Public Schools of North Carolina
State Board of Education
Department of Public Instruction
Financial and Business Services
Division of School Support
School Planning Section

MOST FREQUENTY MENTIONED SCHOOL PLANNING REVIEW COMMENTS

Relating to the Construction and Maintenance of Public Schools in North Carolina

September - 2009

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PURPOSE

In compliance with North Carolina General Statute 115C-521, The State Board of Education is responsible for reviewing all Pre-K - 12 public school construction projects. The School Planning Section within the Department of Public Instruction performs the plan review process for the State Board. The architects and engineers within School Planning have reviewed many school projects over the years and many of the same deficiencies keep repeating themselves. This publication attempts to bring to the attention of the designers and owner's representatives these problems or potential problems so that they can be solved before sending the project to School Planning for review.

The publication of "Most Frequently Mentioned School Planning Review Comments" provides comprehensive and useful information for designers of public school facilities. Content covers major architectural and engineering elements that are code items, principles that experience has shown to be desirable and practical in design and construction stages and best practices from a variety of professional sources. This publication identifies a variety of items of interest to architects, engineers and educators engaged in the development of plans for public school facilities.

Please refer to our other publications, "North Carolina Public Schools Facility Guidelines" and "Engineering Check List for Public School Facilities", for design planning purposes also. All these documents can be found on our web site at www.schoolclearinghouse.org.

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ARCHITECTURAL COMMENTS

GENERAL PLAN REVIEW

- The "Feasibility and Cost Analysis" form available on our website must be filled out and sent to School Planning for each school building that is scheduled to be demolished and replaced with new construction in lieu of renovation.
- Please respond in writing to our previous plan review letter.
- When submitting projects to School Planning, please provide the new transmittal form we have posted on our website.
- Provide the building code data sheet.

SITE

- Provide accessible parking within 200' of building entrance including marked pathways across vehicular.
- Provide covered walkway from bus and auto load/unload locations.
- Make the main entrance to the school obvious to visitors.
- Handicapped access to playfields is required by the NCSBC.
- The bus parking spaces should be arranged so that an adult supervisor on the sidewalk between the bus parking lot and the building can see the bus doors. The buses should be headed directly toward the sidewalk or angled toward the bus driver's left @ 45 to 60 degrees.
- School bus traffic should be separated from parent automobile traffic as soon as it can on the school site. It is even better if the two types of traffic can be separated before entering the school site.
- Provide sufficient length of driveway for the long lines of parent automobiles that wait in the afternoons to pick up students. (60 cars = almost ¼ mile in length)
- Arrange the parent automobile pick-up/drop-off drive and parking lot such that parents aren't tempted to short-circuit the line of cars by going through the parking lot and picking-up/dropping-off students in the parking lot, requiring them to cross the busy drive.
- Straighten out the parent drop-off curb as much as possible to make it easier for the parents to position the car the proper distance from the curb.
- The parent automobile driveway should be one way (counter-clockwise), wide enough for two lanes of traffic, and, any parking along the drive, should be located on the lefthand side, across the drive from the pick-up/drop-off walkway area.
- Direct access to playfields from the gymnasium should be provided so that students don't have to cross any vehicular traffic ways or parking lots.
- Driveways encircling the building are dangerous. However, fire truck access required by the Fire Code must be provided. In some cases removable bollards or

gates have been allowed by fire officials to keep out casual traffic. We further suggest that no curb cut be provided.

- Every effort should be made at elementary schools to provide a large, soccer sized grassy play area. Elementary schools do not utilize a baseball field with a skinned infield as a part of the PE program. With careful planning, such a field could be overlaid on the outfield.
- Provide curved or 45 degree walk intersections to save the grass.
- Avoid grass in courtyards due to maintenance problems. A mixture of paved areas (avoid plain concrete-causes snow blindness) and heavily mulched planting beds work well. Also oversize or provide two means of drainage to avoid creating a swimming pool when something gets "stopped up."

BUILDING (GENERAL)

- Be sure that locking-off portions of the building for control of after-hours functions does not result in dead-ends exceeding the 20' maximum allowed by code or prevent access to the required number of toilets.
- Use 2'x2' lay-in acoustical ceiling system in lieu of 2'x4' to avoid excessive deflection of the panels.
- When doing an addition to an existing school, try to integrate the addition with the existing by providing an enclosed connection that allows students to have access to all parts of the campus without going outside or through unconditioned space.
- Provide ventilation for the space under a stage if the stage floor is a structurally suspended type.
- Masonry screen walls are very susceptible to moisture penetration from the top, causing efflorescence, unless the detailing of the top of the wall includes through-wall flashing or a metal cap.
- Stair and other similar railings: Where possible, run railing "in-fill" components vertically or use a mesh to reduce the temptation for children to climb on them.
- Undercut doors in lieu of using door louvers where possible. Door louvers are easily damaged in a school environment.
- Yard maintenance shop, tractor storage, and similar exterior storage areas must be separated from the remainder of the building with 2-hr, fire-rated construction and properly ventilated. Better yet, provide a separate building away from inhabited spaces.
- Masonry wall control joints should be shown on the building elevations, not just left up to the contractor using a maximum dimension called out in the specifications. Aligning control joints with the masonry openings present a problem at the lintel bearing, which would bridge the control joint.
- Wired glass: Per the N.C. State Building Code, section 2406.1 Human Impact, all glazing in hazardous locations (See section 2406.3) shall pass test requirements of CPSC 16 CFR 1201. Wired glass conforming to ANSI Z97.1 is no longer allowed, except as noted in section 2406.3.1.1 where glazed openings in doors have an opening that will not allow passage of a 3-inch sphere.

- Although allowed by the building code, School Planning discourages the use of structural wood construction for school buildings from a longevity, safety and insurance perspective.
- Will it be apparent to visitors where the main entrance to the school is after the new addition is constructed?
- Provide foundation drains around the elevator pit to reduce the water head pressure and show the drain's extension on the civil drawings.
- Hydraulic elevators are gradually being phased out due to improved technology that allows the elimination of the machine room. Only one manufacturer now offers the standard hydraulic elevator.
- Show the ladder and the sump pit on the enlarged elevator floor plan.
- For small janitor's closets, swing the door outward so the floor space can be used to store bulky items, such as floor machines, etc.
- When re-using a prototype design don't forget to re-study any daylighting features or solar shading devices to suit the new site orientation, if different.
- A room near the service yard is recommended for the receiving of bulk items upon delivery to the school until the items are taken to their final recipient within the building or placed in storage.
- If lockers are to be located in the corridors, be sure there is enough corridor width to accommodate them and the resulting congestion. (Add 2 ft to the recommended regular corridor width for lockers on one side and 3 ft for lockers on both sides).
- We recommend a ship's ladder to access a mechanical mezzanine or roof in lieu of a vertical wall ladder. It is difficult to climb a vertical ladder with a heavy tool box or equipment part.
- Stairs: In as far as possible, run the in-fill portion of the railing vertically or provide panels. Horizontal railings promote climbing by students.
- There appears to be a dead end corridor, exceeding the 20 ft allowed by the building code.
- Corridors serving more than 8 classrooms are recommended to be 9'-0" minimum in width.
- We recommend that if drywall type partitions are to be used in the corridors that the abuse-resistant type be selected. (School Planning prefers CMU corridor walls for ease of maintenance and longevity.)
- Folding type partitions are expensive and can provide good sound isolation. For that reason, the construction above the ceiling, usually metal studs & drywall, should include sound batts to avoid short-circuiting of sound over the ceiling.
- Buildings move in response to many changing conditions, such as temperature, differential settlement, etc. Early in the design process, coordinate with the structural consultant as to where the building expansion joints should occur and what size they will be. Then thoroughly detail the conditions at all walls, ceilings and floors to allow the b.e.j. to work properly.

CLASSROOMS

- Raise wall cabinets located above sink base cabinets to 5'-0" minimum above finished floor to avoid a teacher "head-knocker" condition.
- Heat producing appliances located within the Pre-K through 5th grade classrooms are hazardous, and School Planning does not recommend them.
- Where heat-producing appliances are used in conjunction with the Exceptional Children's classrooms for Pre-K through 5th grade, it is recommended that any cooking center space be in a separate room, shared by two or more classrooms. A "kill-switch" with a power-on light for these appliances, including the wall outlets above the base cabinets where such similar type appliances might be used, should be provided. This switch should be under the control of the teacher and out of reach of children.
- Classrooms containing 1000 square feet or more (net) need two exit doors, swinging in the direction of exit travel. Recess the doors to the corridor so that the door swing will not interfere with persons passing in the hallway.
- Interior classrooms without windows (something we discourage) require two exits leading into different smoke zones, unless the building is fully spinklered.
- Allow at least 36" width for each computer station.
- In a proposed elementary classroom addition for an older building, Pre-K, K and 1 grade rooms are what are usually really needed (rather than 4/5 grade). By adding only a couple of hundred square feet, the addition would be much more flexible.
- Pre-K is being added to almost all elementary schools due to new programs. If you are doing an addition, you should seriously consider making at least 1 classroom conform to Pre-K requirements.
- We have concerns about locating self-contained classrooms above the ground level, especially for those students needing assistance to evacuate in an emergency situation. Their teacher and aide alone are insufficient to accomplish this.
- Teacher "wardrobe" units typically should only contain about 12" of hanging space. The remainder is usually equipped with adjustable shelves.
- Classroom sinks: Move them away from walls or tall cabinets so that several students can gather around the sink for teacher instruction.
- A base cabinet with sink and work top space is recommended in middle school classrooms, just as in elementary classrooms.
- Several of the classrooms in this project are significantly below the net area recommended by the "N.C. Public Schools Facilities Guidelines". A "Deviation Form" will be placed in the file for this school facility.
- The minimum recommended width for a classroom is 24 ft. Anything less results in sight line problems for those seated along the sides.

PRE-K CLASSROOMS

- Hot water to the lavatories in Pre-K (within a very narrow range of temperatures: 80 to 110 degree F) is required.
- Note that classrooms used for Pre-K programs used to require a toilet to child ratio of 1 toilet/15 children. Some requirements for Pre-K have been revised, however, to allow classrooms that comply with the requirements for kindergarten, including only one toilet, to be approved.
- Note that Sanitation and Health standards for Pre-K rooms do not allow bare (exposed) bulbs. If parabolic lenses are used, provide clear plastic sleeves over tubes or provide lenses on those fixtures.
- The N.C. Department of Human Resources, Division of Child Development requires a fenced-in play area for Pre-K classrooms. School Planning recommends these play areas be contiguous with the classroom and accessed through a door directly from the classroom. The gate from this play area can only latch securely, not lock.

SCIENCE LABS (Note: Beginning in the fall 2009, DPI, School Planning will be "approving" school science facilities for safety.)

- It does not appear that there are enough science rooms to support the number of students. Generally, one-fourth of the regular middle school academic classrooms should be science.
- Two sinks for 26 students seems very minimal, which may result in difficulty/long time in performing simple experiments. We see at least four and usually six sinks.
- Science prep rooms need 12 month's humidity control.
- Provide a two-speed exhaust fan in each science lab and each prep room.
- A separate room accessed from the chemistry lab preparation / storage room for the storage of chemicals should be provided.
- Chemical storage rooms: Year-round conditioned air is required to keep chemicals from spoiling.

TOILETS

- Urinal screens should be floor-mounted (stile only) and overhead-braced and tied into the typical toilet partitions. The cantilevered type is too easily damaged by vandalism.
- Do not mount mirrors over lavatories in group toilets because of the potential for hair to cause clogging of the drains. Instead, use a tall mirror mounted on an adjacent wall that doesn't compromise the visual screening from the corridor. This will serve handicapped and other students as well.
- In group toilets containing 6 or more flushing fixtures, a second handicapped toilet stall, 3'-0" wide x 6'-0" long, is required by code.

- The N.C. Plumbing code requires a minimum of 4 flushing fixtures in school group toilets.
- Provide visual privacy barriers ("maze" wall-type) in group toilets & locker rooms that do not rely on doors to be effective.
- The Building Code mandates that the maximum distance that a student or faculty member should have to travel to a toilet is 200 feet. Sometimes this may be overlooked by a designer when an add-alternate for additional classrooms require them to be placed at the end of a classroom wing.
- School Planning prefers moisture resistant gypsum board ceilings in spaces like group toilets where lay-in acoustical panel systems are subjected to abuse from moisture and vandalism. Also, the space above these ceilings can be used to hide contraband.
- Be sure the requirements for ceiling access doors in the drywall ceiling is covered sufficiently either in the specifications or on the drawings.
- Individual lavatories or hand wash fountains are preferred in a school toilet setting to sinks in a counter top. Counter top lavatories are easily damaged and deteriorate quickly.
- The N.C. State Building Code requires students and teachers in mobile classroom units to be located no further than 200 ft. from suitable toilets, just as in regular classrooms.
- The N.C. Building Code Council recently approved an exception to allow lavatories to be visible from the corridor for K-8th grades. We recommend that the teacher be able to monitor the students' hand washing process.
- Show the floor drains and indicate desired slope on the large scale toilet plans.

ADMINISTRATION

- Fixed glass in the secretary's office and adjacent rooms looking into the reception area will allow other people to "watch the front door" in the absence of the receptionist.
- To allow the staff to supervise the health/first-aid room, glass in the door or a sidelight is needed from the reception area or from a nearby administration suite corridor. Provide blinds for times when privacy is required.
- The door to the toilet adjacent the health room should swing outward. If a person faints in the toilet and blocks the door it would be difficult to give assistance.
- School Planning does not recommend private toilets for individual offices, including the principal's office. This is expensive and an inefficient use of space.
- We suggest placing the assistant principals' offices in key (corridor intersections) remote locations from the administration area to provide better surveillance of the school building.
- Study receipt of teachers' mail and how they will receive it without creating congestion within the administration area A room off the corridor with an "in" and an "out" door and a pass-through rear-fed casework unit is ideal. . Vertically oriented slots (rather than horizontal) are easier to determine if there is mail in the mail box.

MEDIA CENTER

- Media office/workroom should be located near the checkout counter and the checkout counter near the entrance from the corridor/lobby.
- Book shelving units located away from walls should only be 42”-48” high for better adult supervision of students and be on casters for flexibility.
- Two-story media centers are never recommended.
- Media centers must be located on the first floor in elementary schools.
- When sufficiently designed, including placement of equipment and furniture, but still in the preliminary stages, a media specialist here at DPI, will review the media center. Any comments she may have will be sent in a separate letter.

MUSIC

- Provide oversized doors to music rooms and instrument storage rooms.
- The door to the corridor from the band/choral room should be an acoustical door.
- Provide two doors for the instrument storage room, one to enter and one to exit. This will reduce congestion.
- School Planning does not recommend built-in risers for choral or band rooms. A flat floor with portable risers is preferred. The portable risers do not reduce the much-needed room volume, and a flat floor makes handicapped accessibility and future flexibility-of-use more easily attained.
- Provide a large, deep sink in the music suite for cleaning large brass instruments.
- Band and choral instrument and uniform storage rooms need 12 month’s humidity control.
- We suggest the use of an allowance and unit prices to add to or deduct from a base bid quantity of sound absorbing panels, to be determined by “tuning” the space after construction.
- Provide drinking fountain reasonable close to vocal and instrumental music rooms.

VISUAL ART

- The kiln should be located in a separate room. The kiln room should only be large enough for the kiln itself and a minimum amount of non-combustible shelving for ceramics use (40-60 square feet). Provide a separate storage room (80-150 square feet) for paper/flammable type materials.
- Provide an outside art patio accessible directly from the art classroom whenever possible.

THEATER ARTS

- School Planning recommends that when a new auditorium is included in a school project that the entire facility be planned for theater arts instruction, although it may be a multi-use space. Even if the budget cannot allow the support spaces to be constructed now, an addition can be planned for the future to provide such things as a drama classroom, scenery shop and storage, costume shop and storage, dressing rooms, toilets, etc.
- Stage wing space should be a minimum of one-half the proscenium opening.
- A location within the auditorium seating area (removable seats in the flat area along the center portion of the room) for lighting and sound controls is desirable as an alternate to a 2nd floor control booth for a potential handicapped operator.
- Orchestra pits in school auditoriums are not recommended by School Planning. They are dangerous to students performing on stage. Also, student musicians are a part of the presentation and their parents want to see them perform. A flat floor in the seating area, just in front of the stage, with removable seats, can provide a good place for the orchestra.
- Two double doors or a maze entry in lieu of only one double door for auditorium entrances are preferable to isolate sound and light to prevent interruptions to performances.
- An access pathway from an exterior loading dock into the back stage area with oversized doors, 8’ high, minimum, should be provided for large scenery/props assemblies. A shop/storage area may be part of this access “pathway”.

CHILD NUTRITION

- Locate the scullery/dirty dish room to facilitate getting the garbage/trash out to the dumpsters and avoid passing through the clean/food preparation areas of the kitchen.
- The toilet that serves the kitchen staff cannot open directly into the kitchen food preparation areas. Section 310.1 N.C. Plumbing Code. (Usually a locker room with a door is used as a vestibule to provide separation.)
- If a raised dock is proposed at the kitchen service entrance, provide a ramp in addition to steps to facilitate handling items delivered from trucks that do not fit the dock height and also to allow garbage and trash to be wheeled out to the dumpster. It is preferable, however, that dumpsters are located adjacent to the dock so that garbage/trash can be dumped directly from the dock level.
- Walk-in freezers in most school kitchens are considerably larger than the coolers. Verify with the owner the desired capacity of each.
- The kitchen supervisor’s office should be located where observation of food preparation/serving areas and loading dock entry is easy.
- The food services facilities must be reviewed by the N.C. Department of Environment and Natural Resources; Food, Lodging & Institutional Sanitation Branch. (919) 715-0927.
- How are dishwashing, trash, and garbage handled?

- A half high screen wall to hide the trash cans/recycling may be useful outside of the tray drop window.
- A hand wash sink is required in the dish room / scullery.
- Provide for future electrical needs for vending machines, ice cream machine, etc.

PHYSICAL EDUCATION

- Provide a minimum of 8’-0” safety clearance at the basketball court end lines and 6’-0” along the side lines. If this is not possible, use a generous number of wall pads to protect players.
- So that students will be more likely to use the showers in the locker rooms, make the enclosures of the individual showers at least 6’-0” deep. Install two curtains so that a small dressing area with a seat and several robe hooks separate from the shower area can provide privacy.
- Provide oversize door to the laundry room to allow commercial type washers and dryers to pass through. Be sure this extra width doorway extends to the exterior delivery location.
- Extend the vapor barrier under the volleyball net post inserts to maintain the integrity of the moisture protection for the gym floor.
- Supervision of the gym locker rooms from the coach’s office is highly desirable for prevention of abuse and fights.
- A gymnasium is considered to contain two teaching stations and, as such, hearing and understanding speech in these spaces is very important. Many times gymnasiums are too “lively” acoustically. An exposed cement fiber roof deck or similar construction, and special wall treatment will enhance the sound quality of these areas. An acoustical consultant may be needed here.
- Accessible seat-transfer showers require clear space on the seat side of the shower.
- Where acoustical panels are used for sound absorption in a gym, in addition to a specified quantity in the base bid, use a cash allowance w/ a unit price so that the space can be “tuned” after the room is constructed.
- The gym doors into the corridor should be recessed so that passersby in the corridor will not be hit. Sometimes a wing wall or elongated pilaster in the corridor, in lieu of recessed doors, will serve the same purpose.
- Handicapped access is required to the announcement booths, at football field or similar facility.

BOILER ROOM

- DPI School Insurance no longer requires a 2-hr fire-rated boiler room ceiling / roof construction unless required by the NCSBC.
- The Building Code does not allow doors from boiler rooms to the interior of the building. All doors must be to the exterior. (NCSBC section 423.1)

- For boiler rooms of 500 square feet, or more, two remote exits to the exterior must be provided.
- Section 423.1 of the NCSBC requires school boiler rooms to be separated by 2-hr fire-rated construction

EXTERIOR WALL SECTIONS

- Provide ventilation for space above uninsulated soffits.
- Place finish grade at a minimum of 8" below finish floor (except where needed at entrances) to help in keeping water out of the building.
- Cavity wall flashing should pass through the exterior wall face one brick course below finish floor. This condition will provide a more positive moisture protection. Weeps will still be above grade and will still be operable even with heavy mulching at planting beds, etc.
- Call out weeps at the locations where through-wall flashing exits the masonry, and note the spacing thereof.
- Face brick should extend down 8" minimum below finish grade.
- Typical wall section: Provide additional metal ties/masonry wall reinforcing for the upper-most brick course/s so that the dimension from the top of the masonry down to the last masonry reinforcing does not exceed 8".
- Provide expansion joint material or a bond-breaker, such as 30# felt, along the edge of the floor slab (on grade) along masonry walls that go below the slab.

ROOF PLAN

- Call out minimum dimensions from the top of the roof membrane up to critical points such as curbs, through-wall flashing exits, etc. (usually 8" to 12")
- Show how the wood blocking is secured to the substrate.
- Provide permanent access to roof mounted equipment located 16' above grade.
- Provide roof walk pads at the bottom and top of roof access ladders, at the active side of roof access hatch doors, doors from roof penthouses and other locations which receive concentrated foot traffic such as roof top units. This will protect the roof membrane.
- School Planning does not recommend roof top air conditioning units for school projects. Rooftop units are difficult to service and have a shorter useful life than other units because of harsh exposure. Roof leaks and premature roof failure are often associated with rooftop units.
- We suggest a ship's ladder roof access in lieu of a vertical ladder, or, one of the regular stairs could be extended. Be sure to block this portion of the stair off with a locked door at the floor level just below roof access to prevent student access.
- Good roofing practice typically calls for a minimum of ¼" per foot slope with both new and reroofing construction unless prevented by existing through-wall flashing heights.

- Continuous snow and ice guards should be provided along the eaves of metal roofs to protect the gutters and downspouts from sliding sheets of snow and ice, not just at building entrances for protection of people only.
- Provide overflow scuppers for emergency draining of roof areas if the primary drain is clogged.
- School Planning does not recommend running exposed piping or conduit across the roof.
- Built-in gutters are not recommended. They are expensive and subject to leaks that are difficult to fix.

OUTBUILDINGS

- We do not recommend sealed concrete floors for spaces such as toilets, concessions or janitor's closets due to the difficulty of keeping these spaces sanitary and because of potentially slippery conditions. Ceramic or quarry tile is a better choice.
- This building will be closed and locked for most of the year. To prevent the build-up of mold and mildew, provide good natural ventilation low and high and provide durable, easily cleanable finishes.
- For a proper plan review, a site plan will be required.
- Home and visitor locker rooms: A visual barrier such as an "L"-shaped wall maze is needed at each entrance. For doors in an exterior wall, the "maze" can be built outside the plane of the exterior wall face of the building to conserve interior square footage.

OUTDOOR BLEACHERS

- Where ramps are required at bleachers for handicapped accessibility, ramps will be required at each end. School Planning recommends a set of steps and a ramp at each end for convenience.

STRUCTURAL COMMENTS

GENERAL

- Subsurface exploration report shall be part of the project specifications.
- Show wind design pressures for components and cladding at different zones of walls and roofs in accordance with the latest NCSBC.
- Do not design structural members for minimum weight alone. Such a design may be require more pieces and more connections and will be more labor intensive in both the shop and the field, and in all likelihood will be more expensive.
- Show all necessary loads/forces on design drawings to avoid costly over-designing of connections or dangerous under-designing.
- Utility lines shall not be placed through or below foundations without approval of the structural engineer.
- Building expansion joints should be provided at separate wings like L, U, and T shaped buildings and at adjacent to the existing building.
- Indicate masonry shear walls, braced frames or moment frames on foundation and framing plans.
- Specify design diaphragm loads to be transferred at masonry shear walls, braced frames or moment frames for proper connection of deck units to supports.
- We do not recommend the combination of masonry shear walls and steel moment frames to be utilized in the same direction to provide lateral stability of the building.
- Properly attach wood blocking and nailers to structural member with bolts.
- Roofs work best when their geometry is simple. Multiple hips, valleys, changes in roof pitch and mixing with different roofing materials will greatly increase the cost of roof, the possibility of leaks and higher maintenance costs.
- Relief scuppers should be limited to no more than 6” above the nearest lowest spot on the roof (usually the lowest spot is at nearby internal drain).
- Use columns wherever are possible to support critical roof/floor loads rather than using complex design such as cantilevered framing.
- Whenever possible and practical, the slope required for roof drainage should be incorporated into the structure layout to effect initial and replacement cost savings.
- Demolition of existing structural members should not be left solely to the contractor. Where the design for demolition or renovation of existing buildings involves replacing or removing structural members, the method for their removal and for the shoring of remaining structural members should be detailed on the contract documents.
- Specify light weight concrete only when it is available at local market.
- Prepare complete design drawings that will accurately interpret the intent of the design. There will be far less chance for ambiguities, misinterpretations, errors and/or omissions.

- The provisions of structural tests and special inspections shall be submitted as part of the construction documents to assure construction quality and workmanship in accordance with Chapter 17 of NCSBC.
- Obtain Building Permit and CO (Certificate of Occupancy) for all projects from local building inspection department.

SOILS AND FOUNDATIONS

- Foundation design shall be based on subsurface exploration report.
- Provide subsurface exploration report information in the foundation section of the General Notes on the drawing. Ex: geotechnical company name, date of report and recommendations for foundation type and design criteria.
- Footing excavations shall be inspected by an independent testing laboratory for suitable soils, bearing pressure and compaction.
- Presumptive soil bearing pressure per section 1804 of NCSBC needs to be field verified.
- Avoid designing two or more foundation systems for the same building to prevent costly damage consequence from differential settlement.
- Lower column and wall footings at roof drain leaders.
- When new footing is poured next to the existing wall or column footings, make sure that the bottom elevation of new footing should match the bottom elevation of existing wall footing. The soil next to existing footing is most likely a loose back fill.

SLAB ON GRADE

- Slab on grade should consist of a minimum of 4” crushed stone/2” sand, 6-mil polyethylene vapor barrier and 4”- 6” concrete slab.
- Welded wire fabric should be specified in sheets not in rolls.
- Keep concrete slab on grade floating without direct contact or tie to concrete footings and masonry walls.
- Provide and detail concrete slab control joint.

STRUCTURAL STEEL/JOISTS

- Select a proper mix of A36 and high-strength steels A572 grade 50. High strength steels are advantageous when strength is the major design criteria.
- Avoid designing column splices at mid-story height. If the splice can be located no higher than 5’ above the tops of steel beams, it will save the expense of extra rigging or scaffold.
- KCS joist should be utilized to support uniform loads plus concentrated and non-uniform loads.

- Specify joist seat depth in accordance with the joist manufacture's standard for economic reason.
- Design joist to support folding partition for the worst load condition.
- Specify concentrated loads from brick veneer wall or mechanical equipment and consider surcharge loads from snow drifts for joist design.
- Steel joists shall span along with the roof slope.
- Make sure high end minimum seat depth is coped at roof slopes 3/8:12 or greater.
- Use joist substitutes (VS series) for short spans (10' or less).
- Joist bottom chord extension does not require welding to the stabilizer plate unless it is considered in the design of both the joist and the overall frame to transmit horizontal forces.
- Cross bridging shall be clearly indicated on the structural drawings at end of bottom chord bearing joists to provide lateral stability. EX: full depth cantilever end or square end. This bridging shall be installed as the joists are set in place.
- Specify net wind uplift load for joist design.
- A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.
- Indicate force for each member of braced frames and special trusses.
- Show diagrams of special truss design including bearing locations and member sizes. Provide force for each member and provide details at connections and splice joint.
- Show elevation configuration of all braced frames and provide details at connections.
- Provide lateral bracing to the bottom chord of long span trusses, joists or joist girders.
- Structural members delivered to the field are not manufactured in accordance with the plans and specifications and with code standards shall be rejected. Field modifications of any steel member are prohibited. Damaged members shall be returned and shall not be used.
- Load diagrams should be provided for proper joist design at special loading conditions.
- OSHA safety standards for steel erection require that open-web steel joists on or near column lines be bolted for erection safety.

STRUCTURAL DECK

- Metal deck shall be a minimum 22 gauge thickness and a minimum 20 gauge thickness for wind speed 110 mph or higher. The maximum span of 1 ½" metal deck should be limited to 5'.
- Standing seam metal roof deck has little diaphragm capacity. Either horizontal cross bracing should be provided on the roof plan in both directions or employ a roof deck with adequate diaphragm capacity to go with it.

- Make sure steel deck has enough strength and welding/fasteners to transfer diaphragm loads/lateral forces at masonry shear walls, moment frames or braced frames.
- Proper reinforcements and force transfer mechanisms should be provided to assure the continuity of floor/roof diaphragm action at any interruptions such as large openings, clerestories and multiple hips & valleys configurations.
- Any proprietary roof or building system should be bid as an alternate to non-proprietary base system (G.S. 133-3).
- Consider the following guidelines specifying cement fiber/Tectum roof decks:
    1. End joints must occur at supports unless bulb tees are utilized.
    2. The diaphragm action of the deck.
    3. Joint must be tight.

MASONRY

- Provide bond beam reinforcements at corners and intersections.
- Provide reinforcements for seismic requirements in accordance with the NCSBC. Vertical rebars should be provided at all corners, end of walls, each side of control joints and each side of wall openings.
- Please identify masonry shear walls on the plans and provide adequate reinforcements.
- Provide and detail masonry unit control joint and brick expansion joint.
- Show details of reinforcement around openings.
- Provide a lintel schedule and end bearing requirements.
- All exposed steel lintels and shelf angles shall be hot-dip galvanized.
- Provide adequate lateral supports for interior and exterior walls.
- Extend vertical reinforcing bars into reinforced bond beam with standard hook at high wind area.
- Please specify type S mortar cement.
- Solid grout/pea gravel concrete fill shall be provided in all masonry units below grade, all cavities with reinforcing bars, all cavities with embedded or drilled-in anchors, and bond beams. Grout/pea gravel concrete shall have a min. compressive strength of 3000 psi at 28 days.

MODULAR UNITS

- Any building including modular/mobile units should be designed and constructed as a permanent building in accordance with the latest NCSBC.
- Provide foundation plan showing the location of masonry piers & tie down anchors, size of masonry piers & their footings.
- All footings shall rest on undisturbed soil or compact fill having a min. of allowable bearing capacity of 2000 psf.
- The bottom of masonry pier footings shall be a min. of 12” below finished grade.

- Masonry piers shall be laid in type S mortar. It is acceptable for masonry piers to be dry-stacked and four sides of pier shall be coated with surface bonding cement and the first course above the footing shall be set in a bed of mortar.
- The ramp/platform support legs need footing for anchorage and support.
- Please submit drawings and details of the third party engineer for review.
- The drawings from third party engineer are required to be updated with the engineer's seal, signature and date.

PRE-ENGINEERED BUILDINGS

- Standing seam metal roof deck has little diaphragm capacity. Horizontal cross bracing should be provided on the roof plan in both directions.
- Provide portal frames and/or cross-bracing at side walls to properly stabilize the building.
- Provide horizontal ties such as tie rods or hairpins to resist outward thrust at the base of rigid frame's column.
- Use pre-engineered frames at end walls and add wind columns as necessary in between the columns of pre-engineer frame. It should easily accommodate future expansion.
- Foundation system should be prepared by a North Carolina professional structural engineer. It must be checked against the forces calculated by pre-engineered manufacturer.
- Limit the drift of pre-engineered frames to L/600 if brick veneer and/or masonry wall are part of the building enclosures and are supported laterally by girts.
- Provide and show the location of all collateral loads such as sprinklers, basketball goal, exhaust fan, underhung equipment, mechanical & electrical systems and ceilings.
- To insure the quality of structural steel work, we recommend that pre-engineered manufacturer be AISC (American Institute of Steel Construction) certified steel fabricator.
- The structural system must be checked and approved by an independent registered structural engineer of your choice, other than a registered engineer in the employment of the manufacturer.
- Certificate of review will be issued after we receive a copy of final manufacturer's structural shop drawings and a letter confirming adequacy of design from the independent registered structural engineer.

WOOD

- Truss members and components shall not be cut, notched, drilled, spliced or otherwise altered in any way without written concurrence and approval of a registered structural engineer.

- Hurricane & seismic ties shall be provided on both sides of the stud wall to properly anchor roof truss to the wall top plate. The ties should be installed diagonally across from each other.
- Must have 2x4 cross bridging along the line of truss bearing if the height of truss at bearing is 2’-0” or greater.
- Use Plywood or OSB sheathing at all corners of the building to assure a minimum structural rigidity of the building.
- Pre-engineered trusses should be designed and sealed by a North Carolina registered structural engineer.
- Please identify the interior load bearing walls for trusses.
- Leave a space between top of the non-load bearing wall and bottom chord of roof truss to allow the deflection of roof truss under loads.

MISC

- It is very important that drawings be coordinated dimensionally between the architect and engineer.
- Indicate weights of mechanical units or roof top units on framing plan.
- Please provide structural documentation indicating the ability of all roof and floor systems to support new equipment and detail each type of attachment to these systems.
- Non-load bearing exterior wall serves a structural function. Design the wall and provide details around openings.

PLUMBING & MECHANICAL COMMENTS

PLUMBING

- Please require floor drains in mechanical rooms.
- Please confirm potential for corrosives or acids to be disposed of through science room and work room sinks. If likely, require diluting drum traps.
- Please require plaster or interceptor traps for all Art Room sinks.
- Please provide a floor drain (min. 3") in all group toilets.
- Trap primers should be avoided where ever possible. Where necessary drains from clear water fixtures or hose bibbs may be installed to keep traps primed.
- Please provide a service sink in the Kitchen per NCSBC Chapter 29.
- The elevator sump pump discharge connection to the sanitary sewer system must be by indirect/air gap connection (NCSBC Chapter. 30).
- When removing plumbing fixtures where the sewer connection is not being reused, please comply with NCSBC (plumbing) par. 704.5 which prohibits dead ends in the sewer system.
- Please require water hammer arrestors in the domestic water piping as recommended by PDI or ASPE. The location of these devices should be indicated on the construction documents.
- Please provide tempered water to safety showers and eye wash stations as required by NCSBC (plumbing) paragraph 411.1.
- Please require a solids interceptor for the disposer, when connected to the grease waste system, as required by the NCSBC (plumbing) paragraph 1003.3.2.
- Discharging oil into the sanitary sewer is prohibited. To ensure that this does not occur, please require an oil monitoring system for the elevator sump pump to stop the pump when oil is sensed in the elevator pit.
- Please comply with the NCSBC (plumbing) paragraph 403.9.5.2 where a minimum of four flushing fixtures are required in all group toilets.
- Please require emergency shut off valves in gas piping serving each science/chemistry classroom. The valve or actuating switch should be located behind a lockable panel accessible to the teaching staff.
- Please require an eye wash station in the Science Prep room.
- A central acid neutralization or dilution tank should not be located inside the building due to the potential for hazardous fumes being released into the building as well as a disruption in school activities during service of the system. Please locate the neutralization or dilution tank outside the building.

HVAC

- School Planning does not recommend the use of roof mounted heating and cooling equipment. Problems include reduced life of equipment, low efficiencies, higher cooling loads, noise issues, high maintenance, damage to roof, possible contaminated fresh air supply, etc.
- School Planning does not recommend the use of two pipe systems. These systems may not provide consistent temperatures between interior and exterior spaces, change over between heating and cooling result in uncomfortable conditions in the building, there is a lose of energy during the time of change over and most importantly there is no capability of controlling humidity.
- It is recommended that a life cycle cost analysis be performed to compare different HVAC system types.
- School planning does not recommend the use of exterior wall mounted units. These systems have a short service life, poor outside air control, poor operational efficiencies, elevated noise levels and require more maintenance than alternative systems.
- Exposing ductwork on the roof should only be considered for an existing building where available space simply makes it impossible to fit any other way. A new building should be designed to accommodate the mechanical systems without requiring substandard installations. Please coordinate with the architect to create sufficient space for these systems within the building envelope.
- Duct liner should be avoided in all forced air systems unless used in a double wall application. Liner can contribute to the collection of microbial growth. Liner may also deteriorate over time and can create blockages in the duct system as well release fibers into the air stream. Use of liners in transfer ducts would not be considered problematic. Consider the use of double wall ducts with a perforated liner where noise is of concern.
- The pump variable frequency drive pressure sensors are not properly located in the system. Placed as indicated will not result in full benefits of reducing flow. The indicated location will in function create a constant volume pump. The sensors should be located across a representative terminal. Reference ITT Technical Bulletin No. TEH-685.
- The bypass variable air volume system will not consistently provide the code required quantity of fresh air to all spaces and may result in poor indoor air quality.
- Please require a cleanout (collection box) at the bottom of the dryer vent.
- Please supply conditioned air directly to group toilets.
- Automatic air vents should be avoided. These vents can hang open and result in flooding the space or introducing air into the system. Manual air vents prevent this potential problem.
- The indoor and outdoor design conditions are not in compliance with the NCBC (energy). Please correct any calculations and equipment selections impacted by these requirements.

- Provide Code Data Summary as required by NCSBC (administration). All calculations and equipment selections must be based on the NCSBC (energy) requirements for indoor and outside design conditions and DPI recommended indoor design conditions.
- Provide a bell mouth fitting for all open ended ducts to reduce pressure loss.
- The NCSBC (energy) par. 503.4.5 requires the terminal unit air flow be reduced to 30% of the cooling CFM or to the required outside air cfm before or when reheating the air. Please revise the heating cfm to meet this requirement.
- Please provide ventilation for Lawn Storage. This space may store lawn mowers and gasoline containers. Consider a fan and heater that will not be a source of ignition.
- Please provide an outside air summary indicating the cfm used for all types of spaces. This should be in compliance with the NCSBC (mechanical).
- Please consider using a 42 degree chilled water supply temperature and a 12 or 14 degree delta T. The 42 degree supply temperature will allow for better moisture removal and the higher delta T will allow for down sizing the pumps and piping thus saving on construction cost.
- The carbon dioxide sensor control of the outside air is incorrect. You have not sized your heating and cooling equipment for this load, nor should you, and it may result in a loss of control of the building conditions. The code required minimum outside air flow should be maintained unless the space is not occupied, as sensed by the carbon dioxide sensor, then it should be reduced to save energy.
- Please control return/relief fans based on space pressure. This will account for intermittent exhaust systems and varying outside air quantities and ensure a positive pressure in the building.
- Please provide controls diagrams to indicate proper placement of control components in all applicable system types.
- Please indicate the design pump efficiency to ensure efficient pumps are provided and that all pump manufacturers consider similar pumps.
- Please require direct drive fans whenever possible for better reliability and reduced maintenance burden. Use speed controllers to adjust the speed of the fan to provide the required air flow.
- Please provide individual emergency exhaust systems for each Chemistry and Physical Science Classroom. These systems should be manually controlled and sized at six air changes per hour to provide a negative pressure in the space to prevent fumes and vapors from spreading to other parts of the building in the event of a chemical spill.
- Please provide continuous exhaust for all spaces where chemicals are stored.
- The maximum unrestricted mounting height for temperature sensors that allow for adjustment, provide visual indication of temperature, or override activation allowed by NCSBC (accessibility) is 54”.
- Serving offices along with a classroom will result in inconsistent and uncomfortable conditions in the office areas. Please consider a separate system or an automatic thermostatically controlled diffuser for the office.

- The NCSBC (mechanical) requires that fresh air be continuously supplied during occupied periods; therefore, the outside air dampers cannot be closed unless the building is un-occupied. Where there is a risk of freezing water coils, please preheat the entering air to above freezing with a non-temperature sensitive medium (electricity, heat reclaim, etc.).
- Please detail exhaust duct connections for each type of wood working equipment connected to the dust collection system.
- Including metal working (welding, grinding, cutting, etc.) in the same room as wood working (sawing, sanding, etc.) is prohibited by the NCSBC (fire). This is a very hazardous condition with a high potential for fire.

MODULAR UNITS

- Please require a main shut-off valve in the domestic water line serving the unit.
- Please require a condensate drain line extended from the wall mounted heat pump to a french drain installed below grade adjacent to unit.
- Please require balancing of the heat pump unit (total supply air and outside air), as well as toilet exhaust. Each should meet the requirements of the NCSBC.
- Please require checkout of heating and cooling controls. Controls must be set such that heat pump supply fan will run continuous during occupied periods to provide a continuous supply of fresh air.

GENERAL

- Please indicate room names and numbers on all plans.
- Please indicate all fire rated construction on all plans and include symbol in legend. Referencing to the Architectural drawings by note is not considered the best practice.
- Please include applicable UL details for penetration of all rated construction types and ratings. Please include all relevant symbols for fire rated construction in legend.

ELECTRICAL COMMENTS

RISER DIAGRAMS

- Riser Diagrams shall be included with all panel layouts drawings unless not practical to do because electrical work is limited and is connected to existing panels that are located at various places.
- All conductor feeder sizes including services and power services, neutrals, and grounding conductors shall be indicated. All conduit sizes shall also be on riser diagrams or attached identified tables on same sheet.
- All three and single phase volts transformers shall have main circuit breakers or fused disconnect on the secondary size. Generally rules are covered by NEC 240-4(F). Transformer shall have KVA rating and identify type if not a standard transformer.
- All riser diagrams shall include existing and new identified panels that are used in the electrical drawings. They can be supplied by single line or riser diagrams.
- Grounding methods for electrodes that are required for main services, transformers, and emergency generators shall have sizes for the conductors that are used and how to be tied in with neutrals and grounded conductors. All connections to building, water piping and natural gas, and other electrodes sizes shall be shown on drawing.
- All equipment such as emergency generators, separate building connections from the main panel, and automatic emergency transfer switches, etc. shall be shown on riser diagrams.

ELECTRICAL PANELS

- On panel schedule, information such as voltage, number of phases, main breaker or main lugs size, lugs that feed other panels, KVA for panel circuit, total connected KVA, KAIC rating, circuit names such as computers, HVAC, kitchen, receptacles, lighting, etc. Additional information such as circuit breakers for each load that is fed and conductor sizes should be shown.
- Another item that should be shown is summary of KVA on panel and types of loads that are attached and total calculations for complete KVA. Also if information such as what panel feeds another panel, it can be included for information.
- All panels shall indicate the type of loads that are fed.
- Service panel that have a 1000 amps on 277/480 volts shall have ground-fault protection of the main service equipment.
- A panel that is over 800 amps has to have conductors to at least the size of the circuit breaker. If under 800 amps the conductors are allowed to go down to the next lower standard size conductors and the next larger breaker can be used.

- Lighting panels that had 42 circuit restrictions now can have 84 circuits.
- Conductor sizes may need to be larger than what is required for breaker size because of voltage drops. This might be required in parking areas, sport fields, and other areas where distant cause 5% drop in voltage.
- Services should be three phase except when there may be some for mobile units or small modular units.
- Main Service electrical panel should be 277/480 volts, three phase wye with 4 conductors or 120/208 three phase wye with 4 conductors. What is used will depend on size of installation and cost. Also grounding conductors shall be used.
- On larger new schools, two power company transformers that are 120/208 and 277/480 volts separate services can be used so that transformers do not have to be used inside the school. This has been done by some engineers.
- On the electrical main service that is located in one building feeds a service in another building, the smaller circuit shall also have a main breaker installed. The grounding and neutral conductors shall not be tied together in the building that is fed from the main service. Required electrode(s) shall be furnished for the grounding conductor.
- The transformer that is furnished from the power company can serve several main service panels such as another building, outside HVAC equipment, outside sports etc. Panels that fed from power transformer meet normal service requirements to each separate main circuit.

LIGHTING

- Energy efficient lighting shall be used in all parts of new school buildings and outside areas such as sports fields. Inside and outside light requirements shall meet the requirements of the NC State Building titled Energy Conservation Code. Section 505 covers the electrical power and lighting requirements. Buildings being renovated shall use efficient lighting as required for new buildings.
- The engineer is required to fill out and sign Energy Lighting Compliance Statement. Also a Legend in drawings shall indicate items such lamp type, numbers of lamps, ballast type, number of ballasts, total wattage, and description of fixtures. Summary of interior and exterior lighting shall be shown on compliance.
- In classrooms, corridors, libraries, etc. T-8 fluorescent lights with electronic ballasts are primarily used. Other lighting types that might be checked would be T-5 or T-5HO. Also on each of these light and fixture types there are different efficiencies depending on lighting equipment used. In gyms, sport fields and similar areas, normally metal halides are used. Gym in elementary schools can be used with fluorescent fixtures. Metal halides fixtures take time to light fully if turned off and some incandescent fixtures are used for temporarily low lighting levels.
- Outdoor lamps used for required exit areas in case of electrical power failure shall have two lamps, which can be done with one two lamp fixture or two one lamp fixtures.

- Fixtures in legend should have at least three manufacturer listed if possible as required by North Carolina purchasing laws.
- Lighting control systems can be used in classrooms, cafeterias, and other larger areas by using motion detectors to determine movements to turn fixtures on or off. It is being used in primarily new schools and some renovations.
- In school classrooms and other areas, two lamp switches are required by code to adjust for different lighting levels.
- Night lights should be used in corridors and other needed areas as needed.
- Emergency egress light fixtures shall be used for corridors, auditoriums, gyms, cafeterias, exits, and other areas that are needed. Areas on the outdoors of exits shall have emergency lights. All exit signs and emergency egress fixtures shall have either battery backup or a generator.
- Outside fixtures other than emergency should be installed on the outside of building. They can be controlled by photo-cells or other items that control on/off operations.
- Due to the sensitivity of electronic equipment such as lighting or computers now installed in new construction or renovations, transient and surge protection is usually required. Additionally two neutrals instead of one may need to be used for electronic load circuits. These devices can be installed in service entrance panels or feeders and in panel boards or receptacles serving electronic equipment. Protection may be provided at one or any combination of these locations, based upon professional knowledge and judgment. Protection is required for telephone and data conductors--particularly those that enter the premises from outside sources and that run from building to building.
- Kitchen and similar areas with heat-producing equipment should be controlled by teacher with an electrical cut-off switch in classrooms having exceptional children in an emergency situation.

FIRE ALARM SYSTEMS

- Fire Protection Systems are summarized in NCSBC: Fire Code. The basic rules are that a manual fire alarm system is required in Group E occupancies per paragraph 907.2.3. However items such as strobes in classrooms are required to meet ADA rules. That requires the use of a Fire Alarm Control Panel which then involves NFPA 72.
- Fire Alarm Control Panel (FACP) is used in schools for new building and major renovations .Circuit diagrams of major controls, specifications, and alarms locations such as smoke detectors, smoke detectors in duct returns to air handlers, kitchen hoods, strobe/horns etc. shall be included.
- Kitchen hoods shall provide connections for fire extinguishing system to the fire alarm system and shall provide shutdowns for cooking equipment that is electrical (shunt trips), natural or LP gas, and hood supply and exhaust fans.
- All smoke and heat detectors, including those which activate the shut-down feature of air handling units, and kitchen hoods shall be tied in to the fire alarm system and shall activate all alarms.

COMMUNICATION SYSTEMS

- Thoughtful planning is required to accommodate sufficient numbers and proper locations of computers, telephones, TV, intercom/paging/radio and other integrated communication equipment. For the computer and other high-speed electronic equipment, the backbone can be fiber optic cables feeding level 5 or 6 copper wiring to the individual items of equipment. Surge suppression and lightning protection devices should be used to protect all electronic equipment and the panels to which they are connected. Sufficient wire ways should be installed and located for ample expansion. Cable tray over lay-in ceilings in corridors is the most common method for routing communications and computer

.

TECHNOLOGY INFRASTRUCTURE

- Advances in technology occur rapidly and the price of today's technology drops rapidly as time passes. School construction usually takes one to two years, depending upon the type and size of the school. Because of these factors it is uneconomical to build in obsolescence to include bids for technology at the same time as the bids for the construction of the rest of the school project. Instead, it makes good sense for the electrical contractor to provide only the *pathways* (cable trays, conduit and boxes) for technology in his contract and to bid the actual cabling and infrastructure equipment near the end of the construction period.