Design Guidelines and Requirements

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Introduction

Minneapolis Public Schools strives to ensure that upwards of 33,000 students who attend school at one of our 75 schools which are located throughout the city have adequate facilities in which to learn. This document is intended to provide architectural and engineering consultants with a basis for design across the variety of spaces in any of our buildings. This document is not intended to be prescriptive, but rather to define Minneapolis Public Schools (MPS) expectations for design of existing and new facilities within the school district. Within this document you will find guidelines for:

- Spatial design
- Building systems
- Equipment and furnishings required by specific instructional areas
- Facilities needs for various academic programs
- Building design that stop short of a Master Specification

Mission

We exist to ensure that all students learn.

We support their growth into knowledgeable, skilled and confident citizens capable of succeeding in their work, personal, family and community lives into the 21st century.

Vision

Every child college and career ready

Values

- Right to a quality education
- Importance of family
- Equity
- Diversity
- Respect for employees
- Partnership for youth
- Transparency and accountability
- Sustainability

Our Promise

Minneapolis Public Schools promises an inspirational education experience in a safe, welcoming environment for all diverse learners to acquire the tools and skills necessary to confidently engage in the global community.

Site

Sites for our schools range from very little room around the school building to connections with City of Minneapolis parks. As such, each site will present its own unique set of challenges for vehicular and pedestrian circulation, playgrounds, open space, and athletic facilities.

Arrival and Departure

Make every effort to separate vehicular traffic from pedestrian traffic during arrival and departure. Ideally, busses will have their own drop off areas and lanes to enter and exit the site. Student and parent vehicles will have an entrance that will not interfere with bus traffic. For safety, every effort must be made to provide pedestrians and bicycles a separate and safe entry that does not cross driveways, vehicular lanes, or parking lots.

Guidelines from *Safe Routes To School*

- Building entrances
    - Support pedestrian "desire lanes" for access
    - Support safe pedestrian access
        - Avoid pedestrians crossing bus lanes or driveways
        - Avoid pedestrians crossing at mid-block away from crosswalks
    - Signage is clear to indicate primary entrance as well as alternate entrances for arrival and departure
- Non-vehicular arrival and departure
    - Provide bicycle access and storage to encourage biking
        - Covered shelters if possible
        - Secure bike racks
        - Located within view of school entrance
    - Locate entrances to encourage save pedestrian access
    - Separate bicycles and pedestrians from vehicular traffic as much as possible
- Busses
    - Single file, right wheel to curb staging
    - Provide two outbound lanes for left and right turning busses
    - No backward bus movement required for staging

    - One-way circulation, in a counterclockwise direction to ensure right wheel loading on the side of the building entrance
    - Students should not be required to walk between busses
    - Loading zone should not straddle pedestrian access
    - Parent traffic should not share circulation with busses
- Parent traffic
    - Design parent traffic so it does not block bus traffic
    - When possible, provide onsite parent loading lanes
- Driveways and internal traffic
    - Use separate entrances for busses and parent traffic at elementary and middle schools where possible.
    - Additional driveways may be needed at high schools
    - Design in a left turn lane to streamline exiting traffic
    - Design driveways so that most drivers turn right when exiting the site
    - Pedestrians should not be required to cross busy driveways to access the school.
    - Locate driveways to avoid interlocking left turns with other streets or bus driveways
- Safety
    - Crossing guards should be well trained to understand vehicular, pedestrian, and bicycle access to the school and wear bright colors
    - Loading zones should not require backward movement of vehicles
    - Avoid loading zones where students being dropped off need to cross vehicular lanes before entering the building
    - Communicate vehicular patterns to parents clearly
    - Allow for longer pick up times than drop off times when possible
- Parking
    - Where possible, separate student and staff parking from bus and parent loading zones
    - Avoid shortcuts that parents can take during loading to avoid pedestrian conflicts
    - Provide short term parking near main entrance
- Supplemental devices
    - Where needed use traffic cones and signage to facilitate the movement of vehicles, pedestrians, and bicycles during loading times.

Plantings

MPS follows the list of non-toxic plantings produced by the Minnesota Poison Control Center. No plants that are listed as toxic are allowed to be planted on MPS grounds. Guidelines for site plantings are:

- Select low maintenance trees, shrubs, or native grasses that are drought tolerant.
- In areas where snow will be piled in the winter, select species that are salt tolerant.
- Avoid installing new non shrub or tree plantings and mulched area when possible
- Ensure adequate snow storage when designing new fencing and shrubs at parking lots.
- Pursue alternate compliance to avoid building tree islands within parking lots.
- Follow CPTED principals when designing trash enclosures and screes for ground level mechanical units

Site Surveys

MPS prefers to produce complete site surveys instead of small areas of a property. Please adhere to the following criteria when requesting proposals for a full site survey. All work must be performed and signed by a Minnesota Professional Land Surveyor in accordance to its legal requirements.

Survey Limits

Provide a site plan to describe the survey limits. This will nearly always be the property lines of the site in question.

Deliverables

- All plans will be
    - Created and provided as a pdf file from AutoCAD Civil 3-D or other approved software compatible with Revit software.
    - Provided with all pertinent AutoCAD Civil 3-D files using eTransmit.
- The drawings are to be submitted on a mylar material (a check plot can must submitted on paper for review before plotting to mylar).
- All title work will be provided

Requirements

Control

- Horizontal coordinates will be based in the Hennepin County Coordinate System.
- Vertical elevation will be North American Vertical Datum of 1988 (NAVD 1988).
- Permanent benchmarks in the form of the top of fire hydrants, if present, or other fixed features shall be located within the survey area.
- Show site benchmarks. Project site benchmarks shall be established by measurement from two local benchmarks.

Legal Description

- Full legal description including the bearing and distance of plats, easements, property lines, property boundary monument locations, property dimensions, existing structures on the property, structure setbacks to property lines, and lot corner elevations.
- Show the required primary setbacks from protected areas and site boundaries.

Topographic

- All topographic features located within the area identified shall be recorded and plotted: retaining walls, fences, bridges, swales, culverts, etc. Show the location, length, and height above finished grade of all fences, rockeries, and retaining walls. Note heights at end and mid points.
- Locate the center of all trees over 4" in diameter to within accuracy of plus or minus 0.5 feet. Record the size and species of all such trees.
- Identify on the drawing the surface materials, including sod, bituminous, concrete, dirt, gravel, etc.
- Locate all manholes, catch basins, valve boxes, etc. visible from the surface.
- An accurate location of any existing site improvements such as fences, light poles, play equipment/features, signs, etc. shall be identified and recorded.
- Provide spot elevations for building entrances, top and bottom of curbs, steps, concrete slabs, driveways, playground containers and any other features necessary to provide a clear and accurate representation of the site condition.
- Show the location of all existing buildings. Show the perpendicular distance to the property and right-of-way lines when significant to development.
- Show the streets, the right-of way lines, monument lines, edge of pavements, concrete surfaces, asphalt surfaces, gravel surfaces, and channelization if

relevant. Show the curbs, curb cuts, wheelchair ramps, gutter and flow lines, sidewalks, landscape areas, pedestrian and bike paths.

Contours

- In addition to all break points, provide a 50' foot grid with spot elevations located at intervals of 50' feet within the survey limits line area
- Show existing contours at 1-foot intervals for portions of the site with less than 5% slope, at 2-foot intervals for portions of the site with slopes greater than 5% and less than 40%. Identify slopes greater than 40%. Include the top of slopes greater than or equal to 40%.

Utilities

- The location of the existing utilities should be recorded, field-checked, and verified by review of the as-built drawings obtained from the utility owner. The size, use, and material of all utilities below ground should be indicated. A call to Gopher State One to locate all utilities within the Survey Limits line is recommended.
- Storm and sanitary sewer main size and direction of flow should be accurately determined and shown on the drawing. The inverts of all catch basins, storm and sanitary manholes and drains should also be accurately determined and shown on the drawing. When more than one sewer main, storm drain or catch basin run enters or exits from a storm or sanitary structure, individual inverts should be shown.

Playgrounds

Playgrounds are an important feature at MPS elementary schools. We strive to provide students with engaging outdoor play and exploration facilities that meet industry safety standards. When designing a playground keep in mind:

- Manufacturers guidelines for safety zones around moving equipment
- Fall heights
- Shock absorbent surfaces
- ADA guidelines
- Sight lines for supervision
- Separation of areas for toddlers, preschoolers, and school age children if applicable

In addition to the guidelines outlined here, playgrounds on Minneapolis Public Schools property must comply with:

- ASTM standards for public playgrounds
- Manufacturers requirements for installation and fall protection
- Public Playground Safety Handbook by the U.S. Consumer Product Safety Commission

Playgrounds may include and are not limited to:

- Rope or chain climbers on angles
- Climbing pieces
- Horizontal bars
- Cooperative pieces such as tire swings
- Slides
- Sliding poles
- Open spaces to run and play ball
- Exploration areas such as
    - Nature trails
    - Large composite structures
    - Play houses
    - Sand boxes
    - Sand diggers

Age Separation

Separate playgrounds into uses for 6 months to 2 years, 2 to 5 years, and 5 to 12 years of age to have distinct play areas. If a playground is planned for pre-k use, consideration should be taken to provide separate areas for the younger than school age children.

Conflicting Activities

Active, physical activities should be separate from more passive or quiet activities. Separate composite play structures that are very popular from one another to prevent overcrowding in any one area of the playground.

Safety zones around equipment

Follow all manufacturer's guidelines to allow adequate safety zones around play equipment. Examples of this include but are not limited to:

- Moving equipment such as swings
- Slide exits
- Composite play structures

Sight lines

Take care to ensure that adult supervisors are able to maintain clear sight lines of children at play. Play areas for children of varying ages should be close enough together that one care provider could supervise children in each area.

Absorbent surfaces

Install absorbent surfaces below play equipment per manufacturer's guidelines for critical fall heights.

Athletic Facilities

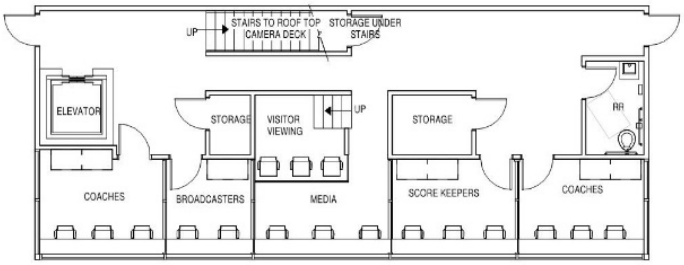
Outdoor

MPS maintains athletic facilities at our building sites as well as a handful of separate sites in Minneapolis. The district also has athletic facilities that are operated through a partnership with the City of Minneapolis Parks Department. MPS outdoor athletic facilities are operated in coordination with the Athletic Department and the Grounds Department. The outdoor athletic facilities may include:

- Athletic fields
- Track and Field facilities
- Pools

Athletic fields

All athletic fields that are used for competition should be fully enclosed with a lockable fence. Controlling entry to the fields allows events that charge admission to control attendance. It also allows the Grounds Department to close the field to allow it to regenerate in the case of grass fields. In addition to the playing surface of the field, facilities could include:



- Concessions stand
- Ticket booth
- Restrooms
- Locker rooms
- Storage room that is large enough for all the sports that use the field
- Bleachers
- Press box
- Scoreboard
- Football goal posts
- Soccer/Lacrosse/Field Hockey goals
- Baseball and Softball dugouts
- Practice equipment for various sports

Outdoor athletic fields can house any number of MPS athletic events or community events including and not limited to:

- Football
- Soccer
- Lacrosse
- Field Hockey
- Baseball
- Softball

Track and Field

High Schools within the district have track and field facilities on their building site or near the school. Tracks are often co-located with athletic fields and may share the same infrastructure amenities such as concessions and ticket booths. Equipment storage is often shared between athletic field sports and track. The running track should have:

- 400 meter length
- 110 meter stretch
- At least six lanes
- Sufficient quantity of adjustable height hurdles
- Surfaced in a shock absorbent material

Field events may include facilities for:

- Pole vault
    - Adequate length for runway
    - Adequate area for crash pad
    - Shock absorbent surface
    - Crash pad, cover, crossbar, and adjustable height standards
    - Pole vault box made of resilient material
- High jump
    - Shock absorbent surface
    - Adequate room for approach and crash pad
    - Crash pad, cover, crossbar, and adjustable height standards
- Long jump/Triple jump
    - Adequate length runway
    - Shock absorbent surface
    - Pit filled with absorbent material such as sand
- Shot put/Discus

- Implement deflection netting or adequate separation from other events
- Concrete throwing circle

Pools

MPS does not currently maintain outdoor pool facilities. Outdoor pools found on or near our district properties are maintained by the City of Minneapolis Park Board.

Classrooms

Academics are at the core of what we do and nowhere is that more important than in the various types of classrooms found within the district. Classrooms are grouped as:

- **Core Classrooms**: classrooms where a variety of coursework can be taught that does not require specialized equipment to be installed. The area, length of white board, and storage needs vary across grades.
- **Science Classrooms**: dedicated science classrooms are found in middle and high schools.
    - High school chemistry
    - High school physical science
    - High school physics
    - Biology and middle school science
    - General science
- **Arts Classrooms**: dedicated arts classrooms can be found across all grade levels.
    - Elementary
    - Middle School
        - Ceramics
    - High School
        - Ceramics
        - Darkroom Photography
        - Print making
- **Performing Arts Classrooms**
    - Dance
    - Theater
- **Music Classrooms**
    - Elementary
    - Middle and High School Vocal
    - Middle and High School Instrumental
    - Piano
    - Guitar
    - Sound Design
- **Career and Technical Education Classrooms**: can be found in high schools
    - Healthcare
    - Construction Labs
    - Automotive
    - Cosmotology

- **Physical Education Facilities**
    - Gymnasiums
    - Fitness centers
    - Locker rooms
- **Computer Labs**

Core Classrooms

High Schools

Core classrooms in high schools may be where math, English, foreign languages, history, and a variety of other courses are taught. These rooms need to accommodate a variety of subjects and must be flexible to changing curricular needs.

Spatial Guidelines

While many of the older buildings in the district do not meet these minimum area requirements, our guidelines for new construction of core classrooms or renovation that combines smaller rooms in to larger rooms in high schools are:

- Area per student = 26 sf
- Students per classroom = 34
- Area per core classroom = 900 sf

Infrastructure

These are not meant to be prescriptive and rigid guidelines, but rather goals to aim for in new construction and renovation.

- Flooring – Vinyl
- Area of windows = 90 sf
- Storage
    - 16 lf of base cabinets
    - 16 lf of wall cabinets
    - 4 lf of tall cabinets
    - 10 lf of shelves
- 12 duplexes (1 per 75 sf of floor area) evenly distributed around the perimeter of the room
- 1 wifi router
- 1 duplex in the ceiling for the wifi router
- 4 data ports on walls and one in the ceiling for the wifi router
- Voice port

- PA system
- Lighting
- 40-50 foot candles
- Clock
- Projector
- Sound system
- Interactive white board

Equipment

Equipment in a core classroom in a high school includes:

- White board – 24 lf
- Tack board – 16 lf
- Tack strip – 30 lf
- Teacher's desk
- Teacher's wardrobe

Middle Schools

While many of the older buildings in the district do not meet these minimum area requirements, our guidelines for new construction of core classrooms or renovation that combines smaller rooms in to larger rooms in high schools are:

- Area per student = 28 sf
- Students per classroom = 32
- Area per core classroom = 900 sf

Infrastructure

These are not meant to be prescriptive and rigid guidelines, but rather goals to aim for in new construction and renovation.

- Flooring – Vinyl
- Area of windows = 90 sf
- Storage
    - 16 lf of base cabinets
    - 6 lf of tall cabinets
    - 10 lf of shelves
- 12 duplexes (1 per 75 sf of floor area) evenly distributed around the perimeter of the room

- 1 wifi router
- 1 duplex in the ceiling for the wifi router
- 4 data ports on walls and one in the ceiling for the wifi router
- Voice port
- PA system
- Lighting
- 40-50 foot candles
- Clock
- Projector
- Sound system
- Interactive white board

Equipment

- White board – 14 lf
- Tack board – 8 lf
- Tack strip – 120 lf
- Teacher's desk
- Teacher's wardrobe

Elementary Schools

Elementary schools have a range of spatial guidelines. See below for specific requirements. The infrastructure that is common to all core classrooms in elementary schools:

- Flooring – Vinyl unless otherwise noted
- Area of windows – varies – see below
- Storage
    - 16 lf of base cabinets
    - 6 lf of tall cabinets
    - 10 lf of shelves
- 1 per 75 sf of floor area – see below plus one in the ceiling for the wifi router
- 4 data ports plus one in the ceiling for the wifi router
- 1 wifi router
- Voice port
- PA system

- Lighting
- 40-50 foot candles
- Clock
- Projector
- Sound system
- Interactive white board
- Toilet
- Sink that is mounted at a height appropriate to the students who use the room

Equipment

- White board – 14 lf
- Tack board – 8 lf
- Tack strip – 120 lf
- Teacher's desk
- Teacher's wardrobe

Spatial Guidelines

High 5 Half-Day

- Number of students: 40
- Square feet per student: 30
- Square feet per room: 1,200
- Square feet of windows: 120
- Cubbies: 20
- Student storage (instructional): 20
- Carpeted area: 800 sf

Kindergarten

- Number of students: 26
- Square feet per student: 46
- Square feet per room: 1,200
- Square feet of windows: 120
- Cubbies: 26
- Student storage (instructional): 26
- Carpeted area: 800 sf
- 15 duplexes (1 per 75 sf of area)

Primary (1st-3rd)

- Number of students: 26
- Square feet per student: 35
- Square feet per room: 900
- Square feet of windows: 90
- Student storage (instructional): 26
- 15 duplexes (1 per 75 sf of area)

Intermediate (4th-5th)

- Number of students: 32
- Square feet per student: 28
- Square feet per room: 900
- Square feet of windows: 90
- Student storage (instructional): 32
- 12 duplexes (1 per 75 sf of area)

Science Classrooms

Science classrooms require specialized equipment that varies based on the subject being taught and the grade level using the room. MPS does not have dedicated science classrooms in K-5 schools. General science classrooms can be found in middle and high schools. In addition, high schools will have classrooms where chemistry, physics, and physical science may be taught. When constructing new science classrooms please note that laboratories are considered an incidental use to Group E occupancy and as such will require a one hour separation.

High School

- All science rooms
    - Infrastructure needs
        - Dedicated room ventilation on a timer
        - Fire blanket
        - Fire extinguisher
        - Gas with master shut off valve
        - Goggle sanitizer
        - Increased number of outlets from core classroom
        - Resilient flooring such as VCT
        - Equipment that all science teachers can share includes:
            - One sink and dishwasher to wash glassware
            - One refrigerator and freezer to store samples for labs
            - One microwave
            - One deionizing station
    - Spatial needs
        - Chemical resistant lab tables
        - Chemical resistant topped counters
        - 60 sf per student
        - Storage

In addition to the infrastructure and spatial needs listed above, some courses have additional requirements.

- Chemistry
    - Vent hood that contains:
        - Gas valve(s)
        - Sink(s) with acid piping
        - Electrical outlet(s)

    - Sinks with acid piping connected to a neutralization tank
    - Peninsula style counters for lab work. Each station needs:
        - Gas
        - Sink with acid piping
        - Electrical outlet(s)
    - Eye wash station(s)
    - Emergency shower
    - Lockable chemical storage room with always-on ventilation
    - Flammable chemicals storage cabinet with dedicated ventilation
- Physical Science
    - Vent hood that contains
        - Gas
        - Sink(s) with acid piping
        - Electrical outlet(s)
    - Sinks with acid piping that are connected to a neutralization tank
    - Eye wash station(s)
    - Emergency shower
    - Secure ceiling support for hanging heavy objects such as a bowling ball
- Biology
    - Windows that provide daylight for plant growth labs or a grow light station
    - Sink (1) that can
        - Fill a five gallon bucket
        - Handle sediment in drainage
    - Sinks with standard piping
- Physics
    - Secure ceiling support for hanging heavy objects such as a bowling ball
- Earth/Environmental Science
    - Windows that provide daylight for plant growth labs or a grow light station
    - Sink (1) that can
        - Fill a five gallon bucket
        - Handle sediment in drainage
    - Sinks with standard piping
- General Science
    - No additional equipment beyond core science classroom needs

Scheduling science electives

Base the room requirements on the academic standards that align best to the elective science course. If an elective will need daylight for growth labs then the course should be scheduled in a biology room. If the elective has a chemistry focus and access to a fume hood and use of strong acids is required then the course should be scheduled in a chemistry room.

Middle Schools

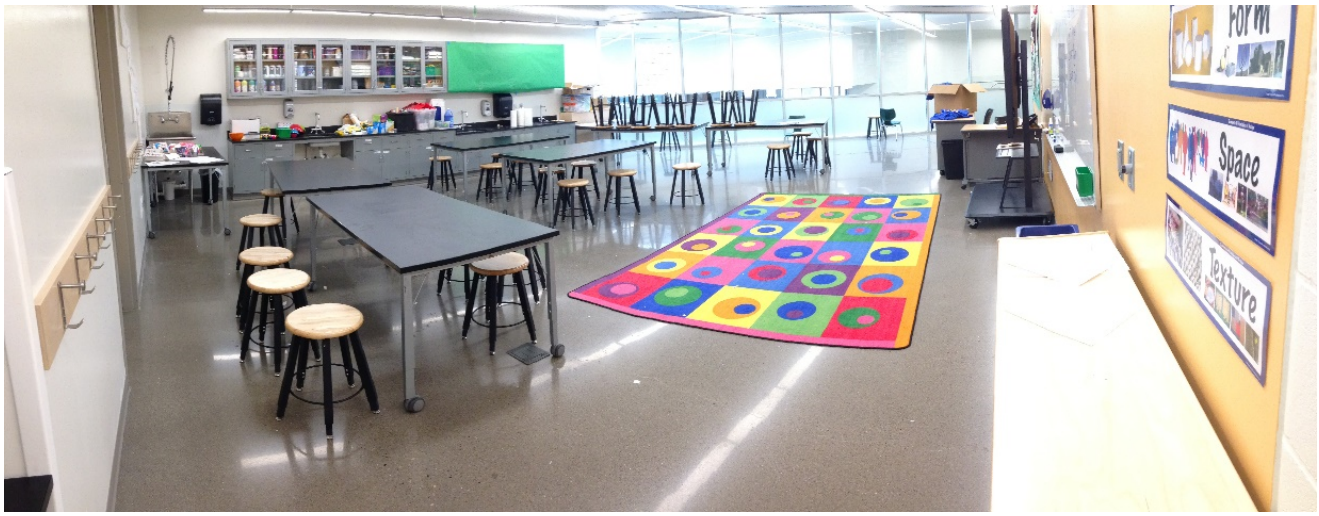
Middle School Science Classrooms all need some basic infrastructure including:

- Infrastructure needs
    - Dedicated room ventilation on a timer
    - Fire blanket
    - Fire extinguisher
    - Gas nozzles distributed at work stations
    - Gas with master shut off valve
    - Goggle sanitizer
    - Increased quantity of electrical outlets from core classroom
    - Resilient flooring such as VCT
    - Eye wash station(s)
- Spatial needs
    - Lab tables with chemical resistant surfaces
    - Counters with chemical resistant surfaces
    - 60 sf per student
    - Storage

The curricular needs in Middle School science classrooms do not necessitate acid piping, fume hoods, or neutralization tanks. These classrooms do not need deluge showers. The layout of the rooms will resemble science classrooms in high schools with lab tables and lab stations at counters.

Elementary Schools

MPS does not have dedicated science classrooms in elementary schools.



Visual Arts Classrooms

Facilities requirements and furniture needs in visual arts classrooms vary by age and use. The elements that are required in all visual arts classrooms are:

- Plumbing
  - Five or more sinks per classroom that are mounted at the height of the students using them
  - Faucets should reach the middle of the sink
  - Sinks should be distributed around the perimeter of the classroom
  - Backsplashes and counters should be made of a material that will frequently be wet and not swell
  - Utility style sinks are preferred
  - Teacher sink
    - Large enough to spray a screen
    - Provide sprayer on a hose
    - Drain should be able to handle sediment
- Electrical
  - Equipment that may have a high plug load includes:
    - Kiln
    - Electric turning wheels
    - Computers in media arts classrooms
  - Provide at least seven (7) duplex that are evenly distributed around the room
- Exhaust
  - Kiln should be in a room with dedicated ventilation

    - Painting booths should be in a room with dedicated ventilation
- Finishes
    - All surfaces should be easy to clean and it should be assumed that they will frequently be wet
    - Floors near sinks should be slip resistant and be easily cleanable
- Furniture
    - All furniture should be sturdy and durable
    - Provide sufficient lockable storage for supplies
        - Flat storage for paper
        - Flammable storage cabinet with ventilation in middle and high school visual art rooms
    - Drying racks for flat work
    - Shelving or cubbies for student work that is in process that is mounted at the height of students who are using it
    - Drying racks for clay
    - Separate and lockable material storage room for teacher
    - Large work tables for groups of six students
    - Area to store backpacks and books for other classes
    - Display cases in the classroom or in the corridor for student work
- Equipment
    - Kiln
    - Wall mounted clay press
    - Electric turning wheels
    - Large paper cutter

High schools will have elements that are not recommended for elementary and middle schools including:

- Paint booths
    a. Dedicated and adequate ventilation on a timer
    b. Dedicated room
    c. Work surface for painting
    d. Area to allow work to dry
- Oil painting and associated thinners and cleaners

- Photography dark rooms
    a. Light lock
    b. Sink
    c. Adequate counter or table space for chemical baths
    d. Area to hang prints as they dry
    e. Enlarger
    f. Development equipment
    g. Storage
    h. Ventilation
    i. Dark room lighting

- Print making
- Paper making
- Ceramics
    a. Sinks that can handle sediment
    b. Durable floors that are easily cleaned
    c. Counters that can frequently be wet
    d. Wall mounted clay press
    e. Shelves to dry student work
    f. Kiln
    g. Electric turning wheels
    h. Seating that is easily cleaned and can frequently be wet
- Flammable chemicals such as
    a. Paint thinner
    b. Acetone

Arts classroom equipment examples

Performing Arts Classrooms

Performing arts classrooms include black box theaters, auditoriums, and dance studios.

Dance

Dedicated dance studios may not be able to be used for other functions. Ideally, the studio has a sprung floor on which nothing heavy is stored.

Plumbing

- Drinking fountain with bottle filler is preferred but not required

Electrical

- No additional outlets are required beyond core classroom requirements
- Robust sound system that can play a variety of media

HVAC

- Dedicated thermostat to control room temperature

Changing rooms

- Multi occupant, single gender dressing rooms
- Provide at least one single stall, all gender changing room
- Storage for student belongings near the door
- Shoe rack near the door

Office

- Office should be in a separate room, or at least off of the sprung floor

Finishes

- Provide a sprung floor for dancing
    a. Marley
    b. Sprung wood
- Nothing should be stored on the sprung floor
- Mirrors
    a. Mirrors should be continuous, wall mounted
    b. Provide a curtain to cover them

Storage

- Shoe storage for course specific shoes like tap or ballet
- Costume storage

Equipment

- Portable ballet bar

Theater

Theater may be taught in a variety of environments including a black box theater, a core classroom, or an auditorium. When available, a black box theater with room to accommodate a small audience is the preferred environment for teaching theater. An auditorium is adequate, but can be difficult to schedule since it is used for large assemblies throughout the academic year.

Black Box Theater

Plumbing

- None required

Electrical

- No extra outlets required beyond core classroom capacity
- Provide a sound system that can both pick up student voices and play soundtrack audio
- Provide performance lighting that can be adjusted

HVAC

- No additional requirements

Office

- Separate instructor office is preferred

Storage

- Storage needs include:
    a. Costumes (may be in auditorium)
    b. Props (may be in auditorium)
    c. Student area to drop backpacks near the door

Equipment

- Portable risers
- Upright flat panels that can be moved and painted for productions

Space

- Classes can be up to 40 students
- Provide room for performance seating as well as flexible, open space for teaching
- If possible, provide up to 2000 sf in an open and flexible layout
- Minimal set building may happen in the space
- Stacking chairs are preferred for flexibility
- Windows are not preferred and if present, should have black out window treatments

Auditorium

In addition to theater, the auditorium serves as a large group meeting space for the entire school. It is not an ideal theater classroom due to scheduling challenges but it may be used for theater events.

Plumbing

- None required
- If accessory space allows for a green room or dressing room(s), provide one sink

Electrical

- Provide electrical for lighting
    a. Front
    b. Top
    c. Side
- Sound system
    a. Pick up and amplify student voice
    b. Play soundtrack audio
- Microphones
    a. On stage
    b. Portable
    c. Lavalier
- House lighting
    a. Aisle wayfinding lighting
    b. Overhead lights

HVAC

- No needs beyond heating, cooling, and ventilating a large assembly area

Spatial

- 40'x40' stage is ideal
- Provide room in front of the stage for a pit band
- Provide fixed house seating
- Wings should be at least 10' deep
- Sound and light lock at main house doors are preferred

- Storage behind the curtain for props
- Green room and/or dressing room(s) near the stage are preferred

Acoustics

- This is a general purpose space and should be able to accommodate:
    a. Projecting voice
    b. Instrumental music
    c. Vocal music
    d. Recorded music
- Provide a choral shell to augment live music
- Provide acoustical strategies to house wall and ceiling as needed

Sound and Lighting booth

- Located in balcony
- Sound and lighting controls

Equipment

- Rigging
- Stage curtains
- Retractable scrim(s)
- Storage racks
- Portable Marley floor for dance performances
- Stage sets

Storage

- Provide a way to store rolls of Marley floor
- Prop storage
- Costume storage

Cafetorium

Some buildings may have a cafetorium, or a cafeteria and auditorium combined into the same space. When possible, the equipment should be similar to an auditorium.

Music Classrooms

Music classrooms vary by grade level and range from general music classrooms in elementary schools to specialized sound design classrooms in high schools. When possible, music classrooms should be remote from other classrooms to minimize sound disruptions.

Middle and High School Instrumental

Plumbing

- Large utility sink for washing wind and brass instruments is preferred

Electrical

- Provide adequate outlets for electric pianos
- Sound system that can record student music and play soundtrack audio

HVAC

- No additional HVAC required

Space

- Built in risers
- Carpet is preferred for acoustics
- Capacity can exceed 50 students
- Practice room(s)
- Ideally instrumental classrooms are remote from other classrooms

Storage

- Stacking chairs
- Music stands
- Instruments that range in size from small to very large
- Electric Pianos
- Lockable cabinet for headsets
- Sheet music

Acoustics

- Acoustical treatments that may include
    - Sound panels on side, front, or rear walls
    - Carpet
    - Acoustical ceiling tile
    - Treatments to prevent sound transmission to other classrooms
    - Design space for acoustical optimization

Piano Classrooms

Electrical

- Outlets distributed around room
- Sound system that can record student music or play music

Storage

- Sheet music
- Music stands
- Electric pianos
- Lockable cabinet for headsets
- Chairs

Guitar Classrooms

Guitar may be taught in instrumental or piano rooms. If it is in a dedicated room it will need chairs, music stands, and storage for sheet music. Provide storage for guitars.

Middle and High School Vocal

Plumbing

- Water fountain with bottle filler is preferred.

Electrical

- Sound system that can record student voice and play soundtrack audio

HVAC

- No additional requirements

Space

- Built in risers that can fit chairs
- Capacity for upwards of 80 students in high schools, 60 students in middle schools
- Space for electric, upright, or grand piano for accompaniment
- Practice room(s)

Acoustics

- Carpet
- Sound panels on side, front, or rear walls
- Acoustical ceiling tiles
- Design space for acoustical optimization

Storage

- Costumes
- Sheet music
- Stacking chairs
- Music stands
- Lockable filing cabinets
- Area for student belongings near door
- Separate teacher office is preferred

Sound Design and Recording

Plumbing

- No additional requirements

Electrical

- Sound system that can record student music and play soundtrack audio
- Extra outlets that are distributed around the room for student workstations
- Laptop cart or dedicated student computer stations

HVAC

- No additional requirements

Space

- Provide student work stations that can accommodate
    a. Laptop, tablet, or computer
    b. Headsets
    c. Electric piano
    d. Other musical equipment

General Music

General music rooms are found in elementary schools and support a variety of music instruction including instrumental, vocal, and movement activities.

Plumbing

- Large utility sink and drinking fountain with bottler filler is preferred.

Electrical

- No additional requirements

HVAC

- No additional requirements

Space

- Risers are not needed and flat floor is preferred
- Carpet is preferred as students may sit on the floor
- Capacity will be similar to core classroom capacity for the age group

Equipment

- Flip forms in place of risers
- Music stands
- Electric, upright, or grand piano for accompaniment

Storage

- Shelves for bins of small instruments
- Space for hand drums
- Sheet music
- Xylophones and recorders
- Separate and adjacent storage area is preferred since instruction requires the use of a variety of instruments

Career and Technical Education Classrooms

Career and Technical Education classrooms are found in high schools. When possible, it is ideal that the classrooms and labs represent the industry for which students are being trained in order to simulate their future work environment.

HealthCare

Classrooms used to teach healthcare skills should resemble real world working environments as much as possible in order to familiarize students with professional settings. A healthcare room could include:

- Simulator Room
    - One hand sink
    - 4-6 hospital beds with adequate room for groups of six students to stand around each bed
    - Room should resemble a hospital room but does not require a bathroom
    - Washable flooring, no carpet

- Instructor office that is big enough to meet with students

Automotive

- Automotive repair classrooms should resemble real world working environments as much as possible in order to familiarize students with professional settings. An automotive classroom and shop could include:
- Concrete floors with a trench drain
- Concrete walls that are painted
- High ceilings
- Garage door(s)
- Dedicated exhaust that can be switched on and off
- Hose system to evacuate vehicle exhaust
- Fluids storage room that is lockable
    - Flammable fluids should be stored in a locked, ventilated cabinet
    - Non-flammable
    - Used fluids

- Paint booth with dedicated exhaust
- Electric needs include:
    - Hoist
    - Air compressors
    - Portable welding units
    - Drill presses
    - Lathe
    - Grinders
    - Buffers
    - Tire mounting
    - Electric and air powered tools
    - Emergency shut off that can turn all the tools off in the room
- Plumbing needs include:
    - Utility sink that can handle grease and sediment
    - Mop sink that can handle grease and sediment
    - Floor drains that can handle grease and sediment

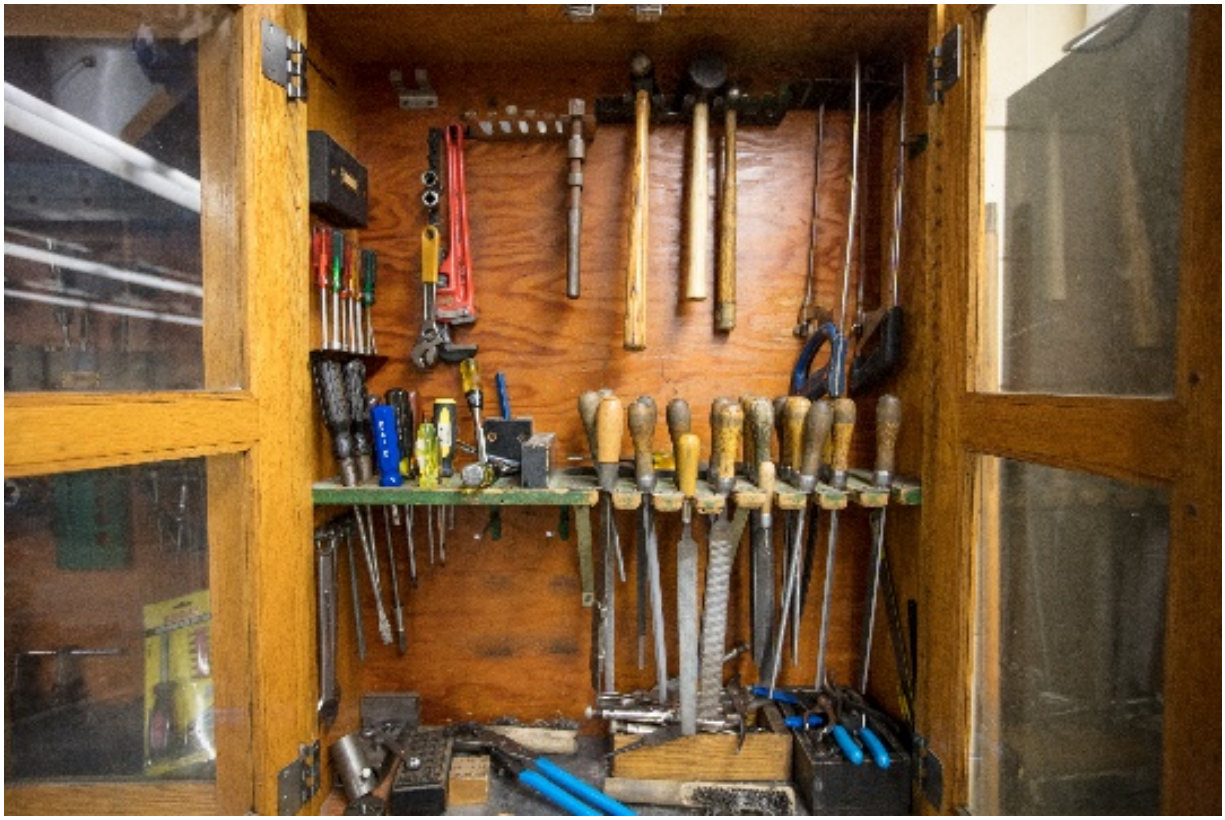
        - Eye wash station(s)
        - Emergency shower(s)
- Classroom that is adjacent to the shop area
    - Storage
        - Text books
        - Simulators
        - Cart
        - Double doors that allow large equipment to be rolled in and out
    - Furniture
        - Durable resin surfaces
        - Tables that can seat at least two students
        - Laptop cart

Construction Lab

Classrooms used to teach construction should resemble real world working environments as much as possible in order to familiarize students with professional settings. A construction lab could include:

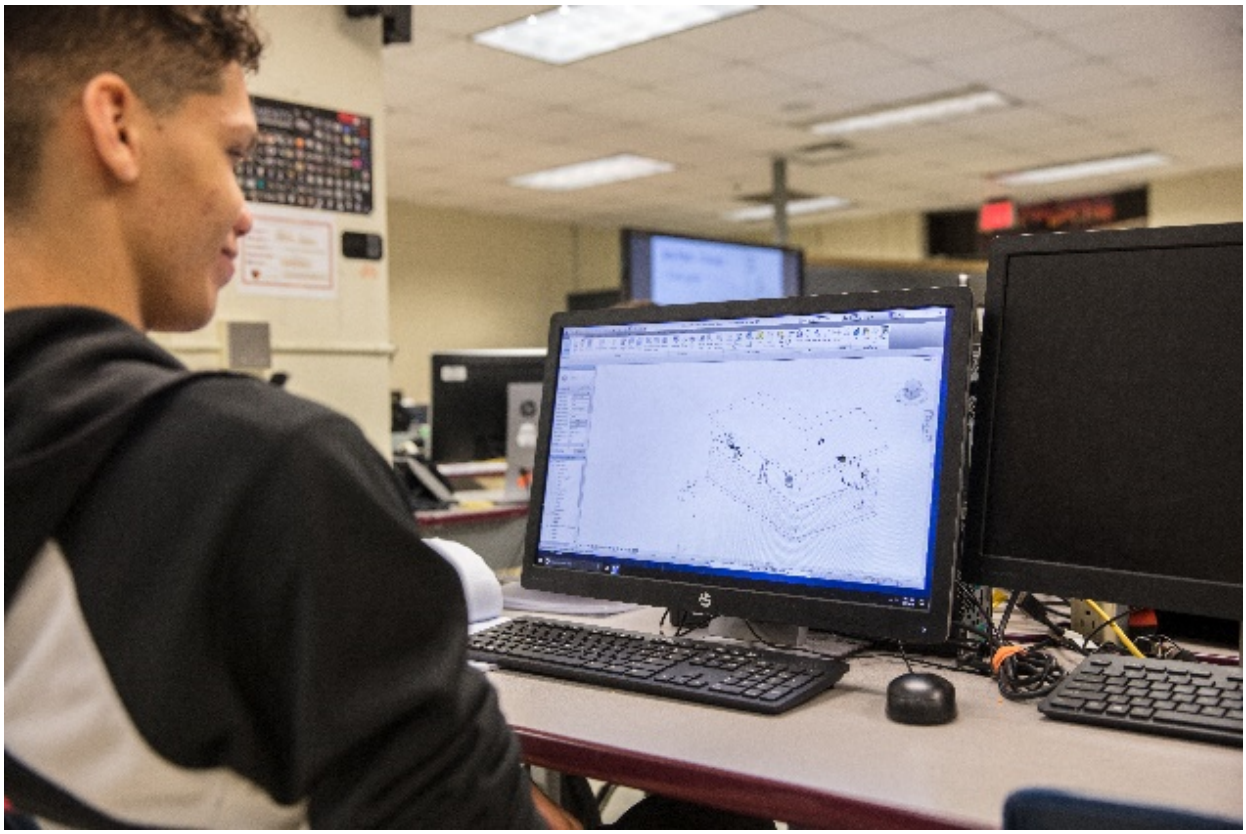
- Concrete floor
- Concrete walls – painted
- Dust collection system
- Floor drain(s) that can handle grease and sediment
- Paint booth with dedicated ventilation
- Tool storage room that
    - Has robust storage system
    - Can be locked
- Materials storage
    - Wood
    - Metal

    - Sheet materials as well as long materials
    - Does not need to be locked
- Utility sink that can handle grease and sediment
- Staging area for protective equipment
    - Hooks to hang student belongings
    - Storage for:
        - Eye glasses
        - Welding gloves
        - Welding jackets
        - Ear protection
        - Project gloves
        - Back up clothes
- Electrical needs:
    - Some 220 outlets
    - One circuit per piece of fixed equipment
    - Emergency shut off switch that can turn all tools off at once



- Layout
    - Provide sight lines so instructor can supervise all students and tools

    - Material storage is ideally near the garage door to facilitate loading and unloading
    - Provide a double door to the corridor
    - High ceilings
- Classroom:
    - Should be adjacent to shop
    - Have borrowed light windows for shop observation
    - Furniture should be durable
    - Tables that can seat two students
    - Tables with resin tops
    - Laptop cart
- Audio system in shop so teacher can teach and be heard over tools



Computer Labs

Desktop Computer Labs

Dedicated computer labs that have desktop computers need adequate electrical and data connections.

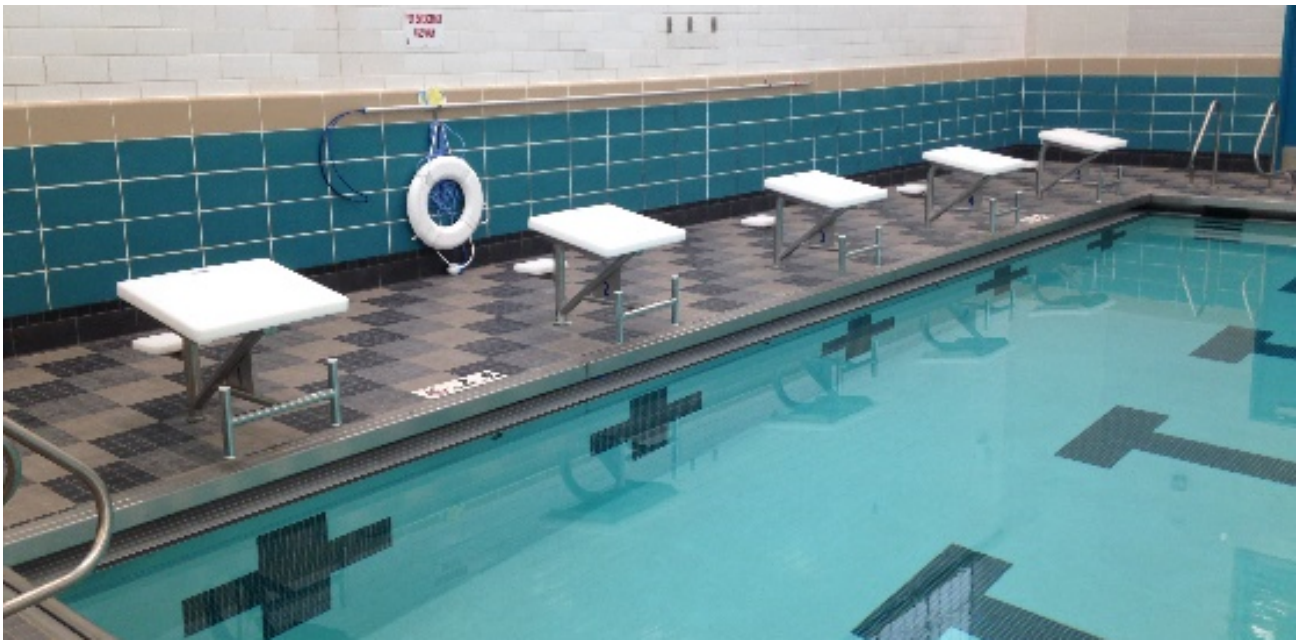
- Electrical: No more than three desktop computers per 20 amp circuit
- Data: One data jack per desktop computer

Laptop Carts

Laptop carts provide a way to allow an entire class to use computers in any classroom in a school. IT services has a standard of one wireless router per classroom that can support up to 50 wireless devices. As such, no additional data is required in a room. Laptops are charged on the cart and do not require additional electrical service in the room in which they are used.

Physical Education Classrooms

Physical education classrooms include gymnasiums, fitness centers, and outdoor athletic facilities. See the section on site for outdoor athletic facilities guidelines. See the section on Athletics for indoor athletic facilities. Whenever possible, locker rooms may be provided for physical education classes that are separate from athletics locker rooms.



Athletics

Outdoor athletic facilities are described in the Site section. Indoor athletic facilities may include gymnasiums, fitness centers, and locker rooms. Indoor athletic facilities may include:

- Pool
  - Diving
  - Starting blocks
  - Life guard equipment
  - Lane dividers
  - Resuscitation equipment
  - ADA compliant pool lift(s)
- Competition Gymnasium
  - Basketball
  - Volleyball
  - Badminton
  - Bleachers
  - Buffer zones
    - 10-12' at baseline
    - 8-10' at sideline
  - Score table
  - Sound system

    - Score board
    - Wall padding along baseline
- Auxiliary gymnasium
    - Athletics practice
    - Junior Varsity competition events
- Locker rooms
    - Large lockers for seasonal equipment
    - Showers
    - Toilets
    - White board and projection area

- Training room
    - Whirl pool tub(s)
    - Ice machine
    - Refrigerator
    - Tables
- Equipment storage
    - Seasonal storage
    - Equipment check in and check out
- Athletic department offices
    - Athletic director
    - Multi occupant, gender separated coach's offices
- Fitness centers
    - Weights
    - Cardio
    - Multipurpose room

Food Service

Food service in schools can be prepared fresh on site or pre-prepared and delivered for service. Kitchens will vary depending on the type of service and school enrollment.

Kitchens

Electrical

- Provide adequate electrical service to kitchens for all equipment per manufacturer's requirements.
- Ensure adequate task lighting at food preparation stations.
- Food service areas will have screens that display the daily menu.
    - Provide power and hard wired data for all required screens. Do not assume that wifi will provide adequate data during lunch periods.
    - Screens should be in queuing areas as well as over each station in a high school.
- Point of Sale devices should be hardwired for data.

Plumbing

Provide adequate supply and drain plumbing lines to all sinks. Provide drain lines to equipment per manufacturer's specifications. Providing a single stall toilet in an existing kitchen is a low priority as space is a premium in these areas.

HVAC

Provide adequate ventilation for all ovens and equipment. Ventilation is needed for:

- Ovens
    a. Grease laden vapors
    b. Heat exhaust
- Stoves
    a. Grease laden vapors
    b. Heat exhaust
- Walk in cooler and freezer compressors if located indoors
- Equipment that generates heat

Finishes

Kitchens must have washable surfaces that comply with all building codes and health department regulations.

Equipment

Food prepared off-site

- Provide adequate cooler storage and reheating equipment

Salad Bar

- Salad counter with sneeze guard
- Cashier counter
- Point of sale
- Mobile milk refrigerator
- Condiment counter
- Silverware and napkin dispenser

Food prepared on-site

- Cold prep area
    a. Fruit sectionizer

b. Food processor
c. Slicer
d. Utility cart(s)
e. Mobile table(s) with drawer
f. Electric can opener
g. High volume mixer
h. Mobile pan rack(s)
i. Reach in refrigerator
j. Pan storage shelving
k. Utility cart(s)

- Hot prep area
  a. Combi oven(s)
  b. Stove(s)
  c. Reach in freezer
  d. Work table(s)
  e. Pass through hot food cabinet
  f. Pass through refrigerator
- Hot and cold food serving line
  a. Tray cart(s)
  b. Hot food counter
  c. Multiple well hot/cold food unit(s)
  d. Sneeze guards

Dry Storage

- When possible, locate storage in an area that is convenient to the loading dock for deliveries.
- Dry storage shelving
- Employee lockers
- Walk in cooler
- Walk in freezer

Dishwashing

- Dish drop counter
- Trash/recycling/organics bins
- Sink with sprayer and garbage disposal
- Dishwasher
- Three basin pots and pans sink
- Hand sink

- Tray and dish racks

Staff office

- When possible in high schools, locate the staff office with a door to a corridor to facilitate student transactions.
- Provide a borrowed light window to allow for kitchen supervision from the staff office.
- Provide small lockers for employee belongings.

Cafeterias

Plumbing

Provide adequate water fountains

Seating

Provide a mix of seating options that may include:

- Rectangular tables
- Circular tables
- High top tables with stools
- Counters with stools

Trash

- When possible, locate cafeterias near the loading dock to facilitate trash removal.
- Trash cabinet
- Recycling cabinet
- Compost cabinet

Media Centers

Media Centers may be found at any grade level throughout MPS buildings. They are a resource to the entire school community. Media Centers house a variety of collections and service a variety of purposes including quite work spaces, group meeting spaces, and computer labs. Media Center design guidelines may be found in Appendix A: Media Center Resources. In addition to the guidelines in Appendix A, some items to keep in mind are:

- Full height walls are necessary in separate rooms within the media center
- Shelves should be arranged at the perimeter to allow for flexibility of configurations in the center
- Mobility and flexibility is critical
- Spatial needs include:
    a. Separate production room for audio and video production
    b. Teaching space that resembles or is a core classroom within the media center. Provide borrowed light windows to the media center.

c. Office for staff usually includes the IT field tech and has high requirements for electric and data.
d. Computer lab with borrowed light windows into the media center. If possible a laptop cart can be used in the classroom that is within the media center.

Administration

Administrative suites may contain:

- Principal's office
- Assistant principal's office(s)
- Reception
- Work room
- Secured file room
- Health office
- Counseling office(s)
- Administrative support functions

Whenever possible, locate administrative suites near the main entrance to the building to allow for adequate supervision.

Restrooms

Elementary Schools

When possible, provide home-like restrooms that include:

- Single occupant restrooms that have one toilet and one sink
- Full height doors and walls

Middle and High Schools

Single Gender, Multiple Stall Restrooms

- Design single gender, multiple stall restrooms to allow for supervision and safety.
    - Locate all restroom facilities in high traffic areas to facilitate supervision
    - Design restrooms so one adult can supervise them
- Specify toilet partitions that are made of a durable material
- Install shields over gaps between doors and panels to allow for visual privacy.

All Gender, Single Stall Restrooms

- Provide single occupant restroom(s) that:
    - Have full height walls
    - Have a lockable door
        - The lockset must have a visual indicator on the outside of the door
        - Staff must have a key to override a locked door
    - May be used by any student or staff person
    - Toilet rooms may contain sinks or a common wash fountain can serve a cluster of toilet rooms

Support Rooms

Some schools may have additional staff and student support spaces depending on the needs of building occupants. These rooms may include:

- Facilities to support commuting by bicycle
- Lactation room
- Worship room

Bicycle commuting support spaces may include:

- A bathroom with shower stall
- Lockers for changes of clothes
- Bike racks
- Indoor bike storage

Lactation rooms can be provided for students or staff who need to use a breast pump while on school grounds. The room may have:

- Sink and counter with a drying area
- At least one electrical outlet
- Chair and table
- A locking door that indicates if the room is being occupied
- The ability to be scheduled in advance
- Shelving for pumps, and pump parts
- Refrigerator with freezer

Worship rooms, or prayer rooms, provide a quiet space for worship. They should be available to any student or staff person who wishes to worship on school grounds. Rooms can include:

- A door that closes
- Adequate open floor area for prayer rugs
- Shelving to store rugs when not in use
- Seating to accommodate occupants if needed
- Foot washing station that includes:
    - A seat
    - A hose bib that is mounted below 24" above finished floor or a bib and a hose that delivers water within 24" of the floor
    - A basin to catch waste water

Entrances

Ideally main entrances to schools are:

- Easy to identify for visitors approaching a school
- Conveniently located for pedestrian and vehicular access for departure and arrival
- Located near the main office
- Designed with Crime Prevention Through Environmental Design (CPTED) principals in mind
    - Visitors must check in at a security desk before entering the school
    - Reception can visually supervise the entrance
    - The building can be locked down in the event of an outside threat

Loading Docks

Loading docks may contain:

- Trash/recycling/organics dumpsters
- Space to store kitchen deliveries
- Space to store deliveries for building engineers
- Space to store deliveries for classrooms
- Large storage may be needed for CTE classrooms if they do not have their own delivery door

Whenever possible, locate loading docks near kitchens to facilitate arrival of supplies and trash hauling. Design raised loading docks to facilitate loading and unloading of goods.

Mechanical Systems

Mechanical Rooms

Mechanical rooms may be located within the building or mechanical units may be placed on the roof or in penthouses. Mechanical rooms within the building must either be locked to prevent student access, or mechanical units must be placed in a way that students cannot access them. MPS prefers that mechanical units are mounted on the floor to facilitate maintenance and repairs.

Electrical Rooms

Electrical rooms in MPS buildings must be secured to prevent student access.

Water Service

Water service rooms in MPS buildings must be secured to prevent student access.

Data Closets

Data racks may be in dedicated closets or located in closets with electrical panels. They are ideally spread throughout the school to make cable runs efficient. These closets must be secured to prevent student access.

Server Rooms

Schools may house server rooms that contain file servers as well as security camera servers. The rooms need adequate electrical and data service. They may not contain plumbing fixtures. They must be secured to prevent student access.

Penthouses and Attics

Mechanical equipment may be located within penthouses. Roof access must be provided to facilitate maintenance and repair of equipment. Ships stairs are preferred to allow maintenance staff to safely access roof top equipment. Clear space around mechanical equipment must be adequate to access equipment. Provide a hose bib and floor drain or slop sink to accommodate cleaning within penthouses.

If mechanical equipment is mounted on the roof outside of a penthouse, install the equipment on steel supports such that a clear space is maintained below the unit to access and replace the roof if needed.

Crawlspaces and Tunnels

Crawlspaces at ground floor are found in many MPS buildings. They should all have concrete floors and lighting. Crawlspaces must be secured to prevent student access.

Crawlspaces should be maintained free of excessive belongings to allow maintenance staff to access mechanical equipment.

Tunnels in MPS buildings must be secured to prevent student access.

Storage

Maintain required means of egress clear of any stored objects. This includes:

- Corridors
- Stairs
- Entrances and Exits

Instructional Materials

Each classroom type requires a varying type of storage. Storage beyond what can be kept within a classroom may be needed. When possible, locate secondary instructional storage near to the classroom that needs to access it. Instructional materials may not be stored in mechanical rooms.

Furniture

Furniture that is not currently in use may be stored within school buildings. Building custodial staff may determine where to keep furniture as long as it does not block a required means of egress or prevent maintenance personnel from servicing building systems equipment.

Apparel

Schools may maintain a supply of backup clothing that is accessible to students at the building administration discretion.

Hazardous Materials

- Store flammable chemicals in an approved cabinet.
- Store hazardous chemicals in a room that has adequate ventilation.

Security

Required Security and Surveillance equipment

- Surveillance cameras and server
- Door access control
    - Buzzers with cameras
    - RFID card readers
- Motion detection / intrusion alarm system
- Burglar alarms
- PA system

Recommended Security and Surveillance Equipment

- Doors with Mag Locks *(only allowed at doors where mag lock equipment is already in place and in use, may not be installed at new door locations or at new sites.)*
- Bollards to prevent vehicles from driving onto outdoor gathering spaces
- Fencing at parking lots and/or entrances
- Main office and reception layout that is conducive to surveillance of the main entrance
- Security desks at the main entrance
- Exterior lighting that illuminates all corners of the building

Systems indirectly related to security

- Restroom designed to facilitate surveillance
- Clocks, which may be tied into the PA system
- Indoor lighting upgrades improve the image quality for security footage
- Fire alarms
- Backup generators that power emergency egress lighting

Required Surveillance Cameras distributed by area:

Cameras (min)	**Area**
2	Main entrances (any doors with controlled entry, or doors commonly left unsecured)

2 per floor	Main traffic corridor
2	Corridor outside restrooms
1	Cafeterias
1	Parking lots

Secondary Security Camera Coverage

Cameras may be provided in these areas as needed:

- Exterior corners of building
- Perimeter of the building
- Parking lots other than primary parking
- Bus Arrival/Departure zones
- Primary corridors with student traffic
- Secondary building entrances
- Common areas
- Outside computer labs
- Outside media center
- Outside rooms where expensive and mobile IT assets are stored
- Stairwells
- Playgrounds and outdoor activity areas
- Additional remote access points as needed
- Additional RFID access points (these are only implemented if there are active doors that are not equipped with other controls and are in high traffic areas, primarily in larger buildings.)

Additional Coverage As Needed

- Additional corridors, entrances, student accessible areas like gyms, auditorium, and offices

Exterior Coverage As Needed

- Anti-climbing measures should be taken where applicable
- Increased lighting in areas that are off camera
- Increased lighting in areas where people could hide

Areas that May not be Covered by Cameras

Areas that have a reasonable expectation of privacy may not be covered by security cameras. These areas include and are not limited to:

- Workspaces
    - Classrooms
    - Offices
    - Counseling offices
- Locker rooms
- Restrooms
- Lactation rooms
- Prayer rooms

Remote access doors

- One (1) master station
- Two (2) remote access entrances
- Three (3) to four (4) points for RFID/Proximity card access
    - Main entrance
    - Staff/parking lot entrance
    - Facility/engineer entrance
    - Gym/activity entrance
    - Food service/loading dock

Public Announcement (PA) System

- The PA system should be audible in
    - corridors
    - classrooms
    - cafeterias
    - multipurpose rooms
    - conference rooms
- New PA systems shall have an integrated UPS (uninterruptable power supply) that shall provide a period of use in the event of a power outage.

Back-up generator

- Back-up generators are intended to power the emergency egress lighting.
- Elements other than emergency egress lighting that are connected to the generator must be connected to a separate transfer switch.
- Additional elements on the generator will be determined based on site need.

Burglar Alarm system

- all first floor rooms and corridors
- door contacts on RFID accessible doors
- glass break alarms inside spaces with storefront or curtain wall glazing

First floor glazing

MPS recommends the use of laminated glass on first floor applications of windows, storefront, and curtain wall systems to reduce the incidence of broken first floor windows.

Elementary (K-2, K-3, K-5)

Early elementary schools should have 12-20 cameras per site. The Office of Safety and Security (OSS) will determine final camera position and count. In general, coverage should include:

- Eight critical shots
- Four cameras in secondary or external areas

Elementary (K-8)

Elementary schools should have 18-32 cameras. The Office of Safety and Security (OSS) will determine final camera position and count. In general, coverage should include:

- Twelve critical shots
- Six cameras in secondary or external areas

Middle School

Middle schools should have 40-50 cameras. The Office of Safety and Security (OSS) will determine final camera position and count. In general, coverage should include:

- 26 critical shots
- 14 cameras in secondary or external areas

High School

High schools should have 60-90 cameras. The Office of Safety and Security (OSS) will determine final camera position and count. In general, coverage should include:

- 40 critical shots
- 20 cameras in secondary or external areas

All other district sites

These sites need to be addressed on a case by case basis.

Environmental Health and Safety

Environmental Health and Safety covers conditions during construction as well as requirements for safe and healthy environments post construction. All contractors much comply with all applicable state and federal guidelines and MPS reserves the right to review and modify any safety plans. This could include and is not limited to: accident & injury reduction, asbestos, employee right-to-know, lockout/tagout, forklift safety, bloodborne pathogens, hazardous waste, chemical hygiene, hearing conservation, playground safety, community right-to-know, indoor air quality, radon, compressed gas, infectious waste, respiratory protection, confined space, lead in construction, technology education, emergency preparedness, lead in water, and underground storage tanks.

Abatement

Efforts should be made to abate hazardous materials outside of school hours.

Construction Phasing

Heavy construction and demolition should be completed outside of school hours and behind barriers that prevent dust and noise from transmitting to occupied portions of the building.

Indoor Air Quality

Follow the Indoor Air Quality Design Guidelines which can be found in Appendix B.

Lead in Water

When reasonable, water testing should be done as part of capital improvement and renewal work. If capital work can remove the source of lead in water that is recommended.

Noise

Loud construction noises should not occur during school hours. All spaces should be designed according to the acoustical design guidelines which can be found in Appendix C.

Roofs

If designing new roof access, MPS prefers the use of ship's stairs to provide safe access to maintenance staff to replace filters and maintain roof top equipment. All roof top work must comply with state and federal guidelines for fall hazards. Avoid details that provide easy and unauthorized access to roofs.

Soils

If excavating for a construction project perform environmental soil tests to avoid unforeseen conditions.

Gifted and Volunteer Construction

All gifted and volunteer construction projects are subject to review and approval of Capital Planning and Construction Management. All volunteer and gifted construction efforts must conform to:

- Current industry-standard building codes
- Current industry-standard construction safety regulations
- MPS design guidelines and requirements
- MPS master specification requirements
- MPS master plan
- Review MPS' procedure for accepting gifted funds and gifted volunteer construction: Standards of Operations – Capital Construction Process for Accepting Donated Funds for Capital Construction

Appendices

Appendix A: Media Center Resources

MPS Library Shelving & Allotment Standards

(as of 11/20/2017)

Collections Development Goals

- 20 exemplary materials per student:
    - Elementary: 15 Physical, 5 digital
    - Middle School: 13 physical, 7 digital
    - High School: 10 physical, 10 digital
- 80% usage of shelf aka shelf allotment (up from 66%)

Formulas to determine materials and linear feet with shelves 80% full (maximum shelf allotment. 1.2 is used to calculate this %)

- (Total number of students*) x (physical materials per student)= Total number of physical materials
- (total number of physical materials) x (percentage of collection) = total number of that part of the collection
- (physical materials per section) / (books per foot of that section/age level) = feet without shelving allotment
- (feet without shelving allotment) x 1.2 = linear feet needed per type. Round up to the next foot (ie 120.2=121 linear feet)
    - *Schools are typically enrolled at least 30 extra students beyond Student Accounting's total projected enrollment. Ex. 967 students, round up to 1000 students to allow for this. Always round to the nearest 50 after adding 30. 967+30=997→ 1000

Since each section is shelved and organized separately, they cannot simply be thought of as ONE total linear feet amount. The Everybody would not share a shelf with the Nonfiction materials, etc. This is necessary to account for as every single Media Center has a different shelving design and available of wall shelving versus mobile shelving units.

The MPS standard is **maximize wall shelving** and then mobile shelving units for the remainder. Current wall shelving standard is Fleetwood. Current mobile shelving units standard is Cascade Nomads from Smith Systems for Fiction and Nonfiction. For Everybody, Jonti Craft 8 section book bins.

Wall shelving standards

ADA recommends no more than 48" bookshelf height. If higher, step stools need to be purchased, staff available to assist patrons with disabilities.

- 14" shelf height for Nonfiction and Everybody books (does not include thickness of shelf itself)
- 12" shelf height for Fiction Books (does not include thickness of shelf itself)

Current Fleetwood wall shelving uses at least 3 inches of height from the bottom of the unit and 3 inches of height at the top for design aesthetic. Each shelf is approximately 1" thick. This should be subtracted when determining how many shelves will be possible given shelf height standards per type of material.

- Ex. Nonfiction wall shelving
    - If 48" unit is purchased, only 42" available before determining shelves and subtracting their thickness. 42"/14"=3 shelves, not accounting for the thickness of the shelves.
    - Preferred is 60" unit.
        - 60"-6= 52" available before accounting for shelf thickness.

Current Cascade Nomads have 13” shelf height. Can be used for Nonfiction but not preferred, especially since NF is the largest percentage of any age collection and would have a larger footprint on square footage.

Sample Breakdowns of Collections: Elementary/K-8, Middle School, High School

Elementary/K-8 Collection breakdown

15 Physical, 5 digital

Type	*Percentage/%*	*Books per foot*
Everybody	25%	25 per foot
Fiction	25%	12 per foot
Nonfiction	50%	22 per foot

Example school with 1000 students

1000x15= 15000 physical materials

Type	**% of collection**	**Total books**	**Divide by books per feet**	**Books per foot**	**Feet without shelf allotment**	**Multiply by 1.2 to create shelf allotment. Round up to next whole number.**	**MINIMUM Linear feet needed**
Everybody	25%	3750		25 per foot	150 feet		180 feet
Fiction	25%	3750		12 per foot	312.5→ 313		375.6→ 376 feet
Nonfiction	50%	7500		22 per foot	340.9→ 341		409.2→ 410 feet

*****_In a K-8 it is HIGHLY recommend to break out the nonfiction for grades K-2 and use book bins so it is more accessible to the younger students/beginning readers, when possible._

Middle School Collection breakdown

13 physical, 7 digital

Type	*Percentage/%*	*Books per foot*
Reference	5%	12 per foot
Fiction	35%	12 per foot
Nonfiction	60%	22 per foot

Example school with 1000 students

1000x13= 13000 physical materials

Type	**% of collection**	**Total books**	**Divide by books per feet**	**Books per foot**	**Feet without shelf allotment**	**Multiply by 1.2 to create shelf allotment. Round up to next whole number.**	**MINIMUM Linear feet needed**
Reference	5%	650		12 per foot	54.16→ 55 feet		66 feet
Fiction	35%	4550		12 per foot	379.16→ 380 feet		456 feet
Nonfiction	60%	7,800		22 per foot	354.54→ 355 feet		426 feet

High School Collection breakdown

10 physical, 10 digital

Type	*Percentage/%*	*Books per foot*
Reference	5%	10 per foot
Fiction	35%	11 per foot
Nonfiction	60%	12 per foot

Example school with 1000 students

1000x10= 10000 physical materials

Type	**% of collection**	**Total books**	**Divide by books per feet**	**Books per foot**	**Feet without shelf allotment**	**Multiply by 1.2 to create shelf allotment. Round up to next whole number.**	**MINIMUM Linear feet needed**
Reference	5%	500		10 per foot	50 feet		60 feet
Fiction	35%	3,500		11 per foot	318.18 → 319 feet		382.8→ 383 feet
Nonfiction	60%	6,000		12 per foot	500 feet		600 feet

Appendix B: Indoor Air Quality Design Guidelines

Minneapolis Public Schools

ACCEPTABLE
INDOOR AIR QUALITY
for
SCHOOL CONSTRUCTION PROJECTS

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ARCHITECTURAL GUIDELINES
for
ACCEPTABLE INDOOR AIR QUALITY (IAQ)
for
SCHOOL CONSTRUCTION PROJECTS

Prepared by:

MINNEAPOLIS PUBLIC SCHOOLS

in cooperation with:

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Armstrong Torseth Skold And Rydeen, Inc. Architects & Engineers
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INTRODUCTION

The mission of the Indoor Air Quality Task Force is to create a more productive learning environment for school children through indoor air quality. Improved indoor air quality should decrease absenteeism and respiratory illness in schools. Studies have shown that:

1. Indoor air quality and relative humidity in buildings is directly linked to the health of its occupants.
2. In schools, absenteeism and the transmission of colds have been found to correlate to the relative humidity and the indoor air quality.
3. Children do not have fully developed immune systems, and are more susceptible to disease transmission, respiratory illnesses, and allergic reactions.
4. Low humidity causes dryness of the throat and mucus membrane, making one more susceptible to disease transmission.
5. Respiratory illnesses are at their peak in winter, when humidity is the lowest.
6. Molds and fungus grow when humidity is too high, which can cause allergic reactions.
7. At higher humidities, flu viruses do not spread as fast.

The following is an outline of Architectural specification recommendations developed by the task force to improve indoor air quality in school buildings, both new construction and remodeling.

*SPECIAL SCHOOL DISTRICT NO. 1
MINNEAPOLIS PUBLIC SCHOOLS
ARCHITECTURAL INDOOR AIR QUALITY TASK FORCE

SPECIFICATION RECOMMENDATIONS

DIVISION 1 - GENERAL REQUIREMENTS

A. Section 01010 - Summary of Work:

Recommendations:

1. Sequence of Work: Establish a timeline of activities: include the time periods in the construction schedule for the following issues:
   a) Off-gasing of materials: Provide schedule that includes time for material off-gasing prior to occupancy. Refer to off-gasing timeline in individual sections.
   b) On the project schedule, provide for sequencing of work to ensure appropriate environmental conditions for products to be installed under manufacturer's recommendation.
   c) Provide adequate time for concealed work to be reviewed by Architect prior to being covered (example: vapor barriers, etc.).
   d) Include time allowance for environmental testing after Off-gasing periods, etc., prior to occupancy.
   e) Do not allow work which generates particulate which could be concealed by previously installed systems (example: drilling above ducts, etc.).
2. Contractor's Use of Premises
   a) Prohibit on-site smoking or use of tobacco.
   b) Isolate from construction areas locations of lunches/breaks where food cannot be left in walls, etc. Prohibit food/beverages in work areas. A designated area for consumption of food and beverages must be provided.
   c) Contractor to immediately notify Architect or Owner of wet condition and provide follow-up correction.
   d) Contractor is responsible for security of building to prevent water damage.
   e) Prohibit tools that create pollutants when site is enclosed, such as generators, etc.
   f) Provide appropriate storage of hazardous materials (fuel, paints, etc.). This should be in a designated storage area, isolated in a

trailer, separate from the building. Storage of fuel oils-to be in a heated trailer outside of the building.

B. Section 01040 - Coordination:

Recommendations:

1. Project Coordination
   a) Specify coordination of trades when concealing work or providing proper environmental project requirements.
   b) Specify coordination of concealed work to be reviewed by Architect: A/E team "tags" areas that have been reviewed.
2. Job Site Administration
   a) Contractor's supervisory staff to be made aware of indoor air quality concerns and project requirements.
   b) Attend IAQ training, 4 hours for job superintendent - could be a video of procedures.
   c) Require all trades attend IAQ training, 1 hour.
   d) Review IAQ issues at weekly OSHA meetings.
   e) Get rid of "not my job" philosophy at jobsite regarding IAQ
   f) Promote timely decisions from Owner and Architect regarding IAQ issues, otherwise penalties will be imposed.
   g) Post special instructions and procedures related to IAQ for products at the construction site. These posted instruction sheets would be included in the specifications appendix, and would list instructions for specific procedures for indoor air quality for a particular product.

C. Section 01045 - Cutting and Patching:

Recommendations:

1. Ensure temporary barriers are dust-free, "contain the debris"; provide dust-free openings. Provide complete enclosure of openings.
2. Employ methods for cutting to minimize dust: use water or direct vent methods. Refer to selective demolition.

D. Section 01200 - Project Meetings:

Possible Environmental Issues:

1. Pre-Construction Conference
   a) Add IAQ as part of agenda, including special products, scheduling related to out-gasing, and ventilation requirements. Coordination of inspections of materials to be covered in a pre-construction meeting.
   b) Have MPS health and safety representative attend regular meetings.

2. Pre-Installation Conference
   a) Include indoor air quality requirements as a part of an agenda or have pre-installation conference when a product affects indoor air quality.

F. Section 01300 - Submittals & Section 01630 - Products Options and Substitutions:

Recommendations:

1. Submittal of safety data sheets for products.
   a) Include MSDS.
   b) Include manufacturers' written installation guidelines.

G. Section 01400 - Quality Control:

Recommendations:

1. Specify Environmental Commissioning (refer to Mechanical).

H. Section 01410 - Testing and Inspection:

Recommendations:

1. Testing and Inspection related to Indoor Air Quality: Testing should be done on site prior to starting construction, after construction is complete, and periodically during construction.
2. Limits of Testing Agency Authority:
   Should be able to recommend to MPS Health and Safety Representative:

a) Additional testing.

b) Correction/stop work orders.

3. Initial tests to evaluate a site include: soil and water samples, ambient air quality data and local contaminant sources.

I. Section 01500 - Temporary Facilities:

Recommendations:

1. Temporary Heat:
   a) Specify that visible condensation is an unacceptable condition.
2. Temporary ventilation:
   a) Provide temporary ventilation to purge the off-gas requirements per Mechanical sections at a rate of 1 cfm per sf.
   b) Provide separate temporary ventilation system if new mechanical system is installed.
   c) Painting and carpet installations are particularly crucial for adequate temporary ventilation and should be done at maximum rates.

J. Section 01569 - Construction Cleaning:

Recommendations:

1. Protect ducts and chases during construction and provide cleaning of ductwork prior to occupancy.
2. Specify periodic cleaning frequency and type of cleaning.
3. Avoid water clean-up.

K. Section 01700 - Contract Closeout:

Recommendations:

1. Maintenance Training: Enforce adequate training by subcontractors for users and building engineers to fully understand operation of all systems to maintain indoor air quality.
2. Specify thorough commissioning of mechanical systems - (see Mechanical).
3. As-builts and O & M manuals to include air quality issues.
4. Provide a close out list related to indoor air quality. Possibly include:
   a) visible condensation.
   b) was off-gassing adequate.

c) commissioning.

d) air balancing (see Mechanical).

e) water damage areas.

5. Provide "special ventilation" before and during initial occupancy of all outdoor air for two hours per day.

6. Isolate construction activities from occupants after building is occupied.

DIVISION 2 - SITEWORK

A. Section 02070 - Selective Demolition:

Recommendations:

1. Methods used in demolition operations:
   Consider one or more of the following methods of containing contaminants:
   a) Water sprinkling, particularly during cutting operations (core-drilling).
   b) Eliminate, minimize or control the use of water on porous or absorbent materials to control possibility of microbial growth.
   c) Prevent ponding or entrapment of water in unreachable areas to prevent pools (standing water).
   d) Increase ventilation to control contaminant concentrations to acceptable levels.
   e) Use of special filtering.
   f) Consider carefully the removal/replacement of existing carpet due to the dust and particulate generated.
2. Maintain clean to dirty air flow between occupied and demolition areas by one of the following:
   a) Isolation, temporary enclosures or other suitable methods to limit dust and dirt.
   b) Where possible, shutdown and seal off HVAC equipment to avoid contamination and/or circulation of contaminates.
   c) Use of direct exhaust without recirculation is the preferred solution.
   d) Use of dedicated temporary exhaust systems.
3. Disposal of demolished materials to be separated due to the dust and particulate generated.
4. Identify testing for hazardous materials.
5. If mold growth was encountered use 1% - 5% chlorine solution for abatement. Use respirator during clean-up.

C. Section 02100 - Site Preparation:

Recommendations:

1. Avoid herbicides to clear vegetation.
2. Remove or seal off underground entrance paths for contaminates.
3. Prebate buildings particularly in food preparation area and waste storage areas, (Integrated Pest Plan). Use boric acid at masonry foundation walls.

D. Section 02900 - Landscaping:

Recommendations:

1. Avoid use of fertilizers and pesticides.

DIVISION 3 - CONCRETE

A. Section 03300 - Cast-in-place Concrete:

Environmental Concerns:

1. Concrete admixtures related to environmental concerns.
2. Use of liquid cure/seal compound.
3. Use of treated expansion joint fillers.
4. Location of vapor barrier beneath interior floor slabs-on-grade due to soil gases. Place vapor barrier directly below the concrete slab.

Recommendations:

1. Where there is soil behind concrete work, seal seams and cracks for soil gases. Provide continuous vapor barrier, seal all seams. Use a minimum of 10 mil. vapor barrier.
2. Take measures to reduce residual concrete dust from construction which can be an airway irritant. This may include air filtration during the mixing of concrete and vacuuming/cleaning surfaces that may accumulate concrete dust during construction. Soft cut concrete with saw while concrete is "green" (less dust). This also provides better quality control.
3. Use water-based sealants at exterior and interior concrete work.

B. Section 03350 - Concrete Finishes:

Environmental Concerns:

1. Methods and chemicals used to finish concrete which may be environmentally questionable, such as blasted concrete, exposed aggregate concrete, or acid etched concrete.

Recommendations:

1. Measures should be taken to control and remove dust produced in finishing procedures from the environment.
2. Avoid finishing surface treatments that are more likely to introduce concrete dust into the atmosphere through contact or crumbling.
3. Do not use finishing procedures or sealants that introduce chemicals with negative environmental effects (particular concern for workers and students during process).

DIVISION 4 - MASONRY

A. Section 04100 - Mortar:

Recommendations:

1. Prohibit rake joints in the interior due to dust accumulation. "V" joint or concave joints are recommended.
2. Epoxy mortar may be better in certain applications to provide a more healthy environment and a more easily maintained surface.

B. Section 04200 - Masonry:

Environmental Concerns:

1. Type of wall flashing and detailing.
2. Type of masonry cleaners used.
3. Use of insulation in wall construction - CFC free.
4. Sealant used relating to cavity wall insulation.
5. Use of foam caulking back-up material and masonry expansion and control joints.

6. Fire safing (fibrous) insulation.

Recommendations:

1. Do not use acoustic block with fiber filler in cavities.

C. Section 04500 - Masonry Restoration and Cleaning:

Environmental Concerns:

1. Chemicals and methods used to clean masonry.

Recommendations:

1. Recommend detergent (TSP) washing in lieu of acid washing.
2. For masonry cleaning, care should be taken that chemicals are not entrained into the building HVAC system. For interior cleaning, provide adequate ventilation during and after cleaning procedures. (See temporary ventilation under temporary facilities.)
3. Control dust produced during restoration procedures - filter/ventilate to outside.
4. Control runoff of any potentially toxic cleaning chemicals.

DIVISION 5 - METALS

Recommendations:

1. Use steel framing in place of treated wood framing in areas where high moisture, termites or other pests prohibit the use of regular wood framing (to avoid VOC problems associated with treated wood members).
2. The oil coating on steel studs is potentially allergenic; however, due to the expense of removing the oil or getting the manufacturers to change products, this coating could be eliminated.

DIVISION 6 - WOOD AND PLASTICS

A. Section 06100 - Rough Carpentry:

Environmental Concerns:

1. Formaldehyde emissions of plywood and other wood products.
2. Treated woods: preservative treated, fire-retardant treated, and insect treated wood.

Recommendations for Formaldehyde Emissions:

1. Specify products using PHENOL-Formaldehyde (PF) and prohibit products using UREA-Formaldehyde (UF) since the Phenol variety has greater stability and minimal IAQ effects. Softwood plywood uses phenol formaldehyde.
2. Use exterior-grade adhesives This is identified by the black color of the adhesive, such as seen in glue-lams.
3. Use kiln dried lumber.

Recommendations for treated lumber:

1. Specify non-treated lumber except when absolutely necessary in situations where other methods of combating decay, fire and insects are not feasible.
2. For indoor areas, enclose and seal with vapor barrier the treated framing in walls and ceiling.

B. Section 06400 - Architectural Woodwork:

Environmental Concerns:

1. Emissions from plywood and particle board used in fabrications.

Recommendations:

1. Specify phenol-formaldehyde bonded particle board and plywood instead of urea-formaldehyde varieties.
2. For hardwood panels, specify hardwood plywood panels or wood veneer particle board panels stamped with minimum HUD standards for emission limits.
3. Where UF bonded particle board must be used, specify low emitting products seal surfaces or encapsulate (such as floor underlayment).
4. Use plastic laminate and melamine, they are impervious to release.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

A. Section 07210 - Building Insulation:

For steel framed buildings, use section 7670.0325, subpart 48(c) of the State energy code to define equivalent R-values of walls containing steel stud framing. In addition, the Architect shall use "Catalog of Thermal Bridges in Commercial and Multi-Family Construction" to identify areas of concern on each project. These areas of concern shall be noted and selected alternates identified prior to submitting documents. Building assemblies are required to maintain the thermal performance of installed insulation and the integrity of building materials against cold weather water vapor condensation and wind wash.

Environmental Concerns:

1. Fibers and/or VOC's released during installation or use of insulation systems.
2. Off-gasing of plastic foam insulation.
3. Use of adhesive and sealants in insulation systems and related off-gasing.
4. Vapor barrier installation, including anchorage and sealing.
5. Release of fibers from exposed fibrous forms of insulations.

Recommendations:

1. Keep insulation dry at all stages of installation and use to prevent growth of fungi and bacteria.
2. When using fibrous material provide adequate ventilation during and immediately after installation to alleviate problems associated with released fibers and dust.
3. Require contractors to follow protective measures recommended by the insulation manufacturer.
4. Use molded polystyrene in lieu of extruded polystyrene.
5. Use mechanical fasteners when installing insulation in lieu of adhesives.
6. Use mechanical fasteners and tape to install polyethylene film vapor barrier in lieu of adhesives and mastics.
7. Seal laps and perforations in polyethylene film vapor barriers with polyethylene tape.
8. Cover or contain fibrous forms of insulation exposed to the building environment which will restrict release of fibers into air and off-gasing of the phenol-formaldehyde binder which is often used in the manufacture of glass wool insulations.
9. Vapor Retarder:

a) A vapor retarder must be installed on the warm side of insulated ceilings, walls and floors: minimum 6 mil. at walls, 10 mil. at concrete slabs.

b) A vapor retarder can function as an air leakage barrier. It will need to be continuous, with all seams sealed with an approved tape as well as sealed with a caulk at the tops and bottoms of exterior walls. Adhere top in place until finishes are complete.

10. Air Leakage Barrier:

a) A barrier must be installed to prevent the leakage of moisture laden air from the conditioned space into insulated ceilings, walls, and floors, as well as to prevent heat loss due to infiltration and exfiltration.

11. Piping and Ducts:

a) Penetrations for piping and ducts into insulated ceilings, walls, and floors must be air sealed.

12. Framing to prevent air leakage:

a) Framing must be installed to prevent air leakage.

13. Exterior joints:

a) Exterior joints must be sealed around window and door frames, between wall cavities and window or door frames, at utility penetrations , between wall assemblies and their rim joists, sill plates, foundations, at exterior corners, between wall and roof/ceiling assemblies, and between separate wall panels.

14. Electrical wires and equipment:

a) Electrical and telecommunication equipment and penetrations into insulated walls, ceilings, floors must be sealed. The service entrance, wires, conduit, cables, panels, recessed light fixtures, electronic equipment, electrical boxes and fan housings must be sealed.

15. Performance Alternative:

a) As an alternative to the prescriptive requirements above, buildings must have an air leakage rate of 0.35 cubic feet per minute per square foot of conditioned space or less when tested in accordance with ASTM 779-87.

16. Wind wash barrier:

a) An air-permeable barrier must be provided at the following locations:

i) Attic edge: A rigid or flexible baffle must be installed at the exterior edge of attic insulation to mitigate wind wash. Baffles must be resistant to wind drive moisture.

ii) Overhangs: A wind wash barrier must be installed at cantilevered floors and bump out windows, including corners with adjoining walls above and below.

iii) Exterior corner joints must be air sealed, including both interior and exterior corners.

17. Framing to assure air tightness and insulation coverage:

a) Insulated ceilings with attics must have a minimum of 5 inches of vertical clearance between the wall top plate and roof sheathing.

b) Exterior corners shall be framed so that insulation can be installed after the exterior sheathing is installed.

c) Intersection of interior partition walls with exterior walls shall be framed to allow for insulation to be installed between the partition wall and exterior sheathing. A continuous air and vapor retarder must be installed between the interior wall and exterior wall framing.

d) Whenever an insulated ceiling intersects a wall, the ceiling vapor retarder must be sealed to a plate or blocking in the wall. If the wall is an interior wall, the blocking must be air sealed.

e) Prior to installing interior horizontal framing or bracing on an exterior wall, continuous polyethylene must be secured to the wall so as to provide a continuous air and vapor barrier behind the framing.

f) Dropped ceilings and soffits shall be installed in accordance with items ‘d’ and ‘e’. In addition, prior to installing framing on an insulated ceiling, continuous polyethylene must be secured to the ceiling so as to provide a continuous air and vapor barrier behind the framing.

g) Rim and band joist framing must be caulked or gasketed or otherwise constructed to prevent air leakage. The sill sealer capillary break must be closed cell foam or other gasket material that will prevent air leakage.

C. <u>Section 07251 - Sprayed-on Fireproofing & Spray-applied Acoustical Materials:</u>

Environmental Concerns:

1. Release of fibers and particulate into environment.
2. Possible negative components within composition of fireproofing materials.
3. Possible introduction of moisture.

Recommendations:

1. Ventilate area and/or filter air in workspace to remove fibers/particulates.

2. Enclose sprayed-on fireproofing in walls if possible, and explore products with finished surfaces that are less inclined to introduce particulates after occupancy (through crumbling, contact, etc.).
3. Try to minimize use.
4. Review alternate methods of fire protection in lieu of sprayed on fire protection (sprinklers, etc.).

D. Section 07270 - Firestopping:

Environmental Concerns:

1. Review products used and the possibility that some manufacturers may have products which are more environmentally friendly than others.

Recommendation:

1. Use silicone-based sealants.

E. Section 07500 - Membrane and Built-up Roofing System:

Environmental Concerns:

1. Off-gasing of roofing system components.
2. The asphalt used in built-up roofing systems causes an odor which can impact workers and occupants of a building.
3. Modified bituminous roofing systems use components which off-gas, including asphalt, adhesives, primers, and coatings.
4. Both built-up roofing and modified bituminous roofing components cannot be recycled into other uses and end up having to be disposed of at the end of their life cycle.

Recommendations:

1. A ballasted EPDM (rubber) single ply roofing system with seam tape used at joints offers fewer roofing system components which are environmentally negative. EPDM sheets can be recycled into other products at the end of the life cycle. Consider specifying 60 mil. EPDM with a 15- or 20-year total system warranty.
2. Protect existing roof during all repairs.

G. Section 07600 - Flashing and Sheet Metal:

Environmental Concerns:

1. Type of sealants used in sheet metal work.

Recommendation:

1. Use silicone-based sealants.

H. Section 07901 - Joint Sealants:

Environmental Concerns:

1. Off-gasing of sealants.

Recommendations:

1. For indoor use, specify sealants with low toxicity and emission rates.
2. Consider sealant curing time and application amounts with respect to off-gasing periods and levels when specifying products.
3. Provide increased ventilation when using sealants indoors.
4. Follow manufacturer precautions such as protective clothing if required.
5. Use silicone and latex sealants at interior conditions and polyurethane at exterior conditions.
6. Reduce the amount of caulking required due to off-gasing.
7. Use metal expansion joints.

DIVISION 8 - DOORS AND WINDOWS

A. Section 08100 - Metal Doors and Windows:

Environmental Concerns:

1. Off-gasing of foam core doors.

Recommendations:

1. Hollow metal doors to have steel reinforced or honeycomb core construction.
2. Use hollow metal steel doors in lieu of doors with particle board core if possible.

B. Section 08200 - Wood and Plastic Doors:

Environmental Concerns:

1. Off-gasing of laminating adhesive to bond veneers to core and off-gasing of particle-board core.

Recommendations:

1. Do not allow foam-core doors.
2. Seal all edges of wood doors.
3. Verify with wood door manufacturers if particle board core could be available with phenol-formaldehyde particle board in lieu of urea-formaldehyde.
4. Specify adhesive used to laminate face veneers to be free of formaldehyde.
5. Specify all edges which expose core construction to be sealed by factory in such a way which restricts off-gasing of core construction.
6. Factory finish wood veneer doors in lieu of field finish doors.

C. Section 08400, 8500, 8600 - Windows:

Environmental Concerns:

1. Due to the humidity levels required for indoor air quality, control of air infiltration and condensation at exterior windows is critical. Excessive condensation can lead to moisture problems (mold, mildew).

Recommendations:

1. Specify air infiltration to not exceed .10 cfm per s.f. of opening when tested with ASTM E283-91 at a uniform pressure of 6.24 PSF. Examples: H-window, Alpana 1150 Awning or Wausau 3250T Awning.
2. Specify historical performance on air infiltration -- 10 years.
3. Specify condensation resistance factors (CRF). Example: H-window : CRF: 67.
4. Specify thermal breaks in aluminum framing systems and establish a high CRF requirement. CRF of 35 is a minimum for thermally-broken systems. Also, for aluminum framing, allow water vapor that enters the frame to escape to the exterior, and collect condensation that does occur and drain to the exterior. However, due to aluminum's low resistance to thermal transmission, aluminum framed windows should be avoided in lieu of wood window systems which generally have higher CRF (in the range of 59 typically).
5. Specify prefinished wood windows. This allows for the factory finishing of the windows off-site, so as to avoid the off-gasing process of the treated wood on site.
6. Minimize use of operable windows due to conflict with mechanical systems, or provide a system interlock for the windows. This system interlocks the opening window with the mechanical system. When

windows are open, the mechanical system can compensate for pressure changes.

D. Section 08800 - Glazing:

Environmental Concerns:

1. Possible off-gasing of glazing products, including sealants.

Recommendations:

1. Specify insulated glass as a minimum; consider triple glazing if budget allows.
2. Specify solar films, tinted glass, or low E coated glass, or argon-filled glass to reduce heat gain. This reduces heating of interior materials which increase VOC emissions.

DIVISION 9 - FINISHES

A. Section 09200 - Lath and Plaster:

Environmental Concerns:

1. Use of acrylic liquids, bonding agents, and other additives used in plaster work.

Recommendations:

1. Specify plasters with no VOC-emitting additives.
2. Avoid the use of adhesives when installing lathing board and specify only VOC-emitting adhesives.
3. Specify mixing of plaster materials to be done in a manner to minimize airborne dust, especially if silica sand is used for texture.
4. Provide dust proof work enclosures in remodeling work to avoid dust getting in carpet, ductwork, or other places that may allow dust to become airborne in occupied spaces.

B. Section 09215 - Veneer Plaster:
(On gypsum board base).

Recommendations:

1. Use plasters with no VOC-emitting additives (typically to affect drying time, etc.).
2. Specify only low emission surface applications/finishes to dried plaster.
3. Specify mixing of plaster materials to be done in a manner to minimize airborne dust, especially if silica sand is used for texture.

4. Provide dust proof work enclosures in remodeling work to avoid dust getting in carpet, ductwork or other places that may allow dust to become airborne in occupied spaces.

C. Section 09250 - Gypsum Board:

Recommendations:

1. Provide for off-gasing of joint compound.
2. Use mechanical fastening systems in lieu of adhesives wherever possible.
3. Use paper joint tape instead of glass-fiber joint tape.
4. Use low VOC-emitting joint compounds.
5. Reduce dust and particulates by finishing taped seams with a wet sponge instead of sanding.
6. Heat and ventilate the area during curing to accelerate the drying process and removal of VOC's.
7. Paint/seal surfaces to reduce both VOC-emissions from the assembly and absorption of VOC's from other materials.
8. Provide dust proof work enclosures in remodeling work to avoid dust getting in carpet, ductwork, or other places that may allow it to become airborne in occupied spaces.
9. Specify that acoustic batt insulation be covered by gypsum board in all locations (this is often left exposed above ceilings).
10. Require removal and replacement of any gypsum board which becomes wet during construction to avoid mildew growth in wall cavity.
11. Gypsum board work should not begin until building is enclosed.
12. Hold gypsum board 1/2" off floor.
13. Provide weeps at bottom of metal wall to allow water to weep out that may develop in the cavity.
14. Green board should be used in wet areas as a minimum. Durarock "Cementitious". is preferred.

D. Section 09400 - Terrazzo:

Environmental Concerns:

1. Type of sealer used on terrazzo.

Recommendations:

1. Allow for adequate curing/off-gasing time (72 hours).
2. Use low VOC bonding agents.

3. Limit use of epoxy or polyacrylic terrazzo, which emit higher VOC's during installation and curing.

E. Section 09510 - Acoustical Ceilings:

Environmental Concerns:

1. Use of ceiling panels which may introduce fibers or particulate into air.
2. Sink capacity of acoustic ceiling tiles - although their own emissions are minimal in most cases, they have the capacity to absorb/desorb VOC's at rates higher than other materials such as carpet.
3. If painted, they should use low emission / toxin paints.

Recommendations:

1. Explore the potential for painting or sealing the surface of the tiles to reduce its sink capacity. Check the implications of such action on the tile's acoustical performance with the manufacturer.
2. Timing: Installation after other products are off-gased. Ceiling tile should follow installation of carpet due to sink effect of carpet. Carpet needs to be protected during installation of ceiling tile.
3. Specify factory-applied antimicrobial treatment (available on limited styles at this time). Example: Armstrong Intersept (limited to some products).
4. Specify washable finishes with minimum Relative Humidity 90 value in restrooms, food service areas, locker rooms and wet areas.
5. In schools without air-conditioning or where high humidity is anticipated, specify acoustical ceilings with minimum. RH90 value to prevent warpage. Because of the additional cost involved, this could be listed as an add alternate.

F. Section 09521 - Acoustical Wall Panel:

Environmental Concerns:

1. Use of panels which may introduce fibers or particulate into air.
2. Use of mechanical methods of anchorage in lieu of adhesives.

Recommendations:

1. Specify mechanical mounting methods in lieu of adhesives.
2. In applicable areas (cafeteria, gymnasium, specify washable finishes such as perforated vinyl wallcovering in lieu of fabric to reduce "sink effect."
3. See Section 099050- wall covering.

G. Section 09650 - Resilient Flooring:

Recommendations:

1. In existing building, old vinyl flooring products may contain asbestos. These materials should be handled or removed only by a trained professional.
2. Strongly consider asbestos abatement in lieu of covering over existing asbestos containing tile with new finishes.
3. Specify low or no VOC-emitting adhesives.
4. Specify flooring products which offer a system of "environmentally-friendly" maintenance products (no phosphates, ammonia-free, low solvent).
5. Specify that products be removed from packaging and allowed to "breathe" for 24 hours prior to installation.
6. Do not install over uncured or below-grade concrete slabs.
7. Increase ventilation during installation. Allow a minimum of 72 hours (after completed installation) before occupying building.
8. Strongly consider flooring products such as linoleum, which are made of natural materials and require very little chemical maintenance (ceramic, porcelain, etc.).

H. Section 09678 - Resilient Wall Base and Accessories:

See "Resilient Flooring" above.

I. Section 09680 - Carpet:

Recommendations:

1. Specify products which contain no latex in the backing system (latex contains 4-PC's). Examples: Lees carpets with "Unibond" backing, or Mohawk's " Nova II" with "PLB" backing.
2. Specify low or no VOC-emitting adhesives.
3. Consider tackless strip installations (such as 3M's "Tac Fast" system), which avoid adhesives completely.
4. Do not specify double glue down.
5. Specify that carpet products be removed from packaging, unrolled and allowed to "breathe" off-site for 24 hours prior to installation.
6. Specify carpets with built-in (not surface-applied) antimicrobial treatments.

7. Allow a minimum of 72 hours to ventilate after completed installation before occupying building.
8. Specify that manufacturer's recommendations are strictly followed in developing a scheduled maintenance program to include recommended cleaning products and procedures. Use HEPA or high efficiency vacuum cleaners/bags.
9. Provide a means to accelerate drying of carpets such as fans in case of spills, etc. during construction: Dry cleaning of carpet is preferred.
10. Specify carpets which have been tested and certified under CRI's "green label" program.

J. Section 09900 - Painting:

Environmental Concerns:

1. VOC-emissions

Recommendations:

1. Consider low-emitting alternative paints (natural, hypo-allergenic, low-biocide etc.) for chemically sensitive clients. Characteristics and handling procedures may vary from conventional paints.
2. For renovations/demolitions consult a professional for proper lead abatement procedures when lead-based paint is present.
3. Even where lead-based paint is not present, increase ventilation for any removal or sanding of existing paint to reduce dust and particulates.
4. Increase ventilation for at least 72 hours following paint application to minimize residual vapors in the air.
5. Store paints and solvents in a designated space away from the work area, preferably its own trailer outdoors, where they cannot contribute to the further build-up of VOC's in the finish space.
6. Water-based and organic solvent-based high solids paints and stains should be preferred for their low emissions and significantly shorter off-gasing period (as little as 48 hours).
7. Specify formaldehyde-free finishes for woodwork.
8. Specify wood stains, varnishes and paint thinners which contain no methylene chloride.
9. Seal exposed edges and faces of plywood panels.
10. Requirements for biocides in water-based products: Biocides introduced by coating manufacture into formulation by water-based products to meet following requirements:
    a) Control bacteria, fungi, yeast and algae.

b) Provide low hazard potential for manufacturing personnel, end-user, and environment.

c) Have Environmental Protection Agency (EPA) registration covering applications specified within this section.

d) Have Food and Drug Administration (FDA) acceptance.

e) Shall not contain:
- Mercury, tin, barium, arsenic, or other heavy metals.
- Formaldehyde or generate formaldehyde.
- Phenols or substituted phenols.

f) Shall not require:
- Detoxification prior to disposal.
- Fish or wildlife warning label.

g) Shall not contribute odor to end products.
Coating manufacturer to submit written certification that biocides introduced into water-based formulations meet specified requirements for biocides.

11. When staining and varnishing of interior wood is required (excluding wood athletic flooring), use a water-based wood stain and varnish similar to Hirshfield's Paint Manufacturing No. 8410 stain and No. 9410 acrylic varnish.

12. When coating metal surfaces, consider using "direct to metal;" 100 percent acrylic coating system or 100 percent solid epoxy coating systems. Epoxy will be affected by UV light and should not be used where exposed to exterior or UV light within interior spaces.

K. Section 099050 - Wall Covering:

Environmental Concerns:

1. Adhesives used in application of wall covering.
2. Off-gasing of materials used in manufacture of wall coverings.
3. Use of fibrous or carpet types of wall coverings.

Recommendations:

1. Specify solvent-free, low VOC-emitting adhesives.
2. Specify wallcoverings which use solvent-free inks.
3. Specify wallcoverings which use cadmium-free dyes.
4. Specify wallcoverings which are non-fibrous to reduce "sink effect" of bacteria, dust, etc.
5. Increase ventilation for 72 hours after installation.

DIVISION 10 - SPECIALTIES

A. Section 10100 - Visual Display Boards:

Recommendations for Porcelain Enamel Chalkboards:

1. Gypsum board is the “safest” core material. Adhesive fumes used in laminating materials together are minimized when sandwiched between the 28 gauge steel face sheet and on aluminum foil panel backing on the back side of gypsum core.

Recommendations for Porcelain Enamel Markerboards:

1. A potential problem with dry markerboards is the felt tip marking devices and cleaners used. Some markers emit solvent fumes strong enough to permeate every part of a classroom. Cleaners for dry erase surfaces can be equally as bad or worse.
2. Due to the concerns associated with markers and cleaners, not using or minimally using markerboards may be considered.
3. If markerboards are used, the owner should use water-based dry ` markers or low-odor markers.

Recommendations for Tackboard:

1. Natural cork boards have fewer additives in composition, but may not stand up as well as sealed composition cork not have the aesthetic appeal. The resinous, vinyl finished, sealed composition cork tackboards possibly do not contribute significantly to the level of indoor contaminants.
2. Safest choice in backing for tackboards would be foil backed exterior grade plywood or hardboard.

Recommendations for Mounting:

1. Mount chalkboards, markerboards, and tackboards to walls using mechanical fasteners in lieu of adhesives.

DIVISION 12 - FURNISHINGS

A. Section 12300 - Manufactured Casework:

Environmental Concerns:

1. Off-gasing of particleboard (see Division 6).

Recommendations:

1. Use particle board with a phenol-formaldehyde binder in lieu of a urea-formaldehyde binder. Verify with casework manufacturers, the availability of product and economic implications.

2. All surfaces of the plywoods, fiber boards, and particle boards used in casework should be laminated. This includes all surfaces that will be unexposed once casework is installed, such as backs, bottoms and cut edges.

3. Open holes drilled for adjustable shelving reduce the effectiveness of the laminate encapsulating the particle board core, this should be avoided unless plastic plugs are used to fill unused holes. Consider using surface mounted metal brackets and metal clips for adjustable shelving. Do not rout standards into cabinet sides exposing particle board core.

4. Cut edges from sink and electrical cutouts should be sealed with an appropriate sealant.

B. Section 12710 - Fixed Auditorium Seating:

Environmental Concerns:

1. Glued-up woods, polyurethane foam padding, treated fabrics, and adhesives are common materials in most auditorium seating. All have a negative impact on indoor air quality, especially in an auditorium where the exposure is significant.

Recommendations:

1. Use hardwood plywood with polyvinyl acetate (PVA) adhesive rather than formaldehyde resin adhesive.

2. Use adhesives which are latex based if possible.

3. Use solid wood, molded plastic, or metal components where possible.

C. Section 12775 - Lecture Room Tables and Seating:

Environmental Concerns:

1. Off-gasing of materials used in manufacturing.

Recommendations:

1. Cover all surfaces of tables with laminate and edges with 3 mil. PVC edge banding so particle board core is completely encapsulated. PVC edge banding allows corners to be rounded.

2. Table core to be plywood with PVA glue or phenol resin formaldehyde glue with all surfaces covered with plastic laminate and edges covered with PVC edge banding.

PRE-DESIGN, PROGRAMMING AND DESIGN

1. Pre-Design:
   a) Additional time allowed for each phase of design to incorporate indoor air quality issues and for option evaluation: according to size and complexity of project.
      i) Schematic Design.
      ii) Design Development.
      iii) Contract Documents.
   b) Additional time allowed for review at each phase.
   c) Additional time allowed for construction.
   d) Additional budget must be allowed for indoor air quality systems, etc.
      i) Establish a criteria for level of indoor air quality to be attained vs. cost; set “tiers” of quality level.
   e) Site Selection:
      i) Include testing of existing site air quality
      ii) Analyize soil, air, and water for contaminants
2. Program:
   a) Adequate space allowed for maximum building occupancy
      i) Student/Occupancy requirements: -- (1 person/20 square feet for classrooms, typically). This must be accurate to insure the systems are not over- or under-designed. Electronic occupancy sensors (CO2) are a method to control air volume as needed.
   b) Adequate mechanical space programmed for ease of service access (not in net/gross factor).
3. Design:
   a) Floor to floor/roof heights adequate for additional mechanical ductwork and equipment.
   b) Location of fresh air intake relative to:
      i) Site related pollutant sources.
      ii) Likely locations for smokers.
      iii) Plan vehicular circulation and parking away from air intakes.
   c) Location/relationship of ‘occupied’ spaces to sources or odors, irritants, etc.
   d) Location of entrances relative to pollutant sources, such as service drives, buses, dumpsters, etc.
   e) Selection of materials:
      i) Include long-term maintenance as factor: i.e. use of cleaners, solvents, etc.
      ii) High-quality vapor barrier, evaluate the number of “perms,” and careful attention to location of vapor barrier. Control of humidity levels is critical.

iii) Windows: operable vs. inoperable, tightness relative to humidity.

f) Pollutant generating areas, such as science labs, locker rooms, art rooms, and food preparation areas should be isolated from the adjacent interior spaces. These areas should be adequately ventilated: with adequate exhaust without recirculation.

g) Avoid dead zones in the design of HVAC systems.

h) Orientation of building to increase natural lighting/energy efficiency.

i) Evaluate “stack-effect” of a design.

j) Commissioning of mechanical system, perhaps a separate agency to perform this function.

k) Include installation in specifications: single-source quality control.

l) Dehumidification in basements.

MECHANICAL SYSTEMS GUIDELINES
for
ACCEPTABLE INDOOR AIR QUALITY (IAQ)
for
SCHOOL CONSTRUCTION PROJECTS

Prepared by:

MINNEAPOLIS PUBLIC SCHOOLS

in cooperation with:

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I. INTRODUCTION

The following mechanical systems guidelines are provided as a minimum set of criteria that need to be included in school construction projects to establish and maintain acceptable indoor air quality (IAQ). These guidelines are typically written for new construction projects. Remodeling construction projects will need to be examined on an individual basis to determine how many of these guidelines can be incorporated considering the extent of the remodeling efforts.

II. DESIGN

A. GENERAL:

1. DOCUMENTATION:

a. The design criteria that was used to design the air handling unit system shall be included in the construction documents.

1) Applicable building codes

2) Outdoor design conditions

3) Indoor design conditions

4) People load

5) Equipment load

6) Lighting load

7) Other loads

8) Design ventilation rates

9) Minimum outdoor air ventilation rates (including the method to calculate)

10) Method of control to maintain constant minimum outdoor air intake

11) Air filtration

12) Other air filtration (such as gas-phase air cleaners)

13) Special exhaust systems

14) Narrative describing modes of control for the air handling unit system(s)

2. PREFERRED SYSTEM DESIGN:

a. Central Station Air Handling Unit:

Central station air handling unit system design is preferred over terminal unit air conditioning system design (such as under-window unit ventilators) for several reasons, some of which are as follows. Terminal unit air conditioning system design should be avoided.

1) Outside air intakes for terminal units that provide outdoor air ventilation are typically located close to grade level whereas intakes for central station units have more flexibility of location which can be important with regard to outdoor air quality conditions.

2) Central station units are easier to maintain than terminal units because there are fewer central station units and they usually have better access than do terminal units.

3) Higher efficiencies of air filtration can be provided for central station units than can be provided for terminal units.

4) The fan and motor noise from terminal units can be destructive to the classroom environment.

5) People sitting directly in front of a terminal unit can become too cold or too hot depending upon the time of year operation.

6) Summer season relative humidity is not directly controlled with terminal units, but is a by-product of space temperature control.

b. Indoor Mechanical Equipment Room:

Air handling unit equipment located inside indoor mechanical equipment rooms is preferred over package rooftop air handling units for ease and frequency of maintenance. Package rooftop air handling unit design should be avoided.

c. Energy Recovery:

Where practical, energy recovery should be incorporated into the air handling unit system design to reduce the dependence on "new energy" for heating and cooling. For example, it may be possible to recover energy from the exhaust/relief air streams and use it to temper the intake outdoor air stream.

1) It may be possible to use desiccant heat wheel technology to transfer both sensible and latent energy loads from the exhaust/relief air streams to the intake outdoor air stream. It is important to select a desiccant material that is designed to transfer heat energy and water vapor only without transferring airborne contaminants.

B. AIR HANDLING UNIT:

1. OUTDOOR AIR QUALITY:

a. At the beginning of the design process, the proposed building site shall be surveyed to determine the quality of the outdoor air. The purpose of this effort is to determine if any special gas-phase air cleaners (such as activated carbon absorption filters, etc.) need to be included in the air handling unit system(s) design.

b. The method by which this survey can be completed is left up to the Design Engineer. If outdoor air quality problems are suspected, it may be possible to hire a testing firm to complete actual field testing of the air quality. The results of these field tests can then be compared with national air quality and emissions trends as published by the Environmental Protection Agency. The problem with this method is that the air quality may vary from hour to hour and from day to day. Accurate field test results may require hourly/daily testing for a period of weeks or months which may not be practical.

c. However the quality of the outdoor air is evaluated, the Design Engineer shall work closely with the Owner to determine the necessity/desirability of special gas-phase air cleaning filters.

2. LOCATION OF OUTDOOR AIR INTAKE LOUVERS AND/OR OTHER TYPES OF INTAKE DEVICES:

a. At the beginning of the design process, it is very important that the Design Engineer coordinate closely with the Architect to establish the location/configuration of mechanical equipment rooms and the consequent location/configuration of the outdoor air intake louvers. The location/arrangement of architectural building elements can greatly affect the performance/effectiveness of outdoor air intake louvers.

b. The location of outdoor air intakes shall be at least 25 feet from any contaminated and/or odorous exhaust air outlets. It is recommended that greater distances be used especially when considering the effects of wind patterns and physical/architectural obstructions.

1) Examples of contaminated exhaust outlets include:

Boiler/incinerator combustion stacks
Combustion stacks
Laboratory/hood exhaust outlets
Plumbing vent stacks
Paint Hood exhaust outlets
Emergency generator
Kitchen Hood exhaust outlets
Industrial Arts exhaust outlets
Welding Hood exhaust outlets

c. The location of outdoor air intakes shall be at least 30 feet minimum from any evaporative cooling towers. It is recommended that greater distances be used especially when considering the effects of wind patterns and physical/architectural obstructions.

d. The location of the bottom of outdoor air intakes shall be at least 3 feet above ground level.

    1) Special consideration shall be given to maintain an adequate horizontal distance between outdoor air intakes and objects that project above grade level so as not to restrict air flow to the intake as well as to prevent snow drifting in front of the intake.

e. The location of the bottom of outdoor air intakes shall be at least 3 feet above roof level.

    1) Special consideration shall be given to maintain an adequate horizontal distance between outdoor air intakes and objects that project above roof level (such as roof parapets) so as not to restrict air flow to the intake as well as to prevent snow drifting in front of the intake.

f. In addition to the above requirements, special consideration shall be given to keep outdoor air intakes away from vehicular traffic areas. It may be necessary to increase the horizontal distance between outdoor air intakes and vehicular traffic areas to be greater than the minimum distance of 25 feet. It may also be necessary to increase the vertical distance above ground level for outdoor air intakes to be greater than the minimum distance of 3 feet.

    1) Examples of vehicular traffic areas include:
        Bus loading/drop-off areas
        Truck loading dock areas
        Vehicle parking areas
        Heavily traveled roadways/intersections

g. The prevailing wind conditions and building architectural elements shall be evaluated with regard to the location of outdoor air intakes. If outdoor air intakes are located down-wind of any contaminated sources/outlets, then the above minimum separation distances may need to be increased.

3. DESIGN OF OUTDOOR AIR INTAKE LOUVERS AND/OR OTHER TYPES OF INTAKE DEVICES:

    a. Outdoor air intake louvers (and other types of intake devices) shall be designed at a maximum face velocity of 500 feet per minute through the "Free Area" of the louver. This will minimize the intake of moisture in the outdoor air stream in the form of rain and snow.

1) It is important that the Design Engineer accurately calculate the "Free Area" of the louver to be used. In many cases, the top fin and the bottom fin of the louver cannot be included in the "Free Area" because they are sealed to the louver frame and do not permit any air flow.

b. Intake louvers should be designed/oriented so as to prohibit the intake of driving rain and blowing snow.

c. Where the intake of rain and snow cannot be totally prevented in the design of the outdoor air intake louvers, a plenum with a floor drain shall be provided inside the building, adjacent to the intake louver to permit any entrained rain or snow to drain away from the air handling unit system intake section.

1) The plenum floor drain shall be connected to the required building waste system using an air-gap, indirect waste connection.

d. Bird screens shall be provided on intake louvers and other intake devices in the proper configuration to prohibit nesting inside the intake louver.

1) This may require the bird screen to be applied on the exterior face of the louver instead of the interior face of the louver.

4. OUTDOOR AIR INTAKE CONTROL:

a. For all variable air volume (VAV) air handling unit systems other than those supplying 100% outdoor air at all times:

1) The outdoor air intake volume shall be measured and automatic control shall be provided to ensure that the minimum required amount of outdoor ventilation air is maintained at all times during the building occupied period operation of the air handling unit system.

5. AIR FILTRATION:

a. Two (2) filters shall be provided for each air handling unit system. The first filter shall be a prefilter with the minimum air filtration efficiency of 30% when tested in accordance with ASHRAE Standard 52.1, Atmospheric Dust Spot Method. The second filter shall be a final filter with the minimum air filtration efficiency of 65% when tested in accordance with ASHRAE Standard 52.1, Atmospheric Dust Spot Method. The prefilter shall be located upstream of any air handling unit components. The final filter shall be located downstream of the prefilter.

1) The air filters shall mount inside the air handling unit using compression clips and gasketed frames to minimize air bypass between the filter units.

2) The air flow pressure drop for each filter shall be monitored by the temperature control system and shall signal an alarm when it is time to change the air filters. The pressure drop value that is used to signal the alarm shall be obtained from the filter manufacturer.

6. HUMIDIFIER CONFIGURATION:

   a. For duct mounted humidifiers, a discharge duct section sized in length to a minimum of five (5) equivalent duct diameters shall be provided downstream of the humidifier location for absorption purposes. The discharge duct section shall be constructed of stainless steel and shall be provided with a cross-broken, sloped, stainless steel drain pan.

   b. For air handling unit mounted humidifiers, a discharge plenum section sized in length to a minimum of one and one half (1-1/2) equivalent unit cross-section diameters shall be provided downstream of the humidifier location for absorption purposes. The discharge plenum section shall be lined with stainless steel and shall be provided with a cross-broken, sloped, stainless steel drain pan.

   c. Humidifiers shall be located downstream of air filters.

7. COOLING COIL DRAIN PANS:

   a. All cooling coil drain pans shall be constructed of stainless steel with a cross-broken, sloped bottom (drain outlet at the lowest point) and trapped and connected to the required building waste system using an air-gap, indirect waste connection. The traps shall be designed to maintain water level in the trap regardless of the positive or negative static pressure condition that exists at the location of the cooling coil during system operation.

   b. It may be possible to use desiccant energy recovery technology to eliminate latent cooling loads from the air handling unit cooling coils. Under this scenario, the air handling unit cooling coils would provide sensible cooling only and operate as dry coils (there would be no dehumidification condensate drainage from the cooling coils). If this scenario is used, cooling coil drain pans shall be provided in the air handling units as a precautionary measure.

8. AIR BLENDERS:

   a. Air blenders designed to eliminate stratification and provide thorough mixing of return and outside air streams shall be provided on all air handling unit systems other than those supplying 100% outside air at all times. The air blenders shall be located upstream of all air handling unit components.

      1) The air blenders shall consist of fixed mixing vanes and be constructed of heavy gauge welded aluminum.

9. ACCESS SECTIONS:

    a. Each air handling unit shall be designed with access sections located in between all air handling unit components. This means that each individual air handling unit component shall have an access section directly adjacent to it on each side of the component. Each access section shall contain a removable access panel or hinged door and be sized to permit the access by maintenance personnel for inspection/cleaning purposes (hinged doors are preferred and should be used whenever available, removable panels should only be used on small units where hinged doors are not available).

        1) Discretion is left to the Design Engineer on how to implement this requirement because of different air handling unit sizes. Small size air handling units will have smaller size access available than large air handling units. In any case, as much as possible, access should be provided on each side of all individual components of each air handling unit system.

10. INTERNAL INSULATION:

    a. Exposed internal insulation inside air handling units shall not be allowed. All air handling units shall contain double wall construction with insulation in between the two walls.

11. AIR HANDLING UNIT CONSTRUCTION:

    a. All air handling units shall be constructed of sheet metal and gasketed and sealed to minimize air leakage.

12. AIR HANDLING UNIT ACCESS:

    a. Air handling units shall be located so as to permit adequate access for maintenance personnel to inspect, clean and remove/replace all individual components of the air handling unit. This applies to units located inside mechanical equipment rooms or units mounted outdoors.

        1) Adequate access shall be provided without requiring the removal of permanently installed building elements and/or other permanently installed equipment elements.

C. <u>OCCUPIED SPACE:</u>

1. ROOM TEMPERATURE:

    a. The heating, ventilating and air conditioning systems shall be designed to achieve the following room temperature conditions in all occupied spaces:

1) Summer: 72 deg. F at 50% Relative Humidity (RH)

2) Winter: 75 deg. F (see below for Relative Humidity)

NOTE: The Energy Code for the State Of Minnesota states: "Indoor design temperature shall be 72 deg. F. for heating and 78 deg. F. for cooling." This means that according to the Energy Code, regardless of how the equipment is designed, it cannot be operated during "normal occupancy hours" to achieve indoor conditions below 78 deg. F. during the cooling season and above 72 deg. F. during the heating season. The Energy Code does permit oversizing of equipment for the purposes of design safety factor and pre-occupancy building warm-up and cool-down operation.

2. ROOM HUMIDIFICATION:

a. Room humidification in all occupied spaces shall be designed to achieve the levels as set forth in the following reset schedule:

Outdoor Air Temperature	Humidity Level
-30 deg. F.	15% RH
-20 deg. F.	20% RH
-10 deg. F.	25% RH
0 deg. F.	30% RH
>0 deg. F.	30% RH

b. Clean steam should be used as the source of humidification. Evaporative humidification should be avoided due to potential problems with standing water and microbial growth.

c. This shall require that the building have a continuous vapor barrier in all exterior walls on the warm side of the insulation. This shall also require that all windows in the building have the minimum requirements of double pane construction with 1/2 inch air space and 100% thermally broken mullions (coordinate these requirements with the Architect).

3. ROOM MINIMUM OUTDOOR AIR VENTILATION RATE:

a. The minimum outdoor air ventilation rates shall be designed and calculated according to the currently adopted version of ASHRAE Standard 62: Ventilation For Acceptable Indoor Air Quality.

1) It is important to note that ASHRAE Standard 62 specifies minimum acceptable outdoor ventilation rates for building spaces. Depending upon the individual building/space situation, it may be necessary to provide more outdoor air ventilation than required by ASHRAE Standard 62 in order to provide acceptable indoor air quality.

b. Consideration should be given to designing all outdoor air ventilation rates to be 10% higher than current occupancy density for future growth in occupancy density.

4. NON-OCCUPIED SPACES:

   a. Consideration should be given to designing air handling unit/ductwork systems and room air change rates for all non-occupied rooms for future use as occupied rooms. For example, all storage rooms should be designed to be converted to future use as offices.

5. NOISE CRITERIA:

   a. Classroom spaces shall be designed to a maximum Noise Criteria Level of NC-35.

      1) The maximum permissible sound pressure level (in dB re 20 mPa) for each octave band center frequency for a Noise Criteria Level of NC-35 is as follows:

Octave Band Center Frequency	Sound Pressure Level
63	60
125	52
250	45
500	40
1000	36
2000	34
4000	33
8000	32

   b. Mechanical and electrical equipment shall be designed and located so as to minimize vibration and sound transmission into occupied spaces.

   c. Internal duct lining shall not be used as a method to control fan generated noise, VAV box generated noise, or duct velocity generated noise.

6. SUPPLY AND RETURN DIFFUSER LOCATIONS:

   a. Supply and return diffuser locations shall be designed to prevent "short-circuiting" of the supply air flow. Short circuiting occurs when the supply air flow is removed from the room/space before it has a chance to mix with the room air volume.

   b. For rooms/spaces with ceiling heights of 12 feet or greater, supply air shall be introduced into the space at or near the ceiling and return air shall be removed from the space near the floor level.

1) Depending upon the individual space situation, it may be necessary to introduce supply air into the space at or near the floor level and remove the return air at or near the ceiling. In any case, with high ceiling spaces, supply and return diffusers should not be installed at the same elevation.

7. ROOMS CONTAINING CONTAMINATED SOURCES:

a. Rooms/spaces containing contaminated sources shall be balanced to maintain a negative air flow condition with respect to adjacent rooms/spaces.

1) Examples of contaminated source rooms are as follows:

Chemistry labs	Biology labs
Industrial arts shops	Locker rooms
Swimming pools	Copier rooms
Toilet rooms	Trash rooms

b. Rooms/spaces containing contaminated sources shall be designed to be 100% exhausted and prevent air recirculation to adjacent spaces unless the room/space containing the contaminated source is provided with its own dedicated air handling unit system or the contaminated source within the room/space is contained within a local exhaust system (such as a fume hood).

c. All exhaust systems shall be fully ducted from occupied space to exterior of the building. All ducted exhaust systems installed within building occupied spaces or within ceiling plenums shall be under a negative pressure in accordance with the State Building Code. Use of ceiling plenum space or mechanical room space for all or part of the exhaust air path shall not be allowed.

D. <u>DISTRIBUTION DUCTWORK:</u>

1. DUCTWORK CONSTRUCTION:

a. Ductwork shall be constructed of sheet metal and sealed to minimize air leakage.

2. DUCTWORK INSULATION:

a. All supply ductwork shall be insulated with externally applied insulation.

1) All variable air volume boxes shall be internally insulated with a cover over the internal insulation. The cover can be made of sheet metal or a poly-type sheet material.

b. All ductwork (supply, return, exhaust) shall be externally insulated if the ductwork is installed inside unconditioned spaces.

c. All ductwork (supply, return, exhaust) installed outdoors shall consist of double wall construction with insulation in between the two walls. The exterior surface exposed to the elements shall be sealed and made weatherproof.

3. EXPOSED INTERNAL DUCT INSULATION:

a. Exposed internal duct insulation shall not be allowed in pressurized ductwork systems.

1) Internal duct insulation shall only be allowed in non-pressurized air transfer ducts for the purposes of sound transmission mitigation. The internal insulation shall utilize an antimicrobial material.

4. SOUND ATTENUATORS:

a. Sound attenuators should be of the baffle-design type without any fibrous sound absorbing material.

b. If a sound attenuator with fibrous sound absorbing material is used, then the fibrous material shall be covered with a poly-type sheet material to prevent exposure of the fibrous material to the ventilation air stream.

5. DUCT ACCESS PANELS:

a. Access panels shall be provided on each side of all duct mounted equipment.

III. CONSTRUCTION/COMMISSIONING

A. CONSTRUCTION TECHNIQUES:

1. USE OF VOLATILE ORGANIC COMPOUNDS (VOC's):

a. The use of volatile organic compounds (VOC's) in construction materials and methods shall be minimized as much as possible. If VOC's are used in a particular area of the construction project, then the following procedure shall be used as part of the construction process:

1) Consult with the manufacturer of the material/product containing VOC's to determine the period of time during which significant off-gasing will occur.

2) After the installation of the material/product containing VOC's is complete and prior to occupancy, provide purging ventilation to that area by supplying and exhausting 100% of the design maximum air flow rate for that area.

a) It may be possible to accomplish this process by using the air handling unit system for that area and operating it in a 100% outdoor air economizer mode during the purging period.
3) The purging ventilation process shall operate continuously for a period of time equal to the period of significant VOC's off-gasing plus 48 hours.

2. CONSTRUCTION FILTERS:

a. If the air handling unit systems are operated during the construction process, then all return and/or exhaust air openings shall be provided with cartridge filters with a minimum air filtration efficiency of 30% when tested in accordance with ASHRAE Standard 52.1, Atmospheric Dust Spot Method.

1) The filters shall be attached to the return/exhaust air openings with compression clips and gasketed frames.

b. A set of filters for the air handling unit shall be installed if the air handling unit is operated during the construction process. These filters shall be the same as specified for the air handling unit. These filters shall be removed at the end of the construction process (prior to system air balancing work efforts) and replaced with new filters prior to occupancy.

3. PROTECTION OF MATERIALS:

a. All construction materials shall be protected from dirt, debris, and moisture while being stored on the construction site. Any materials that become water-damaged shall be discarded and replaced with new materials.

1) Extra care shall be taken to protect materials during any construction process that requires the use of water as part of the process. A good example of this situation is the grinding of terrazzo floors. If it is impossible to prevent the wall board adjacent to the terrazzo floors from becoming wet, then the wall board should be installed after the grinding process is finished.

2) It is important for the construction process to be organized in a manner that will protect materials from damage. Materials should be delivered to the construction site close to the time of installation so that they are not stored for long periods of time at the site. Materials should be installed according to a time sequence that will permit the building to protect itself. For example, interior drywall should not be installed before the roof, walls and windows are completely installed and the building is sealed against rain/snow damage.

4. REMODELING CONSTRUCTION; ISOLATION OF MAJOR CONSTRUCTION AREAS:

   a. Remodeling construction within existing buildings or new addition projects that are connected to existing buildings shall be isolated from the occupied existing buildings using temporary walls, plastic sheeting, or other vapor retarding barriers. These temporary barriers shall be designed and installed to prevent the migration of construction dust, debris, fumes, and other indoor air contaminants from the construction areas to the occupied areas.

   b. The construction areas shall be maintained at a negative pressure with regard to the adjacent occupied areas. This can be done by pressurizing the adjacent occupied areas or exhausting the construction areas.

   c. In situations where a single air handling unit system serves both occupied areas and construction areas, the return air openings in the construction area shall be temporarily capped and sealed to prevent the spread of contaminates. Where dust, dirt, and debris particles are the only contaminates of concern, it may be possible to cover the construction area return air openings with temporary filters during the construction process as discussed above. This will allow the air handling unit system to continue to operate and serve the occupied areas during the construction process.

B. <u>COMMISSIONING PROCESS:</u>

   1. GENERAL: **Refer to MPS Commissioning Plan** dated September, 1999

      a. In as much as possible, all of the following commissioning activities shall be completed after substantial completion of the construction process and prior to occupancy.

   2. DRAINS/DRAIN PAN TESTING:

      a. Drain pans and connecting drain lines under cooling coils, humidifiers, outdoor air intake plenums, etc. shall be tested to ensure proper slope and drainage to prevent water stagnation which could result in microbial growth.

         1) Plug the drain pan and fill it with water. Remove the plug and observe the drainage (it should drain completely in less than 5 minutes without leaving any puddles larger than 2 inches in diameter).

      b. Check the drain pan trap to make sure that the water seal is maintained with the supply air fan operating and shut off.

      c. If the drain pan does not drain properly, it shall be reconfigured or removed and replaced with a correctly designed drain pan.

3. VISUAL INSPECTION OF AIR HANDLING UNIT SYSTEMS:

    a. The inside of all air handling unit systems shall be visually inspected for dirt, debris, and damaged components/equipment. Dirt and debris shall be removed and damaged components/equipment shall be repaired or replaced prior to occupancy.

4. AIR HANDLING UNIT/DUCTWORK SYSTEM CLEANING:

    a. After substantial completion of construction (not before all sheetrock work is completed) and prior to occupancy, the inside of all air handling units, return fans and ductwork systems shall be cleaned to remove all surface dust and debris inside those systems.

5. TEMPERATURE CONTROL SYSTEMS TESTING:

    a. The temperature control systems shall be tested prior to occupancy to determine that they are operating as specified. The Design Engineer working with the Temperature Control Contractor shall activate all control systems one-at-a-time to observe them in action.

    b. Control algorithms shall be activated to determine if the proper control signals are being relayed throughout the control systems. The physical action of control dampers, control valves, fans, pumps, etc. shall be observed to determine if the action corresponds to the control algorithms as specified. Alarm reporting, record keeping, signal interfaces with other building control systems shall also be tested and verified.

6. AIR BALANCING:

    a. Air balancing devices such as dampers, grilles, registers, and diffusers shall be installed so as to permit adequate access for air balancing purposes. Air balancing devises not readily accessible shall be removed and reinstalled at the Contractor's expense so as to permit access.

    b. All ventilation systems (supply, return, exhaust, and outside air) in a building construction project shall be balanced by an independent, certified air balance contractor selected by the Owner to deliver the required air flow rates as specified in the construction documents.

    c. Air balancing shall be completed in accordance with ANSI/ASHRAE Standard 111-1988 or other approved standard.

    d. Air balancing shall be completed if the use of the building changes from its original use as defined in the design criteria established by the Owner.

7. BUILDING VENTILATION PURGING:

    a. After substantial completion of construction and prior to occupancy, provide purging ventilation to the construction area by supplying and exhausting 100% of the design maximum air flow rate for that area.

        1) It may be possible to accomplish this process by using the air handling unit system for that area and operating it in a 100% outdoor air economizer mode during the purging period.

        2) It is important to limit relative humidity levels to a maximum of 60% during the purging process. This may require mechanical cooling of the purging air source. It is acceptable to reduce the purging ventilation air flow rate below 100% of the design maximum air flow rates in order to limit the relative humidity level.

    b. The purging ventilation process shall operate continuously for a minimum period of seven (7) days.

        1) It may be necessary to modify the purging period if VOC's were present in construction materials (see above).

8. SYSTEMS DOCUMENTATION:

    a. The following information shall be provided to the Owner upon completion of the construction project:

        1) Design Criteria/Design Assumptions used to design the systems

        2) Operating & Maintenance Manuals (prepared according to ASHRAE Guideline 4-1993)

        3) Mechanical Shop Drawings for all systems and equipment

        4) Final, complete Air Balance Report

        5) Record Construction Drawings showing field changes

IV. OPERATION & MAINTENANCE

A. GENERAL:

1. DOCUMENTATION OF PERCEIVED INDOOR AIR QUALITY PROBLEMS:

    a. All complaints of perceived indoor air quality problems shall be documented by location, time, date, type of complaint, person registering complaint and types of remedial action taken to resolve the complaint.

2. STAFF TRAINING:

a. Prior to active operation and maintenance duty, all staff shall be thoroughly trained in the acceptable means and methods for operating and maintaining all of the various systems. This is a key aspect to maintaining acceptable indoor air quality for the life of the building.

B. OPERATION:

1. VENTILATION SYSTEM START/STOP:

a. The ventilation systems shall be started at least one half (1/2) hour prior to the beginning of "normal occupancy hours" and stopped at least one half (1/2) hour after the end of "normal occupancy hours".

1) The start times may need to be lengthened if warm-up and cool-down operation sequences are used.

2. AFTER "NORMAL HOURS" OCCUPANCY:

a. Provisions shall be made to operate the ventilation systems as needed for periods of time outside the "normal occupancy hours" during which the building will be occupied. The building should not be occupied with the ventilation systems shut off.

C. MAINTENANCE:

1. DOCUMENTATION:

a. The following documentation shall be readily available to the maintenance personnel:

1) Design Criteria/Design Assumptions used to design the systems from the original construction project

2) Operating & Maintenance Manuals from the original construction project

3) Mechanical Shop Drawings for all systems and equipment from the original construction project

4) Air Balance Report from the original construction project

5) Record Construction Drawings from the original construction project

6) Changes to operating procedures

7) Re-testing, re-balancing, re-commissioning of systems

8) Renovation, retrofit of systems

9) On-going maintenance logs, reports, work orders, etc. documenting all maintenance activities

2. DRAIN PAN CLEANING:

   a. All drain pans shall be thoroughly cleaned at the end of each cooling season. Any organic or inorganic films or material build-up shall be physically removed from both the drain pan and connecting drain line.

   b. All drain pans shall be visually inspected at least once per month during the cooling season to observe that drainage is occurring.

3. COOLING TOWER WATER TREATMENT:

   a. A documented water treatment program shall be put in place for each cooling tower to control corrosion, sediment, and biological growth.

   b. The cooling tower water shall be tested at least once each week during the cooling season.

4. AIR FILTER CHANGE-OUT:

   a. All air filters shall be replaced with new filters when the temperature control system signals an alarm that the pressure drop across the filters has reached the maximum allowable according to the filter manufacturer.

   b. All air filters shall be visually inspected at least once every month for damage, etc.

5. OUTDOOR AIR INTAKE LOUVERS:

   a. All outdoor air intake louvers shall be visually inspected at least once every six (6) months for damage, dirt and debris and cleaned as necessary.

6. TEMPERATURE CONTROL SYSTEM RECALIBRATION:

   a. The temperature control systems shall be checked and recalibrated as required at least once every two (2) years.

   b. Certain types of control systems may require more frequent recalibration.

      1) Carbon monoxide or carbon dioxide sensors shall be recalibrated at least once every six (6) months.

7. AIR BALANCING RECALIBRATION:

    a. The ventilation systems air balancing shall be checked and recalibrated at least once every two (2) years.

        1) The required air flow rates may have changed since the original construction project due to remodeling. It is important to use the current required air flow rates that result from any past remodeling projects.

        2) The required design outdoor air quantities need to be checked to make sure the ventilation systems are delivering the required minimum outdoor air quantities.

    b. Air balancing shall be completed if the use of the building changes from its original use as defined in the design criteria established by the Owner.

8. PERIODIC AIR HANDLING UNIT SYSTEM/DUCTWORK CLEANING:

    a. All air handling unit systems and ductwork systems shall be checked at least once every five (5) years and cleaned as needed.

        1) All air handling unit coils need to be checked.

        2) Supply, return and exhaust grilles and diffusers need to be cleaned.

END OF GUIDELINES

Appendix C: Acoustical Design Guidelines

Minneapolis Public Schools

Effective January 2011

ACOUSTICAL DESIGN GUIDELINES for SCHOOL CONSTRUCTION PROJECTS

MINNEAPOLIS PUBLIC SCHOOLS
Urban Education. Global Citizens.

ACOUSTICAL DESIGN GUIDELINES for SCHOOL CONSTRUCTION PROJECTS

Effective January 2011

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Appendix E: Room Surface Modeling Examples

Glossary

Introduction

Excessive noise and reverberation interfere with speech intelligibility, resulting in reduced understanding and reduced learning. Studies identify that many classrooms foster poor speech intelligibility. It is estimated that many classrooms have a speech intelligibility of 75% or less. This means that only 75% of the words read from a list can be understood by normal-hearing listeners in a classroom. The mission of the Noise Advisory Committee and these guidelines is to create more productive learning environments in the Minneapolis Public Schools (MPS) by creating spaces with improved acoustical quality. It is believed that when this is accomplished, a direct impact on learning outcomes will be made.

The purpose of these guidelines is to provide the construction and renovation design team with reasonable acoustic performance standards and to help identify potential noise problems and solutions. These guidelines are to be a reference for architects, engineers and facility planners to use in the design of new school buildings and in renovation. They are to be used as an aid in the understanding of desirable acoustical conditions in classrooms. They are not to replace the services or responsibilities of the design team or an acoustical consultant. The focus of these guidelines is on classrooms and other teaching spaces. They do not address the special design criteria for performance spaces such as music rooms and auditoriums. Professional acoustical consultants should be involved with the development of these spaces.

The following Acoustical Design Guidelines are an outline of performance standards to be implemented to provide improved acoustical quality in new school and major renovation projects. The guidelines are separated into three sections: Environmental Noise, Architectural Systems and Mechanical Systems. In order to obtain the goal of improved acoustical quality, all three should be considered together in the planning and design phase. Each component can have a direct impact on or relationship to the other. Appendix (A), (B) and (C) are design recommendations provided for each section to give examples of strategies that can be used to meet the standards. These guidelines are to be implemented without jeopardizing items in the MPS Indoor Air Quality Guideline. Exceptions to these guidelines should not to be made without prior approval from MPS.

Section 1: Environmental Noise

The location for new school sites and additions to existing facilities should be evaluated to determine whether interior performance standards could be accomplished at that location and at what dollar cost. These factors should be considered prior to final selection of a proposed site. Design recommendations for this Section are identified in Appendix A of these guidelines.

Environmental Performance Standards

- Noise from any source at a proposed property for a new school or an addition to an existing school should not exceed an average of *60 dBA (L_{50}) or 65 dBA (L_{10})* during the time of day the school is in session.

Environmental noise monitoring should be completed to determine that the site is suitable. Sites exceeding these standards are acceptable if a sound reduction plan is submitted to and approved by MPS. The Site Evaluation Worksheet is to be used as a guideline when evaluating the feasibility of site from a noise perspective (Appendix D).

Section 2: Architectural Systems

Architectural systems should be designed to provide improved acoustical quality. In order to accomplish this, considerations for speech intelligibility, reverberation time, sound transmission and impact isolation need to be incorporated into the design. By focusing design criteria on controlling reverberation time and sound transmission, speech intelligibility of approximately 90% can be achieved. Numerous design techniques can be used to accomplish this, including the location of teaching spaces, the size and shape of the room, building surfaces, etc. Noise criterion (NC) will also have an impact on speech intelligibility and will be addressed in Section 3 of these guidelines.

The reverberation time of a room is the time it takes for sound to decay by 60 dB once the source has stopped. Reverberation is caused by sounds reflecting off hard surfaces. The cumulative result of many strong reflections is long reverberations times. Reverberation masks the sound of the spoken message and increases background sound levels. The longer the reverberation time, the greater the impact on speech intelligibility.

Sound is transmitted between rooms through several paths including walls, floors ceilings, doors, plenums, chases, mechanical penetrations and ductwork. Architectural systems should be designed to minimize the transmission of sound. The amount of sound transmitted through a building component is dependent on the Sound Transmission Class (STC) of the building component. It is also dependent upon the area of the component, the quality of construction and the acoustical characteristics of the receiving room. STC is a laboratory rating of the amount of sound isolation provided by a building component.

Design recommendations for this Section are identified in Appendix B of these guidelines. Examples of room surface modeling strategies that could be used to accomplish the performance standards are identified in Appendix E of these guidelines.

Architectural Performance Standards

- Architectural systems should be designed and constructed to achieve the following reverberation times (RT) in an unfurnished and unoccupied room:

Space Type	RT
Classrooms/Teaching Spaces	<= 0.6 Seconds
Media Center	<= 0.6 Seconds
Industrial Arts	<= 1.0 Second
Cafeteria	<= 1.0 Second
Commons/Non-Teaching	<= 1.0 Second
Corridors	<= 1.0 Second
Private Offices	<= 0.6 Seconds
Open Offices	<= 0.6 Seconds
Conference room	<= 0.6 Seconds
Gymnasium	1.0 thru 1.4 Seconds

The RT requirements identified in this document refer to the RT60 at the octave band centered at 500 Hz. The RT in the octave band centered at 125 Hz shall be no more than 1.7 times the RT at 500Hz, and the RT in the octave band centered at 4000 Hz shall be no more than 0.8 times the RT at 500 Hz.

- Architectural systems should be designed and constructed to provide a Field Sound Transmission Class (FSTC) of *45* in teaching spaces. Sound isolation values for teaching space walls should be designed at an STC 50.

Section 3: Mechanical Systems

Mechanical systems should be designed to provide improved acoustic quality. High ambient noise from mechanical equipment can be disruptive to the learning environment and decrease speech intelligibility. Noise Criterion (NC) is a rating system for the quietness of a room and is typically associated with HVAC noise, but includes all ambient noise present in a room when it is measured. Minimizing the Noise Criterion rating of mechanical systems in teaching spaces will contribute to improved speech intelligibility. Design recommendations for this Section are identified in Appendix C of these guidelines.

Mechanical Performance Standards

- Mechanical Systems are to be designed and constructed to achieve the following maximum Noise Criterion (NC).

Space Type	NC
Classrooms/Teaching Spaces	35
Media Center	35
Industrial Arts	35
Cafeteria	35
Commons/Non-Teaching	35
Corridors	35
Private Offices	35
Open Offices	35
Conference room	35
Gymnasium	45

Note: Field evaluation of NC values can be measured by using a sound level meter. The NC rating is approximately 6 dBA less than the measured decibel level using an "A" - weighted scale.

END OF GUIDELINES

Appendix A

Design Recommendations (Environmental Noise)

Appendix A

Design Recommendations (Environmental Noise)

1. School sites near airports, freeways, high-traffic roadways or industrial operations are likely to have noise levels exceeding the performance standards. When feasible, sites should be located away from these types of environmental noise sources.

2. The school should be located on the site in a manner to provide maximum separation from major noise sources, i.e. airports, freeways, etc.

3. Building envelope construction should be sufficient to ensure that architectural and mechanical performance standards can be obtained (as defined in Section 2 & 3). Specific design techniques and construction materials may be necessary to isolate acoustically sensitive areas from exterior sound. Weak points in sound isolation are commonly the roof, windows, glazing, doors, mechanical penetrations and vents.

4. Playgrounds should be located away from interior teaching spaces. (Exception: Tot lots in relation to kindergarten classrooms)

5. The school's noise impact on the neighboring community from mechanical systems must not exceed established Noise Standards (Minnesota Rules Chapter 7030.0040 & City of Minneapolis: Code of Ordinances, Chapter 389) for the location of the facility and its Noise Area Classification (Minnesota Rules Chapter 7030.0050). Cooling towers, emergency generators, chillers, condensing units, etc., should not be located close to neighboring structures without making provisions to meet regulatory noise standards. The designer should verify compliance with noise standards for the facility. The applicable regulatory noise standards are as follows:

	Daytime		Nighttime	
Noise Area Classification	L_{50}	L_{10}	L_{50}	L_{10}
1. Residential	60	65	50	55
2. Commercial	65	70	65	70
3. Industrial	75	80	75	80

END OF APPENDIX A

Appendix B

Design Recommendations (Architectural Systems)

Appendix B

Design Recommendations (Architectural Systems)

1. Floor plans should be developed isolating spaces likely to generate disruptive noise levels from traditional teaching spaces. Spaces that should be isolated include but are not limited to: mechanical rooms, restrooms, industrial arts areas, music areas, auditoriums, gymnasiums, multipurpose rooms and cafeterias.

2. Second floor spaces should be located over similar use lower floor spaces. For example, corridor over corridor, restroom over restroom. In particular, avoid restrooms or corridors over classrooms.

3. Sound isolation values for teaching space walls should be designed at STC 50. This value may need to be increased based on adjacent noise sources. Buffer spaces can also be used to accomplish this.

4. Flooring systems should be designed and constructed to minimize impact noise and footfall noise.

5. Teaching space ceilings should be acoustically absorbent with a minimum Noise Reduction Coefficient (NRC) 0.60. A minimum of 75% of the ceiling space should be absorptive. Depending upon NC values, the room design and other room surfaces, these values may need to be increased to meet performance standards.

6. Alternatives to carpet use should be explored. Deviation from the District Floor Covering Policy cannot be made without prior approval from MPS.

7. Full height partitions should be sealed, top, side and base along both sides with caulking. Where the partition seals to a rough, textured or corrugated surface, special closure strips may be required in addition to caulking. Where drywall is elevated off the floor to meet IAQ Guidelines, sufficient caulking should be used to accomplish an STC 50.

8. Teaching space partition walls should be insulated and extend to the ceiling deck.

9. Noise generated by lighting systems should not exceed Noise Criteria Standards established in Section 3 of these guidelines.

10. Electrical/data/technology outlets should not be installed back to back. Back to back outlets should be separated by at least one stud space. Holes in boxes and along perimeters should be sufficiently caulked or fire caulked.

11. Teaching space doors should have a solid core and have all sides acoustically gasketed. If possible, doors should be staggered so that they are not directly opposite or adjacent in a corridor.

12. CMU partitions for acoustical purposes should be constructed from dense aggregate blocks with grout-filled core spaces. All exposed surfaces should be sealed with two coats of paint. On double partitions, inner surfaces can remain unpainted.

13. Penetrations through walls (i.e., ductwork, conduit or plumbing) should be sealed with caulking or fire caulking.

14. Wherever sealant or caulking is specified for acoustical purposes, butyl or silicone-base, non-hardening type should be used.

15. Pipe or conduit runs inside, or penetrations through a double-stud partition, must not rigidly tie the two stud sets together. The interconnecting element should be vibration isolated, either by means of a flexible connection, or by packing around the penetration on one side with sponge neoprene or fiber glass so contact is not made with the wall surface. Additional vibration isolation may be required for plumbing.

16. In toilet rooms adjacent to teaching spaces, all plumbing partitions should have 3-1/2" batt insulation between both sets of studs.

17. Sound isolation values for operable partitions should be specified for an STC 50. Pass doors are typically not acceptable.

18. Lockers mounted common to teaching space walls should be specified with a resilient mount.

END OF APPENDIX B

Appendix C

Design Recommendations (Mechanical Systems)

Appendix C

Design Recommendations (Mechanical Systems)

Location of Mechanical Rooms

1. Mechanical rooms should be isolated from teaching spaces and other quiet spaces. Where feasible, they should be located on grade level.

2. Mechanical equipment should not be in direct contact with the structure. Equipment should have spring and inertia isolation. Other attachments should be resilient.

3. Mechanical systems should provide no perceivable vibration in any occupied portion of the building.

4. Penetrations between mechanical rooms and occupied spaces should be minimized or indirectly routed from mechanical rooms to occupied spaces.

5. Where mechanical equipment is located above grade or on a roof, ensure that the construction under the equipment is sufficient to meet the performance standards.

6. Suspended ceilings offer modest reduction of mechanical equipment noise. Mechanical equipment should not be located above teaching space ceilings.

7. Mechanical room walls should be sufficient to meet performance standards. The construction of solid masonry walls with an STC 60 is a good rule. This value may need to be increased based on adjacent room usage.

8. Glass fiber blankets are not suitable sound barriers. They only reduce sound reflected from a surface.

HVAC Equipment Selection

1. Specifications should require mechanical equipment suppliers to submit sound ratings (as per AMCA 300) for their equipment. This information may be necessary for use in acoustic models. This applies especially to equipment that may be situated above ceilings in spaces requiring noise levels below NC 35.

2. Terminal units (VAV, CV, etc.) generate more noise if the total pressure drop across the device is increased. In order to minimize noise generation, select units with a low operating pressure drop.

3. Fans should be selected for and operated at maximum efficiency, which usually results in quietest operation.

4. Air handling units should incorporate the fan and motor on a spring base within a minimum 16 gauge metal acoustical cabinet. These models avoid the problems that sometimes occur

through rigid connection to a fan assembly. Note: according to the MPS Indoor Air Quality Guideline, exposed internal insulation inside air handling units is not allowed. All air handling units should contain double wall construction with insulation in between the two walls.

5. Unit ventilators, fan coil units, heat pumps and ductless split systems in teaching spaces should be avoided. These units contain fans and sometimes compressors that are loud and difficult to treat due to their position in the room.

6. Laboratory fume hood exhaust fans should be selected for low tip speed and maximum efficiency for quiet operation. This equipment should be located remotely from the fume hood to minimize noise in the classroom.

7. In general, low speed equipment is quieter in operation than high-speed equipment. Depending upon the equipment's location in relation to teaching spaces, low speed equipment may need to be used to meet performance standards.

8. When available, select equipment with the motor mounted inside the cabinet.

9. When capacities must be modulated, variable speed drives are quieter than other forms of capacity adjustment. Motors should be selected to be compatible with variable speed drives in order to minimize equipment sound levels.

Installation of Mechanical Equipment

1. Rotating or reciprocating machinery should be mounted on vibration isolators that provide a required 95% efficiency.

2. Variable frequency drives should be mounted with vibration isolators that provide a required 95% efficiency.

3. Isolators should be selected on the basis of machine speed, the type of structure supporting the equipment and structural spans.

4. Piping and electrical connections must be ensured not to short circuit vibration isolation devices. Electrical connections may need to be resilient with flexible conduit. Pipe connections should be made through neoprene pipe connectors.

5. Sound traps should be located in a section of duct where a uniform velocity profile across the duct prevails. The air velocity at the face of the trap should not exceed 1000 ft./min.

6. Noise generated in diffusers decreases if the velocity is reduced. Manufacturer catalogs give the noise level of their products for a given velocity and blade setting. Diffuser selection should be based on noise generated, throw/diffusion capabilities and if a VAV system is used, the high CFM versus low CFM conditions.

7. Dampers should preferably be located a minimum of five feet upstream of diffusers and be followed by externally lined ductwork or a plenum to absorb aerodynamic noise.

Mechanical Equipment above Ceilings

1. Where mechanical equipment is located above ceilings, the sound levels radiated by all the equipment through the ceiling should be less than those required by the room's NC standard.

2. Use neoprene or spring hangers to suspend motor driven equipment above ceilings.

3. Ensure that equipment does not touch the ceiling or ceiling hangers.

4. Whenever feasible, equipment serving teaching spaces should be located outside of the area, i.e. VAV boxes, heat pumps, etc.

5. All ceiling components should be considered when designing ceilings. Much of an acoustical tile ceiling will be made up of grilles, diffusers and lights. Attenuation furnished by these elements should equal or exceed the ceiling attenuation in order not to compromise the acoustical integrity of the ceiling.

Ductwork

1. Noise generated by air movement in a given section of ductwork is proportional to the velocity in the duct. A small increase in duct air velocities may cause a large increase in noise generation.

2. Velocities should be selected which meet ASHRAE standards for the area served by the duct and over which the duct passes.

3. Ductwork should be designed to promote smooth aerodynamic flow. Turbulence produces noise and may cause ducts to vibrate. Architectural plans should be designed to accommodate required duct lengths and diameters for this purpose. Mechanical engineers should be consulted during initial architectural planning.

4. In order to reduce the incidence of duct generated noise, the following points may be considered:

    - A duct attached to the discharge of a fan should be straight for a minimum of 2.5 X the fan diameter before incorporating an elbow.
    - Elbows following a scroll centrifugal fan should turn in the same direction as the fan scroll.
    - Parallel bladed dampers should be avoided.
    - Ducts should not be sized with aspect ratios greater than 2:5:1 unless extra bracing is used externally.
    - When ducting air through an elbow whose width in the radius of the turn is two or more times its height, turning vanes should be used for the complete arc of the turn.

5. Use flexible connections to connect motor drive equipment to ductwork.

6. Ductwork that is common between two adjacent spaces should contain sound traps to inhibit crosstalk.

7. If a sound trap is inserted in a duct in the mechanical room and the duct then passes through the mechanical room wall to an occupied space, the section of the duct between the sound trap and the mechanical room wall may need to be treated to avoid noise breaking into the quiet duct.

Piping and Circulation Systems

1. Piping should be routed over corridors and other areas with lower sensitivity to noise.

2. Black steel piping provides greater resistance to flow noise than copper and pvc. Victaullic type fittings should not be substituted for vibration isolation connections or flexible connections.

3. Flow velocities generally should not exceed seven feet per second to insure quiet operation.

4. Sufficient air vents should be provided to clean trapped air and diminish sound resulting from air entrained in the heating medium.

5. Pumps near peak efficiency should be selected. Plumb inlets and size pumps to avoid cavitation.

6. Pumps may need to be mounted on a concrete inertia base, supported by spring isolators. In-line pumps are difficult to isolate for vibration.

7. All pipe connections to pumps and other rotating equipment should be made through a flexible connector.

Plumbing

1. Acoustically sensitive areas should not share a common wall with a plumbing wall.

2. Cast iron drain waste and vent piping offer superior noise attenuation characteristics as compared to plastic or copper piping.

3. Siphon jet fixtures are quieter in operation than blowout fixtures.

4. Domestic water pressure should be reduced to the Minnesota Plumbing Code requirement of 80 psi. Water hammer arresters are to be used as needed.

5. All domestic water risers serving fixtures with flush valves or solenoid valves should be provided with shock arresters or other method to eliminate water hammer.

END OF APPENDIX C

Appendix D

Site Evaluation Worksheet

Appendix D

Site Evaluation Worksheet

Environmental noise monitoring should be completed to determine if a site is suitable from a noise perspective. Noise from any source at a proposed site for a new school or an addition to an existing school should not exceed an average of 60 dBA (L_{50}) or 65 dBA (L_{10}) during the time of day that school will be in session. Sites exceeding these standards are only acceptable if a plan for sound reduction is submitted and approved by MPS. This worksheet is to be used as a guide during the evaluation of a proposed site and in comparison to other proposed sites. A sketch drawing of the proposed site is to be made on the back of this form.

Proposed Site Location: (address or block area) _____

_____

_____

Type of Area (circle): residential commercial industrial other _____

Description of Noise Influences: (roads, air traffic, adjacent facilities, etc.) _____

_____

_____

Distance/Frequency of Noise Influences: _____

_____

Noise Monitoring Data

A type one sound level meter should be used to measure average decibel levels on the proposed site. A minimum of four property line locations should be tested with two-hour averages calculated for each location. It is recommended that sampling periods start at 10:00 AM and 2:00 PM. Sampling locations are to be identified on the site drawing.

Date of Monitoring: _____ **Survey By:** _____

Instrument Used: _____ **Calibration (circle):** yes no

Activity During Monitoring: _____

	Test Location	Sampling Period	L_{50}	L_{10}
1				
2				
3				
4				

Site Exceeds Performance Standard (circle): yes no

Sound Reduction Plan Required (circle): yes no

Comments: _____

_____

_____

Appendix E

Room Surface Modeling Examples

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Room Surface Modeling Examples

The following three scenarios are shown as examples of how a Reverberation Time (RT) of <=0.60 seconds can be achieved in a 900 SF classroom with varying qualities of ACT ceilings. These examples show how the varying absorption coefficients of different ceiling tiles will affect the RT's in the space. All of the examples below make the following assumptions about the other surfaces in the classroom:

Ceiling: ACT ss noted in each example below. Twelve 2' X 4' lighting fixtures are assumed for each space. If you have gypsum board soffits for ductwork, you will need to place additional absorption (such as absorptive wall panels) in the space to achieve the RT of 0.60 seconds. Also, if you use a ceiling tile with an absorption coefficient lower than that shown in the examples below, you will need to place additional absorption on the walls.

Floor: VCT

Walls Gypsum board, with 64 SF of window glass assumed. Absorptive panels on the walls are assumed to be 2" thick fabric coved glass fiber panels with NRC .90 – 1.0.

Scenario #1

This utilizes ACT with NRC .55, with absorption coefficients as shown below:

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
.35	.29	.51	.70	.71	.73	.55

With the ceiling tile shown above, you will need to add 160 SF of 2" thick absorptive panels (NRC .90 – 1.0) to the walls to reach RT 0.60 at 500 Hz.

Scenario #2

This utilizes ACT with NRC .70, with absorption coefficients as shown below:

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
.32	.34	.76	.87	.86	.84	.70

With the ceiling tile shown above, you will not need to add any absorptive panels (NRC .90 – 1.0) to the walls to reach RT 0.60 at 500 Hz.

Scenario # 3

This utilizes ACT with NRC .95, with absorption coefficients as shown below:

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
.48	.82	.90	.99	.99	.99	.95

With the ceiling tile shown above, you will not need to add any absorptive panels to the walls to reach RT 0.60 at 500 Hz. You can also add gypsum board soffits up to 150 SF and still reach a 0.60 second RT.

Note: You can get large variations in acoustical tiles with the same NRC. For example, one tile with an NRC of .95 may have an absorption coefficient of .90 at the 500 Hz octave band, while another may have an absorption coefficient of only .70 at the same frequency band. Generally speaking, it will be better to use a ceiling tile with a high absorption coefficient at the 500 Hz octave band.

Glossary

The following definitions are identified to provide a better overall understanding of acoustical basics. Not all definitions provided are used in this guideline.

A-Weighting (dBA)
The filtering of sound that attempts to replicates the human hearing frequency response. The human ear is most sensitive to sound at mid frequencies (500 to 4,000 HZ) and is progressively less sensitive to sound at frequencies above and below this range. A-weighted sound level is the most commonly used descriptor to quantify the relative loudness of various types of sounds.

Absorption
The attenuation (or reduction) of sound level that results when sound is controlled by a sound absorptive material such as glass fiber. In the case of sound absorptive materials used in the building industry, attenuation of sound is produced by conversion of molecular motion, which is sound, into thermal energy due to friction of air molecules with fibrous or cellular materials.

Acoustics
1. Acoustics is the science of sound, including its production, transmission and effects.
2. The acoustics of a room are those qualities that together determine its character with respect to the perception of sound.

Ambient Noise
Ambient noise encompasses all sound present in a given environment, usually a composite of sounds from many sources in the near and far.

Barriers
A structure, such as a wall, that blocks the line-of-site between a sound source and a receiver, thereby providing a barrier attenuation, i.e., a reduction of sound level at a receptor. Sound attenuation provided by barriers is principally related to the diffraction of sound over and around the barrier, and the sound transmission loss through the barrier material.

Decay Rate (dB/sec)
The rate at which sound will reduce when the noise source is removed

Decibel (dB)
Unit for reporting the level (magnitude) of sound. A change of 10 decibels is generally considered a doubling or a halving of the perceived loudness of a sound.

Flanking
The transmission of sound around the perimeter or through holes within partitions (or barriers) that reduces the sound isolation between areas. Examples of flanking paths within buildings are ceiling plena above partitions, ductwork, piping, and electrical conduit penetrations through partitions; back-to-back electrical boxes within partitions, window mullions, etc.

Frequency
Frequency is the number of oscillations or cycles per unit time. In acoustics, frequency usually is expressed in units of Hertz (Hz) where one Hertz is equal to one cycle per second.

Hertz (Hz)
Frequency measure in units of cycles per second. See frequency.

Inverse Square Law
The law of physics that teaches for every doubling of distance from the point source the level of the originating signal will diminish by 6 dBA.

L_{eq} (Equivalent Noise Level)
Measure used to express the average sound level (typically express in dBA) over a given period of time.

L_{max}
Measure used to express the maximum sound level over a time period.

L_n Statistical Noise Levels
Sound levels (typically expressed in dBA) exceeded "n" percent of the time. Common statistical levels are L_{10} (level exceeded 10% of the time), L_{50} (level exceeded 50% of the time), and L_{90}. (level exceeded 90% of the time).

Octave Band
Groups of frequencies defined by standards where the upper frequency of each band is equal to twice the lower frequency of the next higher band. Octave bands are usually named by their center frequency. The full complement of octave bands in the audible frequency range is as follows: 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 and 16,000 Hz.

1/3 Octave Band
Frequency band encompassing 1/3 of one octave. Three successive 1/3 octave bands make one full octave.

Noise
Unwanted sound.

Noise Criteria (NC)
Background noise level of a room, typically associated with HVAC noise but includes all ambient noise present in room when measured.

Examples of typical NC ratings:

Below NC 15: Quiet studio

NC 15 – NC 25: Quiet library or classroom

NC 25 – NC 35: Typical Office

NC 35 – NC 45: Noisy Office

Noise Reduction (NR)
The amount of noise that is reduced through the introduction of sound absorbing materials.

Noise Reduction (NR)
The level by which a sound is reduced from one space to another through a wall, floor or ceiling. (See Transmission Loss)

Noise Reduction Coefficient (NRC)
The average of the absorption coefficients (α) for the frequency bands 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. Commonly used to describe the average absorption of acoustical materials such as ceiling tiles and wall panels.

Reverberation
Reverberation is the persistence of sounds in an enclosed space resulting from multiple reflections from room surfaces.

Reverberation Time (RT60)
The reverberation time of a room is the time it takes for sound to decay by 60 dB once the source of sound has stopped. Reverberation time is inversely related to sound absorption and is a way to measure the amount of absorption in a room.

Sabin
A unit of absorption having the dimensions of square feet or square meters, as appropriate. A quantity of the amount of absorption equal to the surface area (SA) of a material multiplied by its absorption coefficient (α).

Signal
A sound carrying useful information or information of interest. The signal could be a test tone, speech, music.

Signal to Noise Ratio (SNR)
A measure of useful signal to unwanted noise.

When computed using sound levels in units of dB, it is a subtraction and not a ratio. SNR = $L_s - L_N$ where L_s is the level of the signal and L_N is the level of the noise at the listeners ear. (See Inverse Square Law)

Sound Absorber
An apparatus or material that reduces the amount of sound reflected back into the environment once the incident sound wave hits it. The most common type of absorber is porous material. Once the sound enters the porous material, its sound energy is dissipated as heat. Also see absorption.

Sound Isolation
Ability of an object or material to inhibit sound from passing through it. Typically isolating material should be nonporous. Mass increases the isolation of materials.

Sound Pressure Level, (SPL or L)
Measure of sound in units of decibels. O dB is considered to be the lower threshold of human hearing. Most often Sound Pressure Levels are expressed in A-weighted SPL (dBA). See also A-weighted.

Sound Reduction Plan
A plan of action to be submitted by the design team to address property noise levels exceeding the Environmental Performance Standard of 60 dBA (L_{50}) or 65 dBA (L_{10}). The plan may include strategies for sound isolation, building layout or envelope construction to combat noise sources. The plan should identify how performance standards can be accomplished on a site exceeding the environmental performance standard.

Sound Reinforcement
Electronic amplification of an acoustic sound source, such as a talker. Sound reinforcement systems typically use microphones, amplifiers and loudspeakers.

Sound Transmission Class (STC)
Single performance rating of transmission loss. It is a standard ASTM ISO rating.

Speech intelligibility
It is the ability to understand spoken words in a particular environment.

Speech Transmission Index (STI)
Analytical measure of the intelligibility of speech in an environment. On a scale of 0 to 1, an STI of 0 is completely unintelligible. An STI of 1 would be perfectly intelligible. STI can be measured in the field or can be calculated using computer models of architectural spaces.

Teaching Space
Any school space designed for and used in part or in whole for the purpose of teaching.
It is a space where a teacher is required to communicate and a student to listen. It also includes spaces used for studying and reading. A teaching space can include but is not limited to the following: classrooms (all types, all levels), computer rooms, art rooms, music rooms, industrial arts rooms, media centers, multi-purpose rooms and gymnasiums.

Transmission Loss (TL)
A standard ASTM test similar to Noise Reduction but removes influences of the test sample size and amount of sound absorption of test room. TL is reported in decibels for individual octave or 1/3 octave frequency bands.

END OF GLOSSARY