procedures.

2.2.2.4. Signage that indicates how to report problems within the classroom shall be placed in the instructor's area. Contact OCM for details.

2.2.2.5. When moveable seating is used, the capacity of the room shall be posted.

2.2.2.6. Control system cover plates such as lighting switches and projection screen switches shall be labeled or permanently etched clearly in 3/16-inch high lettering.

2.2.2.7. General-purpose classroom signage should be coordinated with OCM.

2.2.3. ADA Compliance (LINK TO UNIVERSAL DESIGN SECTION IN PROGRAM INFO/GENERAL REQUIREMENTS)

2.2.3.1. The principles of Universal Access establish desirable goals in classrooms.

2.2.3.2. New classrooms must be accessible and must meet ADA requirements.

2.2.3.3. Refurbished classrooms shall be brought up to as high a level of accessibility as reasonable.

2.2.4. Classroom Doors

2.2.4.1. PROHIBITED: Door transfer grills in new classrooms.

2.2.4.2. Door hardware must meet building code requirements and ADA accessibility criteria, and operate quietly. Include bumpers, gaskets and nylon bushings to muffle the noise of the doors closing. Ensure that minimal noise is transmitted from corridors into classrooms.

2.2.4.3. Classroom entrance doors shall have a small, tinted, glass observation window panel. Glass sidelights shall not be used.

2.2.5. Mechanical Systems in New Construction

2.2.5.1. All fixtures, including pipes, ducts and conduit, penetrating through walls, ceilings, and floors shall be resiliently caulked at the penetration point.

2.2.5.2. Classroom HVAC ductwork shall not be installed in noisy areas. Careful design shall be employed to reduce exterior noise from entering the room.

2.2.5.3. Classrooms shall have HVAC systems with temperature and humidity control that is sufficient to function year-round without the need for through-window ventilation.

2.2.5.4. Mechanical system design and installation must provide space for classroom technology components that may require space above finished ceilings. Examples include projection screen troughs, projector mounts and conduit.

2.2.5.5. Equipment mounted adjacent to a classroom (either horizontally or vertically) shall be isolated from vibration. Consider that transmitted noise shall be kept at a low frequency when installing mechanical components near classrooms.

2.2.5.6. There shall be no air ducts (diffusers) or intakes close to projection screens.

2.2.5.7. HVAC systems shall be designed so there is minimal need to access the systems via the classrooms for maintenance purposes.

2.2.5.8. The HVAC system that serves classrooms shall operate independently of other system(s) that serve other functions within the same building. Refer to Division 15 – Mechanical for more information.

2.2.5.9. Systems that serve classrooms shall be tied to a university central monitoring system. Room occupants shall not be able to

adjust environmental controls in the rooms. Refer to Division 15 – Mechanical for more information.

2.2.5.10. Refer to Appendix DD, Section 6 – Documentation regarding coordination of classroom design documentation.

2.2.6. Mechanical Systems in Renovation

2.2.6.1. All fixtures, including pipes, ducts and conduit, penetrating through walls, ceilings and floors shall be resiliently caulked at the penetration point.

2.2.6.2. For renovation, mechanical systems also shall be considered based on the specifications cited in Section 2.2.5. – Mechanical Systems in New Construction. Systems shall be improved as much as reasonably possible and in accordance with the project scope (that is, full building rehab vs. single room renovation).

2.3. Acoustical Requirements

2.3.1. The acoustics in a classroom can effect how well the listeners can understand verbal communication. Factors include the speaker’s voice and the background noise and reverberation time in the room.

2.3.2. Architectural design can greatly affect reverberation time and background noise. A critical goal in the design of any room is to keep noise outside of the building from being audible inside of the classroom. Noise from passing vehicles, as well as internal building (HVAC) and hallway noise, can significantly detract from the learning experience and must be addressed in design.

2.3.3. Room wall and ceiling treatments can greatly reduce the reverberation time in a classroom. This is another critical factor in improving intelligibility in the classroom and must be addressed in design.

2.3.4. Also refer to Section 2.8. – FF&E Requirements.

2.3.5. Minimum acoustical requirements for classrooms are:

2.3.5.1. NC Ratings

- A. General Classrooms: NC 35 or less
- B. Auditorium/Lecture Hall: NC 25 or less
- C. Studio/Distance ED Room: NC 20 or less

2.3.5.2. Acceptable Reverberation Time

- A. Classroom: RT60 of 0.4 seconds or less
- B. Small Auditoriums: RT60 of 0.8 seconds or less
- C. Large Auditoriums: RT60 of 1.5 seconds or less

2.3.5.3. HVAC: Diffusers must have a rating of 10dB lower than the room NC rating at rated flow. Refer to Section 2.2.5 – Mechanical Systems in New Construction.

2.3.6. Commissioning/Compliance Testing: Refer to Section 5 – Testing Procedures.

2.4. Lighting Requirements

(PROVIDE LINK TO DIVISION 16, SECTION 16500)

2.4.1. Illumination Level Standards

2.4.1.1. Overall even illumination of 60 foot-candles is required. ± 15 is acceptable. Even illumination is defined as ± 10 foot-candles from mean.

2.4.1.2. Minimum note-taking illumination of 5 foot-candles is required. +10 is acceptable. Dimming systems or switching individual lighting tubes in a fixture on/off is acceptable to meet specified illumination levels.

2.4.2. Glare in the field of view of the presentation surfaces shall be a contrast ratio of 3:1 or less.

2.4.3. General classrooms shall have two lighting zones:

- A. Zone 1: The presentation (instructor's) area of the room
- B. Zone 2: The student area of the room. (There may be additional student area zones in large classrooms.)

2.4.4. Auditorium/large classrooms shall have four control lighting zones and variable illumination levels.

- A. Zone 1: The presentation (instructor's) area of the room
- B. Zone 2: The student area of the room. (A large room/auditorium may require multiple student area zones and may require different illumination levels.)
- C. Zone 3: Instructor spotlights for seeing the instructor while showing slides.

D. Zone 4: Signer illumination (sufficient lighting from presentation writing surface light for a sign language interpreter, from front lighting zone or from a separate spotlight)

2.4.5. Presentation Writing Surface (Markerboard)

2.4.5.1. The markerboard shall be illuminated to 75 foot-candles. Lighting shall be distributed uniformly across the entire writing surface.

2.4.5.2. Installation and selection of board lighting shall ensure that the lamps in the fixtures will not be directly visible from the student seating area. In addition, if the projection screen lowers below the presentation surface lighting fixtures, that section of the lighting system directly behind the projection screen(s) shall be separately controlled.

2.4.5.3. Presentation lighting fixtures shall not directly be in contact with or interfere with the movement of the projection screen(s).

2.4.5.4. Refer to Section 5.4. – Glare Contrast Measurement.

2.4.6. Lighting Controls

2.4.6.1. Locations

2.4.6.1.1. Basic classroom lighting controls shall be placed at all entrances in new construction.

2.4.6.1.2. Provide emergency lighting as required by code.

2.4.6.1.3. Controls for presentation writing surface lighting must be placed on both sides of the front wall.

2.4.6.1.4. For new construction, lighting controls for the presentation writing surface shall be configured to allow the projection screen and accessible writing surface to be used simultaneously. That is, the lights over the writing surface shall be controlled in separate sections to provide illumination of a portion of the presentation writing surface while a projection screen is in use.

2.4.6.2. Commissioning/Compliance Testing: Refer to Section 5 – Testing Procedures.

2.5. Classroom Dimensional Requirements

2.5.1. Obstructions: There shall be no sightline obstructions (columns or posts) anywhere in classrooms.

2.5.2. Ceiling Height

Ceiling height for a given square foot of space

| Square feet | Ceiling height at front of classroom |
|----------------|---|
| Up to 749 | 11 feet |
| 750 to 999 | 12 feet |
| 1,000 to 1,599 | 14 feet |
| 1,600 to 2,800 | 16 feet |

2.5.2.1. New classroom ceilings shall be configured to a minimum 11-foot clearance at the front of the room.

2.5.2.2. The sightline from the Most Distant Viewer (MDV) to the top of the projection screen shall not be obstructed.

2.5.2.3. Classroom ceilings may be reduced in height to a minimum of 10 feet outside the front or room area as long as they do not violate the previous sightline requirement as stated in 2.5.2.2. That is, classroom ceilings may be designed to accommodate classroom height requirements in the front of the classroom and stepped or reduced in height to the 10-foot minimum as required elsewhere in the room.

2.5.2.4. Aside from these minimum design requirements, ceiling height requirements will vary depending on room design and dimensions. Refer to Section 2.7.3. – Projection Screen(s) for more information.

2.5.3. Viewing Based Seating Location Guidelines

2.5.3.1. Based upon screen width (W), the minimum distance from the screen to the first row shall be $.5W$.

2.5.3.2. If lines are drawn out at 45 degrees from the outer edges of the screen (width W), they intersect at a distance of $.5W$ from the center of the screen. These lines continue to diverge and form a cone that consists of optimum viewing positions with a minimal amount of optical distortion. Seating outside of this cone is not desirable. Compromise between the ideal cone of vision and

necessary seating capacity may be required in some circumstances. Contact OCM for clarification on a room-by-room basis.

2.5.3.3. Based upon screen height (H), the distance from the farthest screen edge to the most distant viewer (MDV) should be no more than 8H maximum (6H preferred).

2.6. Networking and Telecommunications

2.6.1. A telephone shall be installed in the presentation area of the classroom. When a classroom includes a booth, the booth also shall have a telephone.

2.6.2. Telephones shall be wall-mounted in accordance with building codes and ADA requirements.

2.6.3. Classrooms shall have a minimum of four data connections in a single-gang box located in coordination with the A/V system requirements that OCM outlines. When the classroom has a booth, the booth shall have a minimum of two data connections. If a storage room exists within the classroom space, it shall have a minimum of two data connections.

2.6.4. Refer to Section 6 – Documentation for more information.

2.7. Audio Visual System Requirements

2.7.1. Teaching/Control Instructor Station

2.7.1.1. The projection-capable classroom standards specify a Teaching/Control Instructor Station with a 6-inch by 6-inch wallbox that sits alongside the single gang box as described in item 2.6.3. The wallbox shall have a minimum conduit size of 1-1/4 inches to the ceiling projector for signal and control cables. Provide one duplex receptacle that is mounted at the receptacle height and adjacent to the 6-inch by 6-inch wallbox.

2.7.1.2. Said wallbox shall be located in the teaching area on the floor, front or sidewall, at the standard receptacle height above the floor (if wall located), for connection of the umbilical cable to the Instructor Station. Confirm exact location with OCM.

2.7.1.3. Refer to Section 6 – Documentation.

2.7.2. Video/Data Projector(s)

2.7.2.1. The projection-capable classroom standards specify that a ceiling-mounted video/data projector be located on the centerline of the screen. Two exceptions: when special design criteria specify more than one projector or a booth-mounted location is specified.

2.7.2.2. Projector-mount to structure shall consist of two uni-strut rails, 8 inches on center, approximately 4 inches long and perpendicular to the screen.

2.7.2.3. The center of said assembly shall be located approximately 2.7 times the projected video image height from the screen. Confirm exact location with OCM.

2.7.2.4. A 20-amp duplex outlet is needed at the support for the projector-mounting bracket structural ceiling. The outlet shall be co-located and not switched. It also shall be on the same circuit or, at a minimum, the same phase as the instructor station and termination of conduit.

2.7.2.5. Also refer to the section regarding integration of technology and mechanical systems.

2.7.2.6. Coordinate where the projector shall be placed with OCM.

2.7.3. Projection Screen(s)

Room screen size table

| Ceiling height | Video height | Screen size | |
|----------------|--------------|----------------------|----------|
| 8 feet | 4 feet | 52 inch by 92 inch | Manual |
| 10 feet | 5 feet | 7 feet by 9 feet | Manual |
| 11 feet | 6 feet | 9 feet by 10 feet | Electric |
| 12 feet | 7 feet | 9 feet by 12 feet | Electric |
| 13 feet | 8 feet | 10 ½ feet by 14 feet | Electric |
| 14 feet | 9 feet | 12 feet by 16 feet | Electric |
| 15 feet | 10 feet | 13 ½ feet by 18 feet | Electric |
| 16 feet | 11 feet | 15 feet by 20 feet | Electric |

***Note:** Screen limits shall be used to set actual screen height.

2.7.3.1. Screen dimensions shall be organized based upon a 16 x 9 ratio criteria.

2.7.3.2. Screen sizes 10 feet and larger shall be electrically operated.

2.7.3.3. Screen controls shall be located at switch height next to the lighting controls.

2.7.3.4. For remodeling work, raise the finished ceiling height as high as possible to accommodate screen requirements.

2.7.3.5. In classrooms with high ceilings, it may be desirable to use the wall above the presentation writing surface for the screen surface. This option eliminates the necessity of raising and lowering the screen, the complex control system and the cost of an electric projection screen.

2.7.3.6. As a general guideline, 35 degrees to the top of the projection screen from the seated student viewpoint shall determine the location of the first row of student seats. This grade shall avoid excessively high and uncomfortable viewing angles.

2.7.3.7. Install and maintain mechanical systems (ducts and piping) along sidewalls. This way the front central area of classrooms with screens may be constructed as high as possible.

2.7.3.8. Coordinate with OCM on where projection screens shall be placed.

2.8. FF&E Requirements

2.8.1. FF&E items shall be reviewed with OCM beginning in pre-design and following through all design phases of a project.

2.8.2. Classroom Furniture

2.8.2.1. Moveable Seating

A. Tablet-arm chair tablet arms shall have a minimum writing surface area of 144 square inches.

B. Ten percent of tablet-arm chairs in a classroom shall be left-handed. Coverings and finishes must meet current OCM durability and maintainability criteria.

2.8.2.2. Fixed Seating (Drop Arm Auditorium)

2.8.2.2.1. Fixed seating tablet arms shall have a minimum writing surface area of 130 square inches.

2.8.2.2.2. Ten percent of tablet arms shall be configured left-handed. The arms shall be arranged along the left side of the aisle as viewed from the presentation area.

2.8.2.2.3. One percent or at least one of the aisle seating shall be configured with a moveable armrest on the aisle side for accessibility.

2.8.2.2.4. Coverings and finishes must meet current OCM durability and maintainability criteria.

2.8.2.3. Instructor Seating

2.8.2.3.1. There shall be a chair of appropriate height available at the teaching/control instructor station for the instructor.

2.8.2.3.2. The instructor's seating shall be coordinated with the other room furniture regarding finish detail.

2.8.2.4. Tables

2.8.2.4.1. PROHIBITED: Attached or swivel-mount seating in conjunction with fixed tables for new construction.

2.8.2.4.2. Table finish details shall meet the durability and maintainability criteria that OCM uses. Coordinate the table type and arrangement with OCM.

2.8.2.4.3. A table in the presentation area shall be provided for the instructor. The table shall match the finish of the student table/tablet arm writing surface in the classroom. The dimensions of the instructor's table shall be proportional to the available space in the front of the room, but no smaller than 30 inches by 48 inches.

2.8.2.4.4. Moveable student tables shall provide a minimum width of 26 inches per student without interfering with table legs or supports.

2.8.2.4.5. Moveable student tables shall provide a minimum depth of 20 inches.

2.8.2.4.6. Classroom layouts that are designed for moveable student tables may also be designed and installed with a power infrastructure. This additional infrastructure supports multiple layouts if required, and provides the most

flexibility on how the tables are used. Coordinate such layout with OCM.

2.8.2.4.7. Linear continuous fixed student tables shall have a minimum width of 26 inches per student without interfering with table legs or supports.

2.8.2.4.8. Linear continuous fixed student tables shall have a minimum depth of 18 inches.

2.8.2.4.9. Depending upon specific requirements, moveable tables or linear fixed continuous tables may have power capability specified at student stations.

2.8.2.5. Presentation Writing Surfaces

2.8.2.5.1. Markerboards shall be installed across as much of the front (instructor's) wall as possible.

2.8.2.5.2. Additional markerboards may be required on secondary classroom surfaces. Consult with OCM regarding room requirements.

2.8.2.5.3. Markerboards shall be mounted 36 inches above the finished floor.

2.8.2.5.4. Markerboards shall be a minimum of 4 feet high.

2.8.2.5.5. Markerboards shall have trays that run the full length of the markerboards.

2.8.2.5.6. Markerboards shall have non-removable map hooks placed at the top of the boards.

2.8.2.5.7. Markerboard seams shall be flush.

2.8.2.5.8. Refer to lighting requirements of markerboards in this appendix.

2.8.2.5.9. All classroom presentation writing surfaces shall have useable space for the markerboard while the primary projection system is in use.

2.8.2.5.10. A cleaning supply dispenser system shall be mounted near one end of each markerboard.

2.8.2.5.11. Markerboards shall be securely fastened/ mounted on a wall (not freestanding). Large classrooms shall be designed for multi-sectional (side-to-side) markerboards. Such markerboards shall have many horizontal or vertical panels in each section to provide more space for writing.

2.8.2.6. Surfaces for Displays and Conducive for Tacks

2.8.2.6.1. A tack strip shall be placed above the markerboard that runs the full length of the board.

2.8.2.6.2. A tackboard shall be attached at the doorway outside of each classroom so changes in room schedules can be posted.

2.8.2.6.3. Some classrooms may be required to have a mounted tackboard. Consult with OCM regarding such requirements.

2.8.2.7. Finishes Specification for New Construction

2.8.2.7.1. Walls

2.8.2.7.1.1. A chair rail shall be installed on side and rear walls whenever moveable furniture may contact a wall surface.

2.8.2.7.1.2. Wall surfaces shall be washable.

2.8.2.7.1.3. The lower wall surface shall be extremely durable with an epoxy finish, abuse-resistant panels and so on.

2.8.2.7.1.4. Chose finishes for classroom walls that complement the acoustical characteristics of the room. For example, concrete masonry may be used, but may need to be covered by another material for acoustical reasons.

2.8.2.7.1.5. Teaching wall material around the markerboard shall be non-reflective, durable, washable, and resistant to stains from dry erase marker residue.

2.8.2.7.1.6. Sheet rock (drywall) seams fully taped and caulked to floors.

2.8.2.7.1.7. Internal classroom walls shall run deck-to-deck, with a sound transmission class (STC) rating of 50 or better.

2.8.2.7.1.8. Durable caulking shall be used for all penetrations.

2.8.2.7.1.9. The front wall of the classroom shall have no protrusions into the room, so a presentation surface may run across the entire wall.

2.9. Ceilings

2.9.1. Ceiling finishes shall be of light color and non-reflective.

2.9.2. Ceiling noise reduction coefficient (NRC) shall be .75 or better.

2.9.3. Ceiling attenuation class (CAC) shall be 39 or better.

2.9.4. Ceiling tile shall be sag (humidity) resistant.

2.10. Flooring

2.10.1. Flooring shall comply with the current edition of the Standards and Procedures for Construction, Appendix M – Carpet Specification Guide.

2.10.2. Submit samples to OCM prior to installation.

2.10.3. Floor coverings shall be of medium to light color, and contain some form of subdued pattern or fleck.

2.10.4. Coordinate color selection with OCM.

2.10.5. Choose flooring that complements the acoustical characteristics of the room.

2.11. Windows and Window Treatments

2.11.1. No windows shall be allowed on front (presentation) walls.

2.11.2. Windows shall have an STC rating sufficient to reduce exterior environmental noise levels to meet classroom acoustical standards.

2.11.3. Window treatments, and electrical or mechanical methods that eliminate light from entering the classroom are required in order for projection images to be visible.

2.11.4. Window treatments (shades/blinds) shall be opaque and capable of ENTIRELY eliminating outside light from entering.

2.11.5. A combination of shades and blinds shall be used in new construction.

2.11.6. Shades shall be installed in channels to eliminate light from entering through the sides.

2.11.7. Roller shades shall be of clutch type, chain-operated, and have stops set at the full range of motion (top and bottom).

2.11.8. Specify that the roller shade material be fire-retardant, vinyl-coated fiberglass.

2.12. Miscellaneous

2.12.1. A clock shall be placed on a wall in each classroom (other than the front wall).

2.12.2. The clock shall be self-correcting for accuracy. If DC-powered, the battery shall have an extended (multi-year) life expectancy.

2.12.3. Pencil sharpeners shall be mounted in all classrooms. Larger classrooms shall have multiple sharpeners.

3. Design Guidelines

3.1. General

3.1.1. The success with which a student may receive information from an instructor or can effectively participate in classroom activities will be effected by general factors of classroom design. Site planning and overall building spatial relationships set the stage for development of effective teaching and learning environments.

3.1.2. When determining where to locate a general-purpose classroom in a building, the lower floors are preferred for two reasons. One, students can access it easier, and two, it minimizes disruption from spaces in buildings that are used for multiple functions.

3.1.3. Take into account the location of classrooms when designing entrances, exits, stairs, corridors and exterior approaches. In considering the flow of classroom traffic, account for the students, who generally arrive and depart simultaneously. Therefore, design the classrooms to twice the stated room capacity. If possible, locate large classrooms close to building access points to reduce the flow of traffic, as well as the cost of building design.

3.1.4. If possible, classrooms shall be separated from external and internal sources of noise such as loading docks, parking lots, streets, mechanical and equipment rooms, vending areas, elevators and dining facilities.

3.1.5. Classrooms designed with windows that face south or west shall require a higher degree of blackout capability than classrooms that face north or east.

3.1.6. Classroom doors shall operate quietly, and tightly seal out sound when fully closed. They should be installed in the rear or the side of a classroom so the instructor is not disrupted if used while class is in session. It is recommended that doors be equipped with shatter-resistant vision panels to prevent someone from getting injured if opened unexpectedly.

3.1.7. Provide a directory at each entrance to a building that identifies where classrooms are located. This step will ease the heavy flow of traffic to and from classrooms. Also, appropriately place building signage where students can clearly identify and locate classrooms.

3.2. Classroom Design Examples

3.2.1. In the following section, various representative classroom types are described. These are updated descriptions that were contained in the 1995 University of Minnesota Classroom Study. They are provided as representative of some classroom types, and can be used as guidelines to augment the standards section of this document.

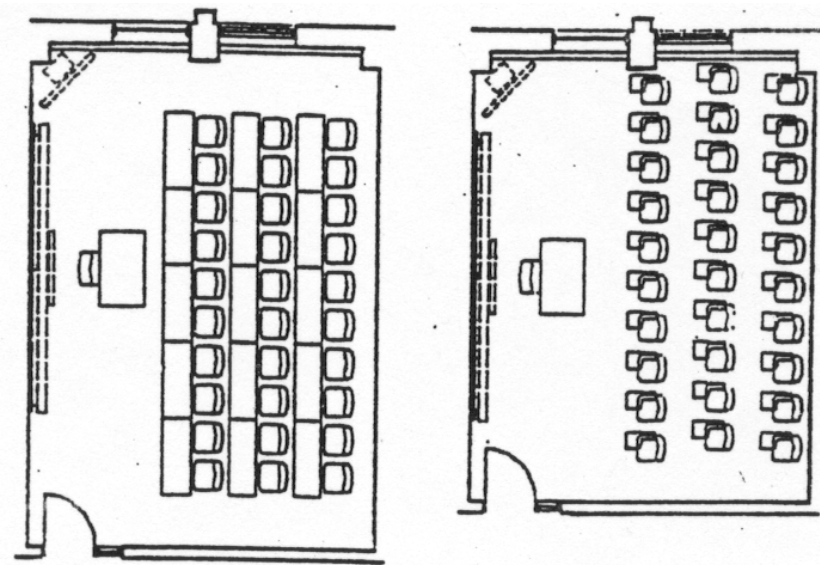
3.2.2. The following factors influence the design of general-purpose classrooms:

- A. The intentional purpose and mission of the individual classroom
- B. Physical dimensions (including room length, width, proportions and ceiling height)
- C. Room characteristics (such as windows, proximity to exterior or interior noise, impact of building structure and lighting)
- D. Furnishings (including type, density, flexibility, mobility, durability, comfort, maintainability and student desktop needs)

- E. Pedagogy (including the type of teaching methodology to be supported)
- F. Technology (including the type, degree of sophistication, power and cooling requirements, future expandability and changing formats)
- G. Space requirements (including square feet per student station, instructor area, available space vs. classroom capacity)
- H. Specific equipment placement parameters (including the location of the projector and screen, student sightline and sight angle requirements, equipment maintenance and security)
- I. Writing surfaces (including markerboard usability, readability and maintainability)
- J. Acoustics (including room properties and the effects of HVAC and mechanical systems)
- K. Accessibility (including room and its approaches, furnishings and equipment, student and instructor considerations)
- L. Ease of use (including room layout, technology, furnishings, operation of lights and basic controls)

3.2.3. These standards and guidelines can not specify all parameters that apply to all possible classroom scenarios. However, they do provide the basis of general-purpose classroom requirements. It is essential that the A/E and OCM collaborate on the specific classroom needs, issues and solutions sufficiently early in the design process to achieve a favorable outcome of the project in each classroom. The objective is to design and build classrooms that meet the teaching needs of instructors and the learning needs of students.

3.3. Classrooms with Approximately 30 Students



3.3.1. Use: This type of room typically is used for small section classes. It is very flexible to allow for many types of classes, including small section lectures, recitation sections and participatory seminars. Tablet-arm chairs often are used because the students can easily move them around for various purposes. If more desk layout space is needed for students, a table arrangement shall be used. The table arrangement will require some additional room area and should be considered early in the design process. Provide wheelchair access and seating for students and instructors in all general-purpose classrooms. Install ADA-compliant signage at every door to a classroom that clearly indicates that it is a general-purpose classroom (with room number).

3.3.2. Room Size: Area: Approximately 500 square feet for tablet-arm chairs and 575 square feet for tables with chairs (must meet building code requirements).

3.3.3. Proportions: Length equals width. Close-to-square proportion achieves a good balance of sightlines and distance to the back row. A level floor with movable tables allows for a flexible layout at a slight compromise to sightlines. The minimum height for the front of this room is 11 feet.

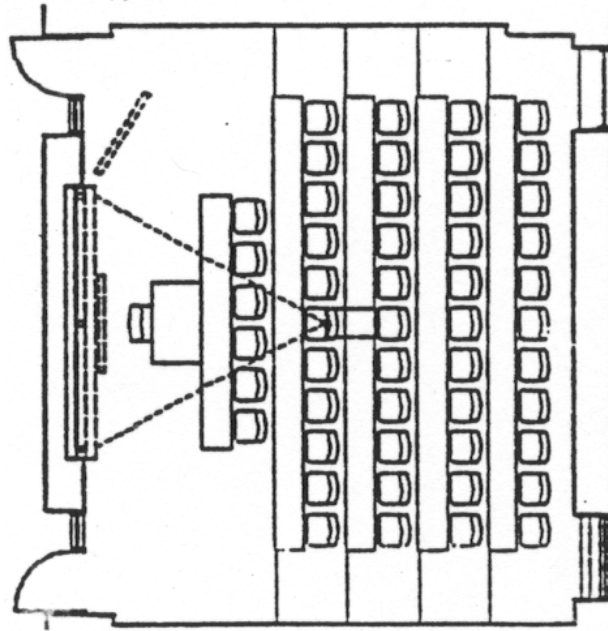
3.3.4. Elements Needed: Furniture: Movable tablet-arm chairs are typical and provide the greatest flexibility. Movable tables with chairs shall be provided if students need more layout space. Provide some wheelchair-height tables. Provide 10 percent left-handed tablet-arm chairs. Provide a movable 30-inch by 48-inch desk with chair for the instructor.

3.3.5. A/V and Information Technology: Must meet projection-capable classroom criteria. Additional technology requirements may apply. 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.

3.3.6. Considerations: Acoustics: Design room acoustics for optimal speech intelligibility.

3.3.7. Future: Flexibility and potential growth for technology are important design elements. Provide recessed floor boxes in several locations around the room to accommodate computer connections in the future.

3.4. Classrooms with Approximately 50 Students



3.4.1. Use: This type of room is most suitable for traditional lectures, A/V presentations and demonstrations. A level floor provides more flexibility for layout, but a tiered floor may be preferable because of sightlines to displays. Provide wheelchair access and seating for students and instructors in all general-purpose classrooms. Install ADA-compliant signage at every door to a classroom that clearly indicates that it is a general-purpose classroom (with room number). A/V equipment shall be ceiling-mounted and/or wall-mounted.

3.4.2. Room Size: Area: Approximately 750 square feet. At a minimum, the room size must meet building code requirements for square footage per occupant.

3.4.3. Proportions: Length equals width. Approximately square proportions achieve a good balance of sightlines and distance to the back row. A tiered floor with rows of fixed tables provides the best sightlines to the instructor for the students. A level floor with movable tables provides more flexibility in layout at a slight compromise to sightlines. Moveable furniture is increasingly important for instructors' desiring flexibility in teaching pedagogy. The minimum height for the front of this room is 12 feet. The height may need to be increased to 13 feet if a tiered floor is used. Code requirements may specify two doors for occupancy above a 49-person capacity.

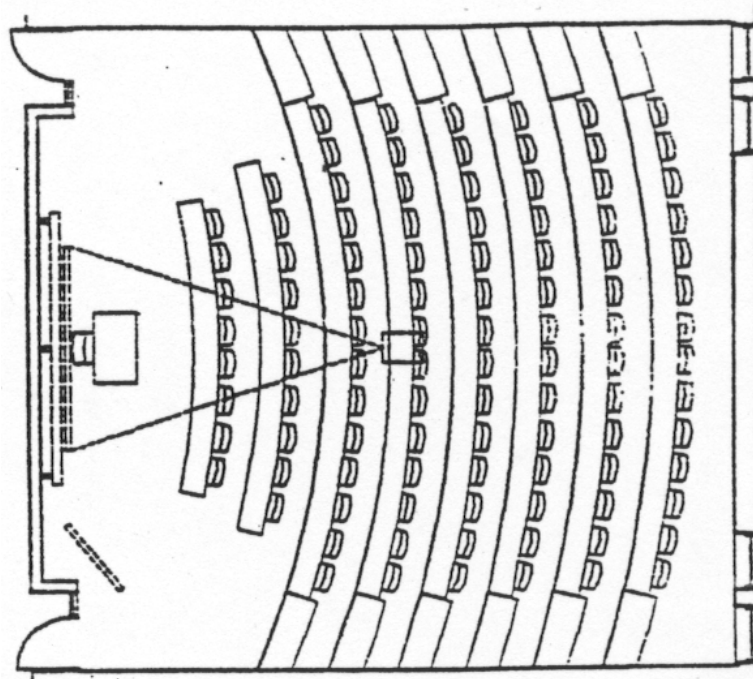
3.4.4. Elements Needed: Furniture: For a tiered room, provide fixed continuous tables and moveable chairs. For a level floor, movable tables with chairs are needed. Provide tables that are the right height for wheelchairs in the front rows. Include a movable 30-inch by 48-inch desk with a chair for the instructor.

3.4.5. A/V and Information Technology: Must meet projection-capable classroom criteria. Additional technology requirements may apply. Flexibility and ability to accommodate growth in technology in the future, particularly in terms of networking is an important part of room design. The room design must accommodate for increased use of wireless technology.

3.4.6. Considerations: Acoustics: Design room acoustics for optimal speech intelligibility. Consider sound reinforcement as an option.

3.4.7. Future: Flexibility and potential for growth in technology are important design elements. Provide recessed floor boxes in several locations around the room for power connections in the future.

3.5. Lecture Hall Classrooms with Approximately 100 Students



3.5.1. Use: This type of room is most suitable for traditional lectures, A/V presentations, basic distance learning and demonstrations. Typically, a sloped floor or tiered floor is required to achieve good sightlines for all seats. Provide wheelchair access and seating for students and instructors in

all general-purpose classrooms. Install ADA-compliant signage at every door to a classroom that clearly indicates that it is a general-purpose classroom (with room number). A/V equipment shall be ceiling-mounted and wall-mounted.

3.5.2. Room Size: Area: Approximately 1,600 square feet. At a minimum, room size must meet building code requirements for square footage per occupant.

3.5.3. Proportions: Length equals width. All seats shall be designed to fall within a 90-degree cone of optimal vision. The slope shall be designed to achieve optimal viewing angles to the board surface and AU/V display units. The minimum height for the front of this room is 16 feet. The height may need to be greater to accommodate for the steeper slope in the floor.

3.5.4. Elements Needed: Furniture

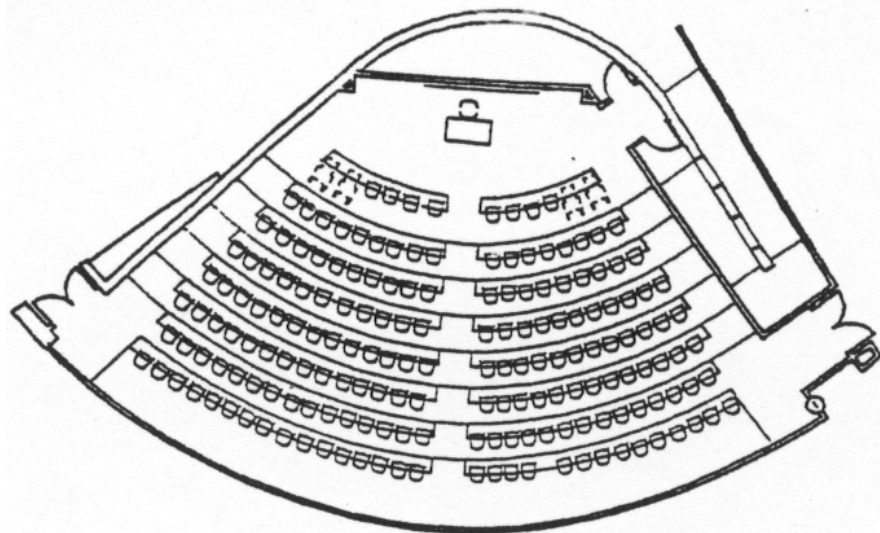
- A. Fixed tables and moveable chairs for student seating
- B. Movable tables and chairs for front rows
- C. Tables that are the right height for wheelchairs in front rows
- D. Movable 30-inch by 48-inch desk with a chair for the instructor

3.5.5. A/V and Information Technology: Must meet projection-capable classroom criteria. Additional technology requirements may apply. 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.

3.5.6. Considerations: Acoustics: Design room acoustics for optimal speech intelligibility. Sound reinforcement is strongly recommended.

3.5.7. Future: Flexibility and potential growth for technology are important design elements. Provide recessed floor boxes in several locations around the room for power connections in the future.

3.6. Lecture Hall Classrooms with Approximately 175 Students



3.6.1. Use: This type of room is most suitable for traditional lectures, A/V presentations, basic distance learning and demonstrations. Typically, a sloped floor or tiered floor is required to achieve good sightlines for all seats. Provide wheelchair access and seating for students and instructors in all general-purpose classrooms. Install ADA-compliant signage at every door to a classroom that clearly indicates that it is a general-purpose classroom (with room number). A/V equipment shall be ceiling-mounted and wall-mounted.

3.6.2. Room Size: Area: Approximately 2,800 square feet. At a minimum, room size must meet building code requirements for square footage per occupant.

3.6.3. Proportions: Length equals width. All seats shall fall within a 90-degree cone of optimal vision. Tier slope shall be designed to achieve optimal viewing angles to board surface and NV display units. The minimum height for the front of this room is 18 feet. The height may need to be greater to accommodate for a steeper slope in the floor.

3.6.4. Elements needed: Furniture:

- A. Fixed tables and moveable chairs for student seating
- B. Movable tables and chairs in front rows
- C. Tables that are the right height for wheelchairs in front rows
- D. A movable 30-inch by 48-inch desk with a chair for the instructor

3.6.5. A/V and Information Technology: Must meet projection-capable classroom criteria. Additional technology requirements may apply. 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.

3.6.6. Considerations: Acoustics: Design room acoustics for optimal speech intelligibility. Sound reinforcement is required.

3.6.7. Future: Flexibility and potential growth for technology are important design elements. Provide recessed floor boxes in several locations around the room for power connections in the future.

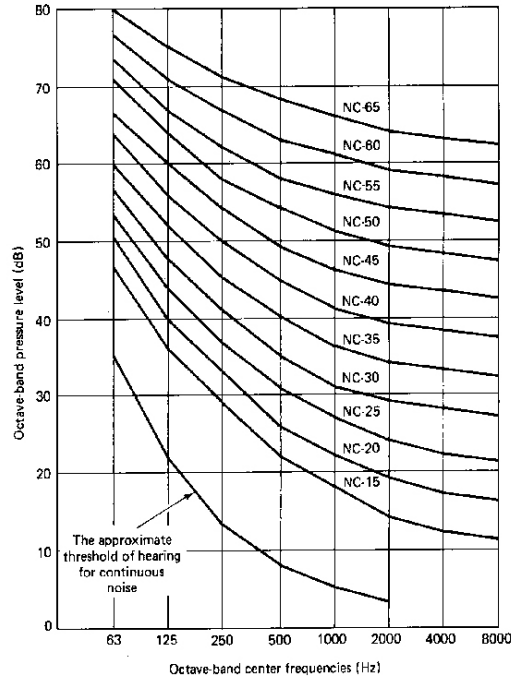
4. References: The Office of Classroom Management, University of Minnesota Web site: www.classroom.umn.edu

5. Testing Procedures

5.1. Acoustical Standard Testing Procedures

5.1.1. Noise Criteria (NC)

5.1.1.1. A reference level based on a chart of frequency vs. sound pressure (dB) curves that displays sound levels perceived by the human ear as equal in magnitude. The highest NC curve touched by a plot is the sound NC level. NC curves apply to sound pressure levels in an occupied space, not equipment sound power levels.



5.1.1.2. Conditions: Windows and doors closed, with the HVAC on in the room and minimal external noise from adjacent locations.

5.1.1.3. Acquire Data: With microphone at 48 inches, AFF located in middle of the instructor location area at the front of the room.

5.1.1.4. Standard: NC of 35 or less for classrooms. NC of 25 or less for auditoriums.

5.1.2. Reverb Time (RT60):

5.1.2.1. Reverberation time is the time required for the sound level in the room to decay 60 dB. In other words, it is the time needed for a loud sound to be inaudible after turning off the sound source.

5.1.2.1. Conditions: Windows and doors closed, with the HVAC on in the room and minimal external noise from adjacent locations.

5.1.2.2. Acquire Data: With microphone at 48 inches, AFF located in middle of the instructor area at the front of the room.

5.1.2.3. Standard: RT60 of 0.40 seconds or less for standard classrooms, RT60 of 0.80 for small auditoriums (100 to 200 seats) and RT60 of 1.50 seconds for large auditoriums (more than 200 seats).

5.1.2.4. Equipment: TerraSonde Audio toolbox or equivalent.

5.2. Lighting Standard Testing Procedures

5.2.1. Work Surface Lighting Levels: The level of light in foot-candles on the working surfaces of the room.

5.2.2. Conditions: Lights on at full capacity. Room shades and blinds closed.

5.2.3. Acquiring Data: Dividing the floor area up into a 3 by 3 grid pattern evenly dispersed across the student seating area. Measure levels at table height of 30 inches AFF.

Front of room looking down

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

5.2.4. Standards

5.2.4.1. 60 foot-candles is required. ± 15 is acceptable. All readings shall be mean averaged and noted.

5.2.4.2. Even lighting is defined as ± 10 foot-candles from mean. Deviation within a space is in excess of 10 foot-candles. Shall be noted.

5.2.5. Equipment: Minolta T-10 or equivalent

5.3. Reduced Note-taking Light

5.3.1. Conditions: Lights on at low volume. Room shades and blinds closed.

5.3.2. Acquiring Data: Dividing the floor area up into a 3 by 3 grid pattern evenly dispersed across the student seating area. Measure levels at table height of 30 inches AFF.

5.3.3. Standards: Five foot-candles is required. + 10 is acceptable. All readings shall be mean averaged and noted.

5.3.4. Equipment: Minolta T-10 or equivalent

5.4. Glare Contrast Measurement

5.4.1. Glare is defined as any brightness in the field of vision that causes discomfort, reduction in vision or eye fatigue. Glare is the result of excess light that is in the normal line of sight in the work area. Excess light can be emitted directly from the fixture, or be reflected from a glossy surface.

5.4.2. There can be actual intensity levels exceeding 1:250 within the space, but the ratio of highest intensity to that of background intensity is more crucial in determining glare conditions. A ratio of 2:1 or greater between the peak and the median begins to feel uncomfortable. Any ratio of 3:1 or greater positively produces a sensation of discomfort and should be avoided.

5.4.3. Conditions: Lights on at full capacity. Room shades and blinds closed.

5.4.4. Acquiring Data: Dividing the students field of view up into a 5 by 2 grid pattern evenly dispersed across the field of view from the middle of the student seating area acquire data and note. Then looking at the brightest point in the field of view and note as the peak reading.

Looking at front presentation area

| | | | | |
|---|---|---|---|----|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

5.4.5. Standards: A contrast ratio of 3:1 or less is acceptable. Average the light level in the field of view and note. Give the ratio to the peak measurement.

5.4.5. Equipment: Minolta LS-100 or equivalent

6. Documentation

6.1. During design of general-purpose classrooms, the A/E or design consultant shall provide drawings for OCM to review at each stage of the design review process. These plans may be scale drawings or an electronic CAD file. Classroom layouts shall include detail sufficient to ensure compliance with OCM design specifications. The drawings shall be separate documents that are prepared with furniture and A/V consultants. Coordinate the drawings with the electrical contract documents to indicate conduit runs, the selection and placement of junction and floor boxes, lighting and power.

6.2. Maintenance, care, and repair documentation shall be included for FF&E installations provided by a project. These covered items would include, but not be limited to, furniture, presentation writing surfaces, flooring and wall finishes.

6.3. Lifecycle and projected maintenance cost estimates for FF&E items above shall be provided.

**End of Appendix DD – Requirements for University Classrooms
University of Minnesota Facilities Management
November 2002 (Revised: December 2006)**