Manual for Planning and Construction of School Buildings 2006

New Hampshire Department of Education
Concord, NH

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"We shape our buildings; thereafter they shape us."
Winston Churchill

This manual replaces the 1975 *Manual for Planning and Construction of School Buildings* published by the Department of Education. The old manual has served us well for the past 31 years, and even though it is old, it remains a very good document. This is a testament to the expertise and thoroughness of its authors.

This new version of the manual highlights the many technical improvements in the way buildings are constructed. It provides school boards and building committees with more information on the options that are available to them and the choices that must be made in organizing and planning a construction project.

You will notice quotes from historical documents at the beginning of each chapter. It is quite interesting to see that most of the issues, concerns, and best practices surrounding school construction have been around for two hundred years or more. Our predecessors did not always understand the science behind these matters as well as we do today, but they understood what makes a good building to provide a safe, healthy, and comfortable environment for learning.

Comments from users of the manual will be greatly appreciated. Please send any comments, using whatever format you desire to:

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APPLICATION OF LAWS, RULES, AND REGULATIONS

This manual is published to assist school districts in the development and completion of school construction projects. There are many federal laws and regulations and State of New Hampshire statutes and administrative rules which apply to the construction and operation of school buildings. Information in this manual in no way supercedes the requirements of federal laws and regulations or state statutes and administrative rules.

Chapter 2 explains the various agencies with jurisdictional authority over certain aspects of school construction projects. Many of the applicable requirements are discussed throughout the manual. An attempt has been made to distinguish between requirements and recommended practices.

School boards, architects, engineers, and builders are responsible to ensure that school construction projects meet current federal and state legal requirements. All are advised to discuss requirements with the Department of Education at the beginning of the planning process and throughout design development. Review with representatives of other authorities having jurisdiction over the project is also highly recommended and in some cases required.

Manual for Planning and Construction of School Buildings - 2006

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CHAPTER 1 – PLANNING EDUCATIONAL FACILITIES

"The success of our whole system depends as much on a thorough reform in the construction and care of school-houses as upon any other single circumstance whatever."
From the Report of the Commissioner of Common Schools to the NH Legislature, June 1847

Long-range planning for educational needs is a vital part of a community's orderly growth and development. The educational climate provided by a community determines to a large extent its outlook for the future. A school building provides a general environment in which learning is to take place and must be the end result of a careful process of preparation and development. The 1998 National Symposium on School Design established six design principles for schools in the 21st century. We must design learning environments that:

1. Enhance teaching and learning and accommodate the needs of all learners.
2. Serve as centers of the community.
3. Result from a planning and design process involving all stakeholders.
4. Provide for health, safety, and security.
5. Make effective use of all available resources.
6. Allow for flexibility and adaptability to changing needs.

Schools should be planned by a representative group of the people who will use them, including educators, parents, students, citizens, senior citizens, and members of civic and business organizations. Participation and active involvement of school board members, citizens, professionals, teachers and students are essential to the success of any school building program. With changes being made in building design and building materials, today's school buildings have more flexibility than in past years.

Schools are being designed to enable inclusion of many activities and can no longer be isolated from maximum use. Increasing construction and operating costs make it essential that schools be constructed economically and efficiently if the building is to serve its occupants and at the same time be a wise investment for the community. It is obvious that the total building process is not a short-term experience. Accelerated building schedules for meeting arbitrary opening dates can short-circuit the planning process and produce schools that do not meet the needs of teachers, students, or the community.

Much emphasis is currently being placed on the creation of high performance buildings which are safe, healthy, energy efficient, and which have the least possible impact on the natural environment. Such schools should not be thought of as special. It should be the goal of every project to construct such facilities; however, a strong commitment is required from all those involved at the very beginning of the planning process. Good planning, design, and construction practices should lead to the construction of schools which meet high performance goals and standards.

Planning takes time, but the time is well spent. By taking time to plan properly, the school board and administration can consider various alternatives to arrive at the best or optimal solution. A plan helps provide focus to use resources wisely and will help establish credibility with the public. On the other hand, you must not plan forever and never make a decision to move forward.

PARTICIPANTS IN THE PLANNING PROCESS

State Board of Education – This board, made up of seven citizens appointed by the Governor and the Executive Council, is the highest policymaking body in the state educational system. The board establishes the standards for all school building construction in the state (RSA 21-N:9).

State Department of Education – The Department of Education carries out the policies of the State Board of Education and provides services for the school districts. By law, the department is responsible for the examination, review, and approval of all building programs for which School Building Aid application is made (RSA 198:15-c). With reference to school building programs, the department:

1. Works with local districts and officials to develop effective educational programs.

2. Assists in surveying school building needs at the local level.

3. Assists in the selection of school sites.

4. Provides information on construction methods, materials and costs.

5. Assists local districts in establishing educational specifications to assure functional adequacy in the program.

6. Reviews preliminary and final drawings and specifications for evaluation and approval.

Local School Board – The district board of education is the corner stone of school organization at the local level. It establishes educational policies pertaining to the local district and is the agency to initiate long-range planning for school needs, as one of its responsibilities is continual evaluation of the educational process of the community. The board performs the following functions with regard to school construction:

1. Initiates the process after evaluation of the district's needs.

2. May appoint a building committee (see below).

3. Works with the administrative and instructional staff and students, as well as members of the community, in establishing educational specifications for the project.

4. Keeps the public informed of school needs and the progress made on construction. The educational specifications may be developed by a curriculum committee under the general supervision of the Superintendent of Schools acting as the board's executive officer. Please refer to Chapter 3, "Educational Specifications."

5. Engages professionals, such as an educational consultant, early in the building program to aid in long-range planning, and an architect at a later stage to prepare drawings and contracts.

6. Approves school sites, plans and drawings; evaluates and awards bids; signs the necessary contracts; supervises the entire process; and approves the completed project.

Superintendent of Schools and Staff – The Superintendent of Schools is the executive officer of the school board. In a building program it is his or her duty to provide and coordinate capable assistance and services to the school board. The Superintendent and his staff will:

1. Utilize the principals, teachers, students, and other staff members in the total building program.

2. Provide the school board with facts to assist its members in the multiple decisions a building program entails.

3. Convey to the architect a clear, concise statement of the educational specifications to be fulfilled in the building.

4. Assist the school board in presenting the program to the public.

5. Develop a financial plan for costs of construction, preparing bond issues, operational costs, etc.

School Building Committee – In New Hampshire it is a commonly accepted practice to appoint a building committee to work with the local school board in a building project. In a school building program, the building committee assists the school board in making long-range plans and assures that these plans are translated into a building program. The committee size is determined by the scope and complexity of the

project. It is usually composed of one or more school board members and citizens from various segments of the community. Do not be afraid to invite members of tax payer groups to participate. It should be emphasized that the building committee, except in cities, works in an advisory role and all plans and specifications for school building must be approved by the school board. Construction in cities with school departments is done under the direction of a joint building committee (RSA 199:3), chosen in equal numbers by the city council and school board. Selection of school sites must also be approved by the school board (RSA 199:2).

In general, the building committee performs the following functions:

1. Reviews existing school facilities, reports, and enrollment projections to determine facility shortcomings.

2. Assists in the formulation of educational specifications.

3. Develops and analyzes alternatives.

4. Assists in the selection of school site and architect.

5. Makes recommendations to the school board on a course of action.

6. Assists the school board in keeping the public informed of the project's progress.

7. Boards and Councils may choose to delegate authority to the committee for general oversight of the project including supervision of the clerk of the works and approval of change orders, but responsibility ultimately remains with the school board.

Local Fire Chief, Health Officer, and Code Enforcement Officer. Under New Hampshire laws, the local fire chief, health officer, and building inspector or code enforcement officer are charged with enforcing the state fire code, building code, and health rules. A building permit is required by RSA 155-A:4. These officials should be consulted early in the design process and throughout all phases of the project. It would be helpful to include them on the building committee if they are available to participate.

Planning and Zoning Boards – The multiplicity of problems that beset today's urban or rural community has resulted in widespread acceptance of the necessity for long-range planning in all areas. Planning boards and commissions have been formed for orderly municipal development. Such groups should be involved in planning school building programs. Most importantly, planning for schools cannot be carried on in a vacuum; educational services must be integrated with the full range of public services, with regard to cost and total development of the community. Under RSA 674:54 school districts are required to give written notification to the local planning boards of their intent to undertake a construction project. Planning boards may hold public hearings on the project and may issue nonbinding written comments. Although school districts are not required to follow the recommendations of planning boards, it is a wise practice to take the concerns of the planning boards into account and to maintain good working relations with them. Local conservation commissions should also be consulted when planning a school project. The planning board, the regional planning commission, and the State Office of Energy and Planning can provide a wealth of information and technical assistance. Planning boards and agencies are formed to deal with the following, each of which affects the educational system:

1. Renewal of urban centers.

2. Population growth and movement.

3. Industrialization of the community – potential for fiscal support.

4. Development of highway systems (local, state, and interstate).

5. Availability of land and sizes.

6. Building codes and zoning regulations.

7. Community relations.

The School Staff – Teachers, administrators, counselors, students, nurses, food service directors, custodians, and other non-instructional personnel should be consulted regarding the following aspects of a building program.

1. Establishment of educational specifications.

2. Survey of present and future needs of the district.

3. Formulation of long-range educational goals.

4. Advice on features to be included in the building in accordance with latest trends and special needs.

5. Evaluation of present methods of instruction and recommendations for possible improvements.

6. Liaison between school and community.

The Community At Large – The community should be kept informed at every stage of the project. Articles in the press, direct mailings, availability of school board members and administrative personnel to inform interested citizens, and public information sharing sessions are ways to maintain two-way communication throughout the planning and construction process. Suggestions from the public should always be given consideration by those in charge of planning, and the community should be informed of the attention given these suggestions. More information on this topic is presented in Chapter 15.

It may seem an almost impossible task to bring together the ideas of the numerous agencies, committees, and individuals listed above into a cohesive program that will achieve the desired goals. This is the function of the design professionals. They are selected and placed under a contract by the school board for the sole purpose of bringing the project to fruition. The specific roles of these individuals is further discussed in Chapter 4.

FUNDING THE PLANNING PROCESS

In a world of shrinking resources and growing demands for public accountability, getting the necessary funding for a facilities planning process can be extremely difficult. While much can be done by volunteers, at some point there will be a need to pay for the necessary professional technical services to analyze existing buildings, to prepare preliminary programming and design studies, to conduct environmental and geological investigations of possible building sites, and to develop accurate cost estimates for the alternatives under consideration. Many districts are understandably reluctant to commit funds prior to a bond vote, but presenting a proposal to the voters without adequate study and accurate cost estimates can be a formula for disaster. Conceptual drawings and a rough cost estimate are not sufficient. It is unwise and very risky to promise the public that a building can be constructed on a particular site for a given cost without having conducted geotechnical site investigations and using only gross estimating techniques for the construction cost. When projects are proposed without adequate planning, the result can be significant cost overruns or major reductions in the scope of the project to fit within the budget. Worse, without adequately researching and analyzing all feasible alternatives, the district cannot be sure that the proposed project is the best solution.

Possible sources of funding include a direct appropriation specifically for planning and design work, funds from a capital reserve account, and funds from impact fees. Many districts appropriate planning and design funds in one year with the expectation that a project will be proposed in the following year. Sufficient funding

should be provided to thoroughly analyze alternatives, to conduct geotechnical investigations and environmental studies of proposed building sites, and to complete at least 50 percent of the design work for any proposed construction.

GUIDING PRINCIPLES FOR A SCHOOL BUILDING PROGRAM

In 1987 and 1988 a team from Texas A&M University, headed by Dr. Harold L. Hawkins, undertook a study of the impact of school facilities on educational programs. Their conclusions remain valid today. Prior to the study, educators primarily thought of school buildings as places to house the educational programs, without regard to how the facilities influenced those programs. Designers tended to focus on the mechanical aspects of school buildings, also without regard to how the buildings affected the educational programs beyond an attempt to keep the occupants reasonably comfortable. After studying schools in the United States and Japan, Dr. Hawkins and his team developed the Interface Profile which concluded that student learning is enhanced when the facility:

1. Is an integral part of the community reflecting
    - Community pride
    - Community involvement
    - Broad utilization
2. Is adaptable to the user's needs through
    - A controllable physical environment
    - Provision for varied and ample storage
    - Flexible instructional space for teaching and learning styles
    - Walls, floor, fenestration serving the learning process
3. Permits teachers to function as professionals with
    - Reasonable control of the learning environment
    - Space which permits work related dialogue
    - Appropriate space for preparation for instruction
    - Motivational environment conducive to professionalism
4. Fosters communication
    - Through the appropriate use of technology
    - Through the use of "learning surfaces"
    - About the school at points of entry
    - That emphasizes student achievement
    - That is demonstrated as important to students
5. Creates an appropriate behavioral setting
    - With an emphasis on aesthetics
    - Which encourages student interaction
    - Which provides a stimulating atmosphere for learning
    - That is a comprehensive laboratory for learning
6. Accommodates a variety of learning styles
    - Through hands-on experiences resulting from building design
    - Which fosters fine arts appreciation
    - Resulting from student interaction
    - Through well designed and equipped space
    - Related to individual needs and interest

In the years since the Texas A&M study, more has been learned about how the building interacts with the educational programs and in some cases how it constrains or prevents future program changes. Most schools are planned and designed for use over many years. To provide long term usefulness to the district and to justify the expensive investment in a school plant, the following principles are suggested as guidelines to the building committee:

1. Flexibility – Modern technology makes available a wide choice of versatile construction materials and methods so that a building will be adaptable to future changes in curriculum and teaching methods.

2. Durability – Buildings and equipment should be constructed of durable materials that need not be necessarily expensive. On the other hand, an initial higher cost of good sound materials may be offset by lower operational or maintenance expense.

3. Maintainability – Materials, system components, and structural features should be chosen with consideration given to ease of maintenance. Mechanical systems should provide plenty of access and room to work for the technicians who will service and repair the equipment in the future.

4. Health and Safety - Schools should be designed, built, and maintained in ways to minimize and control sources of pollution, provide adequate exhaust and outdoor air ventilation by natural and mechanical means, maintain proper temperature and humidity conditions, and be responsive to students and staff with particular sensitivities, such as persons with allergies or asthma. Natural light and fresh air help provide a healthy environment that enhances learning.

5. Security – The threat of physical violence from sources inside or outside the school must be considered. To the extent possible the design should include elements that seek to contain, channel, or otherwise minimize the exposure of students and staff to such threats.

6. Expansibility – The building design should provide for possible future expansion and additions. Original construction should not be so permanent that it precludes changes in the structure.

7. Accessibility – Buildings should be designed to allow easy flow of traffic. This principle applies not only to vehicular traffic (accessibility to public thoroughfares and ample provision for parking), but also to the establishment of good pedestrian traffic patterns within the school. When choosing a location, preference should be given to sites which encourage walking or biking from home to school.

8. Environment – In order to provide the best possible learning environment, surroundings must be comfortable, pleasing, and safe. As much as possible, the school should be designed and built to have the minimum impact on the environment. Maximum use should be made of materials made from renewable resources, products produced locally, and those produced by low impact manufacturing processes.

GETTING STARTED

In most school districts, many years elapse between major construction projects. The school board and building committee may not include a single member who worked on the district's most recent project. The Department of Education strongly recommends that districts request training and assistance from the Bureau of School Approval and Facility Management at the very beginning of the planning process. The Bureau of School Approval and Facility Management can provide the most up to date information on state requirements as well as current practices in design, construction, contracting, and financing for school projects.

The five key elements to a school construction project are:

Set Goals. Goals must be established at the beginning of the project. Every subsequent decision should be made with regard to the manner in which it will satisfy one or more of the project goals. Goals may include things like improvement of student performance, staff satisfaction, economy of operation, energy efficiency, healthy environment, and similar ideas.

Communicate Goals to Design Team. Goals must be clearly stated in the Educational Specifications (Chapter 3) and in the solicitation of design professionals (Chapter 4).

Pursue Integrated Design. Integrated design can help develop a project which meets the district goals while providing the greatest value. It will identify cost trade-offs that can be made to achieve the optimum level of performance from all building systems.

Monitor Design and Construction. Districts have every right to expect the highest level of professional performance from their design and construction teams, but in the end, the facility will belong to the school district. There are a myriad of design and construction choices that will have to be made (Chapter 7) and the district should be the ultimate decision maker, albeit with the professional advice of the designers and builders. When the work is complete, there should be no surprises.

Verify Goals. Employ a commissioning agent throughout the design and construction phases to ensure that the district's goals are met.

The first step in a school construction project is to analyze the reason(s) for the project. This may seem obvious, but before proceeding it is essential that the parties involved have a clear, agreed upon, understanding of the situation that needs to be addressed. Care must be taken to understand the causes of the situation, not just the symptoms. There are a variety of situations that may lead to a school construction project. These include, but are not limited to:

a. Overcrowding
b. Anticipated change in enrollment
c. Condition of existing facilities
d. Changes in educational programs
e. Changes in the method of delivering educational programs
f. Combination of above or other factors

Once the situation requiring resolution has been identified, all feasible alternatives should be analyzed to determine which alternative best suits the community needs in meeting educational requirements within reasonable costs. Construction may not be the best answer. There will almost always be at least three alternatives and there may be many more. Granted, some alternatives may not be popular, but all should be analyzed. In most cases the following options will be available and should be considered:

a. Renovate an existing building and construct an addition if necessary
b. Construct a completely new building
c. Send some or all of the students to another school in or out of the district
d. Redistrict
e. Adjust schedules
f. Variations or combinations of the above alternatives

Each alternative should be evaluated on an economic basis and on the basis of how well it meets the educational requirements. The analysis should be based on the life-cycle of the alternative, not simply the initial costs to implement the particular option. There are many tools available to help conduct a life cycle analysis, but common sense is one of the best. Life Cycle Cost Analysis is explained in the next section.

There are many intangible factors that need to be considered in evaluating alternatives. Some of these may even be more important than the financial aspects. Community pride and attachment to an existing building can be very important. Uncertainty about future population patterns may influence a decision to send students to another district on a tuition basis. The lack of suitable land for a new building might eliminate that alternative. Each situation will have its own unique factors that will influence the process

The alternative selected must meet the State's minimum standards for public school approval, which are found in the New Hampshire Code of Administrative Rules, Chapter Ed 300, Part Ed 306. Construction

projects must meet the standards in Part Ed 321 of Chapter Ed 300 of the Administrative Rules. Local districts may have other requirements or concerns that need to be met. The alternative selected should offer flexibility for growth and other changes that may occur in the future.

LIFE CYCLE COST ANALYSIS

Construction decisions should never be based solely on the initial cost to construct the facility. The initial cost represents only a small portion of the total tax dollars that will eventually be spent on the school facility. The decision should be based on the ultimate total amount to be spent throughout the use of the building. How can this be done?

The answer is Life Cycle Cost Analysis. This is a method of identifying all the expenses for construction, operation, maintenance, and disposal for each alternative over a set period of time, usually the shortest expected life among the alternatives to be considered. Normally, the comparison is made between the net present values of all alternatives. The net present value is determined by estimating an amount to be spent or received as revenue and when it will be spent or received. All anticipated construction, operations, and maintenance costs over the period of time should be identified and estimated as closely as possible. The amounts are inflated to the year in which they will be spent or received and all amounts are then brought back to be expressed in current dollars. The lowest net present value indicates the alternative which will cost the least over the life of the facility. Other methods of comparison that can be used include identification of break even points and payback periods.

In performing a life cycle analysis, one must look at all costs associated with implementing and operating a given alternative over a particular period of time that is common to all the alternatives. For example, a well constructed new school building should provide service for about 50 years with normal maintenance and replacement of equipment. A properly done major renovation project should add about 25 years to the life of an older building. In comparing new construction to renovation, you would look at the costs over a 25 year period. The costs to be considered would include: initial construction, annual maintenance costs, utilities, scheduled system replacements or upgrades among others. The salvage value of a building to be disposed or the residual value of a building to be retained are also considered in the analysis.

There are a number of software programs available to assist in conducting a life cycle cost analysis. They have varying degrees of sophistication, which of course means that the degree of accuracy also varies. As usual, this is a question of getting what you pay for. A more sophisticated program will cost more, but it will produce a more detailed analysis upon which to base the decision. All have several common aspects. One aspect which may lead detractors to speak against life cycle cost analysis is that the results are based on certain assumptions. A number of assumptions will need to be made concerning future costs, inflation rates, depreciation of the value of the building, and the time at which major repairs will be necessary. These assumptions can be tested through a process known as sensitivity analysis. Sensitivity analysis allows the assumed variable to change over a range and then determines at what point a change to a variable would result in a different alternative having the lowest net present value. If for example, inflation would have to increase more than 150% over the next 20 years in order to change the result, you can feel comfortable that the initial choice of an alternative is valid. If on the other hand, it would only take a change of 5% in inflation, you would want to examine your assumptions more closely.

BUILD NEW OR RENOVATE?

Perhaps the most emotional part of planning many school construction projects revolves around the choice of renovating an existing facility or building a new one. Many New Hampshire communities have school buildings dating to the early 1900s, or earlier, with distinctive architectural features that are seldom seen in more modern structures. These schools are sources of community pride and their presence provides many residents with nostalgic memories of their childhood. Inevitably, and rightly, the question of renovating the old school will arise.

In these situations there are likely to be proponents for a new school, those who favor keeping the old building, and, of course, those for whom the lowest cost is the most desirable alternative. Each of these

groups will hold to a particular agenda and will be able to muster strong arguments in favor of their preference.

The building committee and the school board need to do everything in their power to keep the discussion based on thorough, factual, objective analysis rather than emotion. The choice is seldom simple. There is no rule of thumb that says renovation or new construction is the best choice if specific criteria are met, but it will come down to the answers to a few basic questions:

a. What is the general overall condition of the existing building?
b. How well does the existing building meet the needs of the current educational programs?
c. Is it physically possible to make necessary changes on the existing site?

An older building that has been well maintained over the years and that contains classrooms and other spaces in dimensions that work for current programs will probably compete favorably against a new construction alternative. On the other hand, a building that was poorly built initially or that has seen an inadequate level of maintenance can seldom be renovated for a lower cost than construction of a new building. In particular, asbestos abatement, barrier free access requirements, and the fire code can drive up the cost to renovate an old building that has not been updated as new requirements developed. There are some who may argue that an older building must be retained simply because it is on the National or State Historic Register. The need for historical preservation by itself does not outweigh the school board's responsibility to provide the community with high quality education at reasonable cost.

It is not enough to merely bring an older building up to date with current building and fire codes. The process has failed if the renovated structure does not meet the needs of the current educational programs. Some communities have elementary schools housed in buildings that were originally constructed as high schools. Many of these do not work very well because high school classrooms tend to be smaller than elementary classrooms. Old laboratories, shops, and other specialized spaces are often difficult to convert to an appropriate elementary school use at a reasonable cost. Cosmetic improvements may only hide serious problems that will reappear in just a few years.

The inherent operational efficiencies of a new facility should be taken into account. An older building may require 15-25% more space to fulfill the same functions as a new facility specifically designed for those functions. New facilities tend to be more energy efficient and easier to maintain than an old building, even one that has had extensive renovations. Typically, a new building will consume 85% or less energy than an older building of the same size, even if the older building's systems are working at maximum efficiency. On the other hand, to analyze a new construction alternative, the cost of land and site development must be known. This requires adequate environmental and geotechnical studies. Furthermore, any changes in transportation costs and the environmental impact of increased motor vehicle transportation must also be included in the analysis of a new building. The result may favor centrally located older schools where students are able to walk or bike from home.

Any analysis of a new building alternative must also include the plan for disposal of the old building and the cost or revenue from doing so. It is a mistake to keep a building that has been replaced unless it is truly required for an efficient bona fide use, and the budget provides enough funding for necessary repairs and operational costs. Whatever was wrong with the old building which led to the decision to replace it will still be wrong and will cost money to fix. The old building to be retained will need heat, lights, cleaning, and all the other operational services. There must be funds in the district's operating budget to cover these expenses. If the board has to search hard for justification to retain the old building it most likely should be let go.

In the end, the choice of renovation or new construction should be based on the life-cycle costs of the alternatives tempered by non-monetary factors such as the ability of an existing building to support the educational program, historical preservation, reduction of sprawl, or preservation of open land.

ELEMENTS OF THE SCHOOL CONSTRUCTION PLANNING PROCESS

To insure orderly progression of the planning process, school boards or building committees may find the following useful:

1. Basic analysis of needs.
    a. Evaluation of existing plant facilities.
    b. Pupil enrollment projection.
    c. Determination of the educational philosophy of district, evaluation of the instructional program
    d. Analysis of financial status.

    Note: If an educational consultant is to be engaged, selection should be made at this stage.

2. Dissemination of information at the local level through a coordinated public information program (Chapter 15).

3. Development of detailed written educational specifications (Chapter 3).

4. Acquisition of funds for planning purposes (Chapter 14).

5. Selection of architect (Chapter 4).

6. Selection of school site with the assistance of the architect and other specialists (Chapter 5).

7. Development of preliminary drawings by architect in accordance with educational specifications

8. Review of preliminary drawings with State Department of Education following approval of local school board (Chapter 16).

9. Complete detailed specifications drawn up for furnishings and equipment for use in the building.

10. Securing of local authorization of funds.

11. Preparation of working drawings to be submitted to the State Department of Education and other state agencies as necessary for final approval.

12. Completion of necessary forms and applications prior to submission of plans for bid.

13. Advertisement of construction documents for bid, receipt and evaluation of bids, award of contract (Chapter 13).

14. Groundbreaking Ceremony.

15. Completion of site development and building construction, including furniture and equipment.

16. Commissioning of the building and all building systems (Chapter 13).

17. Dedication and presentation of building to public and other officials.

INDICATORS OF A GOOD PLANNING PROCESS

1. The district has a detailed, comprehensive plan for programs, demographics, and facilities for at least 5 years into the future.

2. The district compiles annual reports for each building that detail space utilization, maintenance costs, energy costs, age of major system components, major component failures and major repairs or replacements performed in the past year.

3. Plant operations budgets are developed for each building.

4. There is a space utilization audit which shows the current use of every room in every building for every period of every school day as well as use after hours.

5. Facilities planning involves administrators, maintenance directors and representatives of the entire staff.

6. The district has demographic maps showing where each student lives and the attendance boundaries for each school.

7. Equipment such as furniture, computers and software are not purchased as part of long term construction bond issues when this equipment will be obsolete long before the final payment is made.

8. Five year enrollment projections are maintained for each school.

9. The district does not rush completion of major construction projects to meet an arbitrary completion date. It is nice to be ready for the first day of the school year, but the school will be in operation long after that one day. It is better to be sure that it is built right before opening.

10. The district's long range construction plan is based on careful analysis of population trends, educational requirements, and facility conditions.

11. The district maintains a standing facilities committee.

12. The consultant for long range planning does not automatically become the architect for individual construction projects. This may not be a problem, but planners with no expectation of additional financial gain are likely to be more objective.

13. Discussions about proposed construction projects do not begin with the amount of money to be included in the project budget.

14. Equivalent facilities for all students in the district is a planning objective.

15. Capital improvements are a continuous ongoing process in the district.

16. The district does not build additions to old schools again and again without a long range schematic plan for the final build-out of the old school.

17. The district makes appropriate, economically wise use of buildings that are no longer used as schools. Old buildings are not retained simply because, "We own them."

18. The district renovates buildings according to a plan and does not attempt to give something to everyone and never bring any one building up to current requirements.

19. The district has a written policy for use of its facilities by outside groups, requires outside groups to sign a use agreement, and knows the cost of operating the facility for outside groups even if there is no charge for such use.

THE PROJECT BUDGET

The project budget will consist of most, if not all, of the following cost items:

Studies
Planning and Programming
Architect and Engineering Design Fees
Consultants
Geo-technical Testing
Environmental Studies and Testing
Legal reviews
Permits
Site Acquisition (May have happened many years earlier, but is still eligible for School Building Aid)
Site Development
Construction Costs
Utilities
Furniture, Fixtures, and Equipment
Clerk of the Works
Commissioning
Contingency
Financing costs

As a general rule of thumb, the hard costs, which include site development and construction, should total about 80 to 85 percent of the total project cost. If hard costs amount to less than 80 percent of the total, the design and administrative costs may be excessive and should be reviewed.

CHAPTER 2 – LAWS, RULES, AND CODES PERTAINING TO SCHOOL CONSTRUCTION

"Planning and building a school today is a very complex undertaking. Large numbers of federal, state, and local agencies, and a multitude of specialized individuals are involved both before and after the local governing board announces its intent to erect or rehabilitate a school plant."
From Planning for School Buildings, James D. MacConnell, 1957

School construction and renovation projects in New Hampshire must meet a variety of laws, rules, and codes administered by a number of state and local agencies. Listed below are the agencies (state and local) designated by statute or administrative rules to ensure that building plans and specifications meet the requirements for approval.

State Building Code (RSA 155-A)

The State Building Code currently consists of the International Building Code 2000, the International Plumbing Code 2000, the International Mechanical Code 2000, the International Energy Conservation Code 2000, and the National Electric Code 2005. The code applies to the construction and renovation of all buildings except one or two family dwellings. Local code enforcement officials are responsible to ensure code compliance in each municipality. Architects and engineers must certify by placing their stamp on all construction documents that the project is designed to meet minimum code requirements. The construction contractor is ultimately responsible to ensure that minimum code requirements are met. Local communities may adopt additional regulations provided that such regulations are not less stringent than the requirements of the state code.

State Fire Code (RSA 153:5)

The State Fire Code consists of the most recently adopted version of the National Fire Protection Association (NFPA) Documents Number 1 and 101. The 2003 versions are currently in effect. Specific modifications to the national code are found in the NH Code of Administrative Rules Saf-C 6000. The fire code is administered by the State Fire Marshal and the local fire chief in each municipality. The fire code takes precedence whenever a conflict exists with the building code. All plans for construction, expansion, or renovation of public school buildings must be reviewed and approved by the Office of the State Fire Marshal.

Building Permits (RSA 155-A:4)

"*Before starting new construction or renovation of schools, halls, theaters, or other public buildings the person responsible for such construction shall obtain a permit signed by the board of selectmen, after its due consideration of any written recommendations of the fire chief. In municipalities that have adopted an enforcement mechanism pursuant to RSA 674:51, the permit under this section shall conform to the locally adopted process*." Most cities and large towns have building inspectors who are responsible for reviewing drawings to insure conformance with local building requirements. School project planners in such localities should be in contact with these officials early in the process.

Department of Education
Bureau of School Approval and Facility Management
101 Pleasant Street
Concord, NH 03301
(603) 271-2037

See Chapter 16.
Submit one set of preliminary drawings consisting of a site plan and floor plans which show the dimensions and use of each room.
Submit one complete set of construction documents, stamped by architects and engineers licensed to practice in New Hampshire.

Submit progress prints for review as desired or as requested by the department.
AutoCad drawings may be submitted on a CD to the Department of Education only. Do not send as an e-mail attachment. Other agencies require paper copies of drawings unless otherwise specified.
Submit a letter or letters signed by a licensed architect or engineer on business letterhead stating that the design meets the state building codes per RSA 155-A, the state energy conservation code per RSA 155-D, and the state barrier free access code per RSA 275-C.
Submit a copy of the letters of approval from each of the agencies below as required.

Department of Safety
Office of the State Fire Marshal
33 Hazen Drive
Concord, NH 03305-0002
(603) 271-3294

Submit a complete set of construction documents including plans for automatic sprinkler systems and fire alarms. Indicate the editions of all codes used and note any relevant exceptions. Indicate the construction type, occupancy loads, the area of each story and the perimeter. Document coordination with local fire department for the location and specification of the fire department connection. Provide separate pages which indicate fire walls, fire and smoke stops, emergency lighting, and exit lighting. For sprinklers provide all information required by NFPA 13:8-1. For fire alarms provide all information required by NFPA 72:1-6 and list the strobe lumen and decibel level for each device. Provide a letter from a licensed architect certifying that the design meets the NH Barrier Free Design Code.

Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301
(603) 271-2431

Submit certification, signed by a licensed mechanical engineer, of compliance with the state energy code as specified in the NH Code of Administrative Rules Puc 1803.4.

Department of Environmental Services
Asbestos Management & Control
29 Hazen Drive
Concord, NH 03301-6527
(603) 271-8953

For new buildings, submit certification, signed by a licensed architect or engineer, that to the best of his/her knowledge no asbestos containing materials were used in the construction of the project. School buildings constructed prior to 1989 are required to have an asbestos management plan under the Asbestos Hazard Emergency response Act (AHERA). Designers should review this plan before starting the design. The plan must be modified if the project removes, encapsulates, or in any other way affects asbestos remaining in the building. For renovation projects, submit a letter that certifies that no new asbestos containing materials were used in the project and which explains any changes to the known existing asbestos containing materials and which identifies any newly discovered asbestos containing materials, their condition, and treatment.

Department of Environmental Services
Water Supply Engineering Bureau
29 Hazen Drive
Concord, NH 03301
(603) 271-2153

If the project involves the installation of a well for potable water, submit application as required by the NH Code of Administrative Rules Env-Ws 372.

If the project involves the installation of an onsite sewerage disposal system, submit plans and specifications as required by the NH Code of Administrative Rules Env-Ws 1003.02, signed and stamped by a licensed septic system designer.

A plan to manage storm water during and after construction must be submitted and approved. See the NH Code of Administrative Rules Env-Ws 415. Provide a copy of the letter of approval to the Bureau of School Approval and Facility Management.

Department of Environmental Services
Wetlands Bureau
29 Hazen Drive
Concord, NH 03301
(603) 271-3501

A permit is required if the construction will impact existing wetlands, or if more than 100,000 square feet of land is to be disturbed. Identification and delineation of wetlands must be made by a properly qualified individual. See NH Code of Administrative Rules Env-Wt 100-800 for specific requirements and permit application instructions. Local conservation commissions will have an opportunity for input.

Department of Environmental Services
Air Resources Division
29 Hazen Drive
Concord, NH 03301
(603) 271-1370

A permit is required for combustible fuel burning heating plants which release contaminants in excess of state standards. Installation of air cleaning equipment may be required in exhaust stacks.

Department of Labor
99 Pleasant Street
Concord, NH 03301
(603) 271-3176

The Department of Labor oversees the installation and inspection of boilers and elevators. The department also oversees working conditions, wages, and worker safety.

Department of Transportation
1 Hazen Drive
PO Box 483
Concord, NH 03302-0483
(603) 271-3734

The Department of Transportation should be consulted regarding access roads to the site, as well as drainage of surface water from the area, particularly when these factors affect existing highway systems. The department may require the completion of traffic studies for any project that may affect highways owned or maintained by the state. The department must approve access onto any state maintained roadways.

Department of Cultural Resources
Division of Historical Resources
20 Park Street
Concord, NH 03301-6314
(603) 271-3483

Consult with the State Historical Preservation Officer (SHPO) and local historical societies whenever a project involves or impacts a facility listed on the National or State Register of Historic Places or when work is to be done within a designated historical district. Any renovation work done on an historic structure must

conform to the *Secretary of the Interior's Standards for Treatment of Historic Properties* (rev. 1995). If a facility is thought to be of historical interest, but not officially designated, contact the SHPO to determine what, if any, protective measures are appropriate. A Phase I Archeological Survey is recommended. If federal funds are involved in the project, an archeological survey will be required. A list of qualified archeological consultants may be found at www.state.nh.us/nhdhr/106prof.html . Contact the SHPO if excavation or demolition work uncovers items that may be of historical interest. Grant money may be available for historical preservation measures.

Local Municipal Building Departments (RSA 155 and RSA 155-A)

RSA 155 provides for permit requirements and inspections by local building inspectors or by the selectmen in towns that do not have building inspectors. Permits may be required for curb cuts for access roads. Traffic impact studies may also be required. RSA 155-A assigns responsibility for enforcement of the State Building Codes to the local authorities and authorizes charging of fees for code enforcement activities. Districts are encouraged to involve these local officials early in the planning process to preclude later misunderstandings. Ideally, the building inspector should be a member of the building committee.

Local Planning and Zoning Boards (RSA 674:54)

School districts are required to notify the local planning board, in writing, about planned construction projects. The law requires notification at least 60 days prior to the start of construction, but it should really be done much earlier. The local planning board may hold public hearings on the project, and may issue non-binding comments. Even though the planning board cannot mandate compliance with their directives, school districts should make every effort to resolve differences and to execute projects which fit within the community's overall plan.

Local Conservation Commissions

As stated above, local conservation commissions have an opportunity to provide input to the Department of Environmental Services on applications for wetlands permits. They may request a delay in the approval of permits for up to 60 days in order to hold hearings, conduct research, and prepare their input.

Performance Bonds (RSA 447:16)

Contractors are required to post a performance bond for all contracts of $25,000 or more. The bond must be at least equal to the amount of the contract price or the estimated cost of the work if no aggregate price is agreed upon at the outset.

Federal Agencies

Permits may be required from the U.S. Army Corps of Engineers or the U.S. Environmental Protection Agency (EPA) if projects affect certain wetlands or other protected areas. New Hampshire is one of five states that have not received federal authority to issue construction storm water permits. The permitting authority for storm water discharge from construction sites is the EPA. Additionally, the EPA, Occupational Safety and Health Administration (OSHA), and U.S. Department of Transportation have jurisdiction in the use, storage, transportation, and disposal of hazardous materials, including asbestos and other construction debris. The U.S. Fish & Wildlife Service issues permits for activities that may affect endangered species. The U.S. Departments of Labor and Justice may have jurisdiction over working conditions, contractor wage rates, and civil rights matters, including the Americans with Disabilities Act (ADA). The use of federal funds on a project may increase the level of federal oversight. Federal requirements are found in the Code of Federal Regulations (CFR). Much information can also be found on the websites of the various federal departments. Most have regional offices in New England.

CHAPTER 3 – EDUCATIONAL SPECIFICATIONS

"No architect should be asked to plan a school before a complete set of educational specifications has been developed by the educational planners. It is unfair and unwise to ask the architect to do both the educational and the architectural planning. He is not an educator, and does not pretend to be one…. Educational specifications serve as the link between the educational program and school facilities"
From Educational Facilities: Planning, Remodeling, and Management, Basil Castaldi, 1977

INTRODUCTION

Planning a school facility provides a school district with an opportunity to assess its educational philosophy, goals and objectives. Translated into educational specifications, such assessments will state the problem to be solved in terms of facility requirements to improve education within the district.

Written educational specifications are the stepping stones to a successful building program. As defined by the Council of Educational Facility Planners, educational specifications or program requirements are the means by which the educator describes the educational activities and spaces which need to be incorporated in a proposed new or renovated facility. They are written statements that serve as vehicles of communication between the educational sector and the design professionals.

Educational specifications are a document which evolves throughout the pre-design and design phases of the project. An initial draft should be developed early in the process to serve as a guide for future planning and discussion. It may be appropriate to ask the designers to fine tune the "ed specs", but the basic concepts need to come from the school district, not an outside architect.

In writing "ed specs" two points should be remembered. First, the specifications are concerned with the program and the people to be housed, not the architectural solutions. Second, the educational specifications are written as a single document so one does not rely primarily on discussions, memos, notes, reports and minutes. Subsequent changes made in the educational specifications should also be written and distributed to all concerned parties.

Educational specifications should address the individual spaces required in the building and the desired characteristics of each space in general terms. The desired adjacencies between spaces should be identified and prioritized. There should be a brief discussion of the alternatives considered and the process for selecting the proposed alternative. This will assist the designers in understanding the intent of the project. The educational specifications should establish the district's goals, priorities, and minimum requirements for acoustics, daylighting, energy efficiency, indoor air quality, thermal and visual comfort, use of environmentally preferable materials, siting considerations, and any other factors which the district considers important. The Department of Education has developed some curriculum frameworks which may be useful in the development of the educational specifications. These are available at http://www.ed.state.nh.us/education/doe/organization/curriculum/Assessment/CurriculumFrameworks.htm.

PURPOSE:

1. To describe the need and rationale for the project in sufficient detail that the voting public can understand and support it.

2. To serve as the guiding document for the entire project by describing the educational program (goals, activities and space needs) in sufficient detail that design professionals can translate the program into a building which meets those needs.

3. To provide sufficient information so that the Department of Education can evaluate the necessity for the project and the appropriateness of the design to the proposed curriculum and activities and ensure that N.H. State Minimum Standards for School Approval, found in the NH Code of Administrative Rules Ed 306, are being met or exceeded.

WHO SHOULD WRITE THE EDUCATIONAL SPECIFICATIONS?

It is perhaps easier to start with a discussion of who should not write the "ed specs". The document should not be written by the architect (see the quote at the beginning of this chapter), by the SAU business administrator, or by the school board, although those individuals may contribute to the writing or perhaps compile input from many other people. Educational specifications are best written by a team of educators with representatives from the school board and the administration. The superintendent, principal, or other administrators should be involved to ensure that the policies and philosophies of the district, as have been adopted by the local school board, are reflected in the educational specifications. The building that results from a project must be capable of supporting the district's policies and philosophies. It is wise to review policies and philosophies prior to writing the "ed specs" because they may have been shaped by the existing physical plant and a construction project affords the opportunity to make changes. The principal should provide information on the vision for day to day operation of the school. Teachers and other staff should have input concerning the spaces in which their programs will be housed. Food service and maintenance staff should be consulted on matters within their areas of expertise. Community leaders and planning boards should be involved concerning community use of the facility and the manner in which it fits into the surrounding area. The local fire and police chiefs should be asked for input on safety. While all of these people should have input, care must be taken to put each person's concerns in the proper perspective relative to the entire project and availability of resources. Innovative input should not be overly constrained, but neither should it be unrealistic or excessively customized to suit one particular staff member's ideas. It will probably not be possible to include everything in a project that might be desirable. It is therefore very important that the education specifications also communicate the priorities of the district to the designers.

WHAT TO INCLUDE IN THE EDUCATIONAL SPECIFICATIONS

There is no required format for educational specifications. All the information described in the following template must be provided in some manner.

Template for Development:

The following questions if answered thoughtfully and completely are designed to provide sufficient information so that a local school district can develop a set of educational specifications for a new school that will fulfill the expectations above. It is acknowledged that not all building projects are of sufficient extent or complexity to require a full set of specifications. Therefore the questions below have been divided into related sections such that those relevant to any project can be readily identified.

For new schools it is expected that all questions will be answered. For projects that do not have any permanent effect on the school site, Section IV can be omitted. For projects, which do not affect school program offerings in any way, Section II can be omitted, as well as certain questions in Section III, if not applicable to a particular situation. Examples of projects which may not affect the school program or the site, include roof replacements, windows replacement, HVAC upgrades, code requirements, etc. Finally, if a school district has a school board approved capital development or improvement plan, which adequately addresses any of the following questions, a copy may be included with relevant page numbers referenced to specific questions.

Questions to be Answered by the Education Specifications Document:

Section I Need/Rationale/Process

a) What are the situations the proposed project will address? Examples: enrollment growth, building code violations, program changes, energy efficiency, leaking roof, poor air quality, etc.

b) What alternatives were considered to the solution chosen? Examples: addition/renovation vs. new school, delay project for a year, do project in phases vs. all at once, etc.

c) What methodology was employed to arrive at the proposed solution? Examples: needs assessment, enrollment projections, community survey, building committee report, architect/engineering study, etc.

d) What are the characteristics of the community or region the project is proposed to serve? Examples: community advantages and constraints, unique features, socioeconomic characteristics, physical characteristics, parental expectations, site availability, property wealth, important community beliefs, etc.

Section II The People and Program to be Housed

a) What is the expected opening enrollment? Five year projected enrollment? Number of teachers initially? In five years?

b) What is the organizational pattern of grade levels? Will it change as a result of this project? Will the number of transitions be reduced?

c) What are the activity areas that will be needed to serve the people to be housed? Examples: instructional areas (general purpose classrooms, science labs, physical education areas, art, music, etc.); administrative areas (offices for administrators, guidance, health and special services, etc.); and service areas (media center, food service, storage, custodial, etc.). Include areas outside the building (parking, playfields etc.)

d) What are the characteristics and requirements of <u>each</u> of the activity areas listed above? Dimensions should be specified only when necessary. Refer to published guidelines where appropriate (for example: art classrooms will be designed according to the *Design Standards for School Art Facilities* provided by the National Art Education Association).

- Goals, objectives, and purpose.
- Planned Usage: activities to occur; the number and nature of the users, including staff, anticipated group sizes if they are expected to vary, multi-purpose spaces, etc.
- Relationships: identify the spatial relationships among and between programs and between the instructional spaces and the administrative and support spaces. (Often a diagram is helpful here.) Identify any instructional, administrative or support relationships that affect site design and development.

- Environmental Requirements: identify for each activity space any special visual, HVAC, acoustical, aesthetic, technological or security needs. Also identify any special electrical utility, plumbing, storage, display, or support requirements.

- Special Furniture and Equipment Needs: particularly case-work and equipment that may require modifications to the general design.

- Instructional Space Requirements: identify net square feet for each space.

Section III General Building Considerations

a) How will the building provide for future needs and flexibility for program changes or additions?

b) What is the plan for community use of the facilities? How will the building accommodate these plans?

c) What special provisions will be made to ensure the health and safety of the building's occupants?

d) What building-wide security requirements are planned? What effect will they have on community use of the building?

e) What building-wide communication and technology requirements are proposed?

f) What is the extent to which the building will be "green"? Or that it will be at least energy efficient and low maintenance? Sustainable? High Performance? Is LEED Certification a desired outcome?

g) What will be the characteristics of the maintenance plan? Will it be based on life cycle analysis? Will there be provisions for commissioning and for the training of maintenance personnel? Will total cost of ownership be considered? Will the project cause a need for additional maintenance staff?

h) What provisions will be made for building access, based on the activity area groupings, pedestrian and vehicle traffic patterns, community usage, handicapped accessibility and site constraints?

Section IV Site Considerations

a) Does site meet minimum state requirements for size? If not, how will all program requirements be met?

b) How well does the proposed site allow for realization of the educational plan? Include advantages and constraints.

c) How well does the site address other issues:

- Economy of purchase.

- Accessibility, circulation and parking.

- Room for playgrounds and/or athletic fields.

- Centrality and proximity to other schools, especially feeder schools.

- Topography and development costs.
- What percentage of the students will be able to walk or bike to school?
- Availability of services and utilities.
- Concurrence with town planning and zoning.
- Room for future expansion.

d) Describe the site development plan and how it relates to A and B above.

CHAPTER 4 – THE ROLE OF DESIGN PROFESSIONALS

"It is not even enough to say that architectural practice is an art, a science, a profession, and a business. Architects are expected to be leaders, not of the building industry alone, but in public affairs as well. To maintain this position, in addition to having technical knowledge and skill, the architect must understand political economy, sociology, and history."

From Architectural Practice, Clinton H. Cowgill and Ben J. Small, 1951

Design professionals render invaluable assistance to the school building committee and the school board to assure smooth progress of the project from inception to completion. This section concentrates on two professionals, the educational consultant and the architect. This does not mean that the services of other professionals, such as legal counsel or consulting professional engineers will not be required at some stage of the project, but these two play such an integral part in the planning and execution of any school building program that an outline of their functions may be helpful to planners in selecting competent and professional advisers.

EDUCATIONAL CONSULTANT

Although it is not mandatory for a school board to engage an educational consultant, it is highly recommended in districts where little long-range planning has taken place or where the planning of a building project offers the opportunity to update the curriculum. If a consultant is to be hired, it should be done as soon as possible after the school board decides to initiate a building program. The analysis of educational needs in a school district is a complicated and time consuming project, to which an independent consultant can bring both objectivity and specialization. The major elements of the analysis are as follows:

1. Goals and aspirations – philosophy of the school district.
2. Nature of the students to be educated.
3. An educational plan and specifications
4. Demographic analysis and enrollment projections.
5. Utilization study and future space requirements.
6. Analysis and evaluation of alternatives.

Upon completion of the analysis, the school board or building committee will have a master plan based on the consultant's specialized knowledge in combination with an intensive study of local conditions and needs.

THE ARCHITECT

To qualify for School Building Aid, the plans and specifications of a proposed school building must be prepared by an architect or engineer licensed to practice in New Hampshire. In most cases the architect will lead a design team consisting of one or more licensed architects, licensed engineers in the various engineering disciplines (civil, mechanical, structural, electrical, etc.), and other specialists as needed such as kitchen designers, acoustical engineers, or industrial hygienists. There are large design firms who employ professionals in all of the necessary categories, but few such firms practice in New Hampshire. Design teams are usually formed as partnerships between several different firms whose offices may be located throughout the state. The following information regarding this role is intended to help the committee select a qualified team.

SERVICES RENDERED BY THE ARCHITECT

The architect's services are personal, and he or she offers ideas, skills, imagination, and advice to the committee. The architect's professional services include:

1. **Conferences** – It is the responsibility of the school board, with the assistance of the superintendent of schools, his staff, and frequently with the advice of an educational consultant, to prepare information regarding future educational needs, the curricula to be offered, the specialized facilities

to be provided, etc. That information should be communicated through Educational Specifications, which are discussed in Chapter 4. Conferences between the educational personnel and the architect provide him with the desired goals and objectives. The teamwork resulting from these preliminary conferences often determines the quality of the final project – the new school building.

2. **Site Inspections**. – The architect works with the building committee to inspect sites under consideration and to assist in comparative evaluation of possible sites. He gives advice on topography, orientation, drainage, size and shape, development cost and potential for future expansion, while the building committee concerns itself with transportation cost, traffic pattern issues, fire and police protection, security, land values, and the direction of community growth. The architect may recommend that a geotechnical consultant and wetlands scientist review the site and provide additional information.

3. **Preliminary Studies**. – The architect will present his recommendations in the form of schematic drawings. These preliminary sketches and specifications establish the character of the building and must be reviewed to insure the finished structure will be the best solution to the district's problems.

4. **Preliminary Cost Estimates**. – These estimates are approximations since final decisions regarding structure, equipment, and materials are not made at this stage. Allowance must also be made for the fact that it may be several months before a building program is put into operation and costs may well be higher at that time. The architect's estimates, however, are essential in preparing budgets and determining the project impact on the local taxpayers.

5. **Working Drawings and Specifications**. – The architect's working drawings and specifications constitute the construction documents on the basis of which bids are secured and the structure erected. The drawings must include a site plan, floor plans, building elevations, sections, structural system, electrical, plumbing, heating and ventilation systems. The specifications describe the materials to be used and the quality of workmanship required from the contractor.

6. **Contracts and Bidding**. – The architect advises on the bidding procedures, helps to evaluate the bids, and assists in the preparation of contract documents, such as proposal, contract and bond forms, etc. The various types of contracts and construction delivery methods are discussed in detail in Chapter 10III.

7. **Supervision**. – The architect assumes general supervision of the project, including the checking of shop drawings, approval of materials, periodic observation of the work, expedition of progress through communications with the construction contractor.

8. **Administration**. – On most construction projects it is the architect's responsibility to review the construction contractor's work, to issue certificates of payment for money due the contractor, and to provide general administration of the business aspects of a project until final acceptance of the building by the school district.

9. **Owner's Agent**. – Throughout the period of construction, the architect may act as the owner's agent, thus relieving the building committee and superintendent of many time-consuming details.

In addition, the architect gives advice on such matters as color selections, choice of equipment and furnishings, maintenance operations, and warranties.

When Should the Architect be Employed?

From the preceding description, it is apparent that selection and employment of an architect takes place at an early stage in the planning process, before a site is selected and other final decisions are made regarding the building. The school district should appropriate sufficient funds to cover the cost of a preliminary study and the architect's fee for preliminary work.

Selection of an Architect

There is no state requirement that a competitive selection process be used to hire an architect in New Hampshire. Some municipalities may have policies or ordinances with specific requirements for the process. When hiring design professionals, it is usually not appropriate to base the selection on the designer's fee. The cost of design will ultimately be a small percentage of the total cost. Designers offer different skills and different approaches that are not well compared by looking at cost alone. Designers should be chosen for their level of skill, past experience, and the manner in which they approach the project. Many districts have established confidence in a particular individual or firm through past experience and prefer to use someone with whom they are comfortable. There are many advantages to this approach. Perhaps the most important aspect of a construction project is the level of trust that exists among the owner, designers, and builders. A good relationship based on positive past experience is a powerful tool that can lead to a successful project.

There are times however, when a district does not have an existing relationship with an architect, or simply wants to ensure that the project is given to the best qualified design team. If that is the case, the owner should be guided by one primary consideration: the qualifications of the team for the specific project to be undertaken. The recommended method for hiring an architect is a process known as Qualifications Based Selection (QBS). QBS is straightforward, objective, and fair. It will stand up to public scrutiny.

The QBS process usually involves the following steps, as provided by the NH QBS Coalition:

1. The owner prepares the preliminary scope of services, describing the project to be built or problem to be solved and formulates a schedule of activities.
2. The owner places legal notices of invitation in newspapers or other media and invites qualified firms to submit letters of qualifications in a format provided by the owner. The owner may wish to limit invitations to a selected group of firms that have been pre-qualified based on past experience or other criteria.
3. The owner reviews letters of qualifications, checks references, ranks firms and selects 3 to 5 firms for interviews. It is important that the selection be based on the qualifications of the entire design team, not just those of the lead architect or firm. Pre-interview site visits are arranged with the firms to be interviewed to provide the opportunity for a better understanding of the project requirements.
4. Interviews are conducted. During this process, it is important that the same questions be asked of each firm. In fact, it is suggested that qualification criteria and interview format material be made available to each firm prior to being interviewed. The owner should require that the interview be attended by the individuals who will actually be assigned to work on the project, not just the principals of the firm, or their marketing representatives. Whenever possible, the committee should visit schools designed by the candidates. Visual inspection, and discussion with those using the facility, will provide valuable background information for reaching a decision.
5. Following the interviews, the owner ranks each firm in accordance with a predetermined ranking system. All interviewed firms are notified of the results.
6. The highest-ranking firm is asked to participate in the preparation of a detailed scope of services and to negotiate conditions of the contract, including a fair and equitable fee.
7. If a satisfactory agreement cannot be reached, negotiations with that firm are suspended and negotiations are commenced with the second-highest ranking firm. The process continues until an agreement is reached and a formal contract is executed.

More information on QBS, including model letters and forms, is available at www.nhqbs.org.

Professional Ethics

The architect's code of ethics is contained in the "Standards of Professional Practice: issued by the American Institute of Architects (AIA). Too long to be included here, its essential features are as follows:

1. The profession of architecture calls for individuals of integrity, with business aptitude, communications skills, and artistic and technical ability. The architect's responsibilities cannot be discharged properly unless his motives, professional conduct, and ability command respect and confidence.

2. The architect receives remuneration for his professional service only and should not place himself in a position to receive commissions or allowances from any other source.

3. An architect may propose the services he is able to perform, but shall not, except under unusual circumstances, offer his services without compensation, and shall not submit free sketches.

4. An architect shall not enter into competitive bidding against another architect on the basis of compensation. He shall not use donation or misleading information on cost as a device for obtaining an advantage.

Architectural Fees

There is no schedule of minimum fees. An architect offers services at an agreed fee negotiated between himself and client. For construction projects, the fee is most often established as a percentage of the total project cost. Fees may also be based upon an hourly rate.

Contract Between Owner and Architect

Any undertaking involving expenditure of public funds should be conducted to avoid misunderstandings, disagreements, and possible legal actions. A written contract with the architect accomplishes this objective. The AIA's Standard Forms of Agreement are the most frequently used; copies maybe secured from any architect. Building committees and school boards should review these documents carefully with legal counsel before entering into a written contractual agreement. Local modifications of the standard form contracts are common.

Construction Delivery Methods

There are several different types of construction contracts and delivery methods which are addressed in Chapter 13. The role of the architect varies among the different delivery methods. In fact, in a project being done under a design-build contract, the architect may not even work directly for the school district.

Changing Architects During the Project

Some school districts hire one architectural firm for the planning and programming phases of a project and then another firm for the design phase. This is usually not a wise practice. It is appropriate to establish separate contracts for each phase of the work to allow flexibility in how and when to proceed, but unless there is a problem, it is usually best to retain one architect for the entire project. School boards sometimes think that changing architects is a fiscally wise move to ensure that the architect does not drive the process in a direction that will provide him or her with the greatest profit. Only an unscrupulous businessman would do such a thing and the selection process should eliminate any such bad apples. As stated earlier, it is important to become comfortable with your architect. During the initial phases of the planning process the architect will learn what is important to the district and how you operate. That knowledge will help him or her translate the program into a building design that will meet your goals and needs. It makes no sense to discard an architect who has developed that relationship in favor of one who is completely unfamiliar with your program and goals.

Services of Professional Engineers and Consultants

Professional engineers, by statute, must also be registered in New Hampshire, and final construction drawings that are a product of their work, must bear their stamp. Listed below are some of the responsibilities of the professional engineers and other consultants who may be involved:

1. Surveyors – Identify boundaries, topography, wetlands, existing structures, and other site features. May be hired directly by the school district.

2. Geotechnical Consultants – Identify soil types and nature, explore subsurface site conditions, prepare reports for use by the architect and engineers.

3. Environmental Consultants – Examine the site to identify environmental concerns such as wetlands, historical significance, hazardous materials. Prepare maps and reports for use by the architect and engineers.

4. Civil Engineers – Site plans: grading, layout and design of roads, parking, play fields, storm drainage, water and sewer services, landscaping; obtain site permits

5. Electrical Engineers – Power, lighting, clock, program, fire detection and alarm systems, telecommunications and data systems, as well as security systems.

7. Mechanical Engineers – Heating, ventilation and air-conditioning, plumbing, and sprinkler systems.

8. Structural Engineers – Steel, concrete, masonry framing.

9. Kitchen Consultants – Design of food service operational spaces.

10. Others – As required.

Most engineers in the state are independent and are engaged by architects when needed in a building program. Other consultants may be engaged by the school district at the suggestion of the architect. Larger architectural firms often maintain their own engineering departments.

Districts should pay attention to the location of the engineering offices, especially for small projects. Modern communications systems allow design teams to work from widely spread locations, but there will be times when face-to-face meetings are necessary. On small projects, the payments to the engineers may be relatively low which may result in an unwillingness to travel a great distance for meetings or to inspect the work on site more than a few times. There needs to be an expectation from the district and a commitment from the designers that they will travel to meetings and site visits as often as necessary.

CHAPTER 5 – SITE SELECTION

"Whenever a new [school] house is to be erected, it should first be carefully located, so as best to accommodate the whole district, and by all means on an open, healthy, agreeable site, with ample room about it on all sides, and out of the way of floods of water or of dust."
From the Report of the Commissioner of Common Schools to the NH Legislature, June 1847

Selection of a suitable site for the new school is one of the first steps toward the realization of the plans formulated during the preliminary stage of the project. The site chosen plays an important part in determining how well the final structure will meet the educational, aesthetic, and technical requirements. Criteria for selecting a school site must be broad and sufficiently flexible to allow variations in the size and type of building to be constructed, to fulfill the needs of the educational program, and to make allowance for future expansion and potential changes in curriculum or teaching methods. In analyzing the cost of land, the cost of site development must be included along with the purchase price. Sites with excessive amounts of ledge or wetlands may be less expensive to buy, but may easily be more costly to develop. School planners must work closely with the architect, community planners, engineers, and other professional consultants before a final choice is made.

The committee faces a serious responsibility in choosing a site; not only must it be suitable for present needs, but it must provide for future increases in enrollment and changes in the educational program. Sobering thoughts for the committee to consider are the growing scarcity of available land, steadily increasing costs, and ever more stringent zoning regulations that may well make this one of the last opportunities for selecting adequate acreage for school needs.

LOCATION

The first choice that must be made is to decide where to look for a possible site for the new school. In an urban setting, this may mean a choice between a downtown location or one on the outskirts of the community. Considerations must be given to the population to be served and where they live. If possible, a location which allows students to bike or walk to school is preferred in order to lower transportation costs and reduce pollution from buses and private automobiles. If public transportation is available, the service area and routes may also impact the decision on where to locate the school. In a large rural district, it may not be possible to eliminate busing, but a central location, close to the major roadways in the area, can dramatically reduce the transportation requirements.

The school site should be located away from current or potential future sources of chemical and noise pollution such as large industrial plants, airports, or major highways. Conversely, thought should be given to the school's impact on the surrounding area. Residents of a quiet residential neighborhood may not appreciate the addition of a large high school with its heavy traffic and late night activities. An elementary school in the same neighborhood may be very desirable to the residents.

STANDARDS FOR SITE SIZE

State administrative rules include minimum and maximum requirements for school sites, but the most important concept is that the site must be able to meet the needs of the proposed educational program including the building footprint, parking, and outdoor activities. There should also be sufficient land for future expansion. Minimum size requirements must be met, unless a waiver has been provided by the Department of Education. Maximum sizes limit the amount of land for which School Building Aid may be provided. Districts may acquire larger sites at their own expense. The specific state requirements are explained below. Waivers may be obtained as long as a site plan can be developed which meets all requirements, or reasonable arrangements can be made to use playing fields or parking at another site. It is important to note in this regard that School Building Aid can only be provided for improvements to property owned by a school district. For example, a school may be allowed to use town owned ball fields, but no School Building Aid can be paid for work on those fields. The specific requirements for a waiver request are explained in

administrative rules Ed 321. The minimum and maximum sizes are indicated below. For sites where more than one level of school is located, the limits for the highest level shall govern.

Elementary School: Minimum – Five contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

Maximum – Ten contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

Middle School: Minimum – Ten contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

Maximum – Twenty contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

High School: Minimum – Fifteen contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

Maximum – Thirty contiguous acres of buildable land plus one acre for every 100 pupils in the educational capacity of the facility or fraction thereof.

SCHOOL BUILDING AID FOR SITES AND SITE DEVELOPMENT

The purchase and development of school sites are eligible for School Building Aid however, the aid may not be paid until a construction project has been approved on the site by the legislative body of the school district. The aid paid on the site purchase is based on the total cost of the land plus the cost of any site testing, surveying, or legal work.

WHAT TO LOOK FOR

This brief discussion of the multiple factors to be considered when choosing a school site indicates that a school board or building committee would be well advised to obtain as much professional help as possible, at all stages in the process, from lawyers, architects, engineers and other qualified consultants. Following is a questionnaire that will be helpful in evaluating a potential building site and in comparing one site to another. As a minimum the Department of Education recommends that a Phase I Environmental Assessment and a percolation test be performed prior to the acquisition of real property, even if the property is a gift or bequest. Preliminary geotechnical investigation is recommended if funds are available or if there are any concerns about excess ledge or the suitability of the soils on the site. Access for emergency vehicles from at least two directions is required by administrative rule Ed 321.03.

FACTORS TO CONSIDER WHEN SELECTING A SCHOOL SITE

1. LAND USE:

a. What is the current use of the property? _____

b. What has been the past use of the property during the last 100 years?

_____

_____

c. Current Zoning? _____

d. Has the local planning board been notified about the project? _____ Date _____

e. Character of the surrounding area (Residential, Industrial, Commercial, Agricultural, Urban, Sub-urban, Rural): _____

_____

_____

f. Will the site offer an opportunity for outdoor educational activities? _____

g. Is the site located favorably so it can be integrated for use with the community recreational activities and functions? _____
_____

h. Does the site allow ample room for recreational and physical education activities for the entire school enrollment? _____

2. TOPOGRAPHY:

Level _____ Sloping _____ Mixed _____

Maximum Slope _____%

3. GEOLOGICAL CONDITIONS:

a. Have test borings been taken? _____ Date_____

Results_____

_____
_____

b. Are rock outcroppings visible on the surface? _____

c. Do tree roots appear to have difficulty growing into the ground or are large amounts of roots visible on the surface? _____

d. Description of Soils _____

_____

e. Has a Percolation Test been conducted?_____ Date_____

Results: _____

---

4. HYDROLOGY:

a. Where does surface water runoff currently go? _____
_____

---

b. Distance to and name of nearest stream, lake, or other body of water?

---

c. Will the site storm water system be connected to an existing municipal system? _____

d. Estimated depth to the water table _____

5. WETLANDS:

a. Estimated number of acres of wetlands including required setbacks _____

b. Have wetlands been delineated by a qualified professional? _____

6. WILDLIFE AND VEGETATION:

a. General description _____

---

b. Endangered species _____

c. Ecologically sensitive areas _____

d. Will the site provide opportunity for educating the students in the conservation of natural resources on the site or in the immediate area? _____

e. Can the site be used to provide means of educating children in ways of combating pollution of our natural resources? _____

7. NATURAL HAZARDS:

a. Seismic Zone _____

b. Is any part of the property located in a 100 year flood plain? _____

c. Is any part of the property located within the inundation area of a dam? _____

d. Source and distance to water for firefighting _____

_____

e. Distance to nearest fire station _____

8. HAZARDOUS MATERIALS

A Phase I Environmental Site Assessment (ESA) is strongly recommended

a. Is the site or any adjacent property listed by any local, state, or federal agency as a location of known or suspected contamination? _____

b. Is the site or any adjacent property known to have been used for industrial activity in the past? _____

c. Is the site or any adjacent property known or suspected of being a disposal site for hazardous materials? _____

d. Is there any visible evidence of the presence of hazardous materials on or adjacent to the site? _____
Describe _____

e. Are any Underground Storage Tanks (USTs) known to be present on the site? _____

9. CULTURAL RESOURCES:

a. Is the site located within a designated historic district? _____

b. Are there any existing structures on the site? _____

c. Are any existing structures on the state or national register? _____

d. Age of oldest existing structure _____

e.. Are any existing structures thought to be of historic or architectural interest? _____

f. Are there any known or suspected archeologically sensitive areas on or adjacent to the site? _____

10. UTILITIES:

a. Servicing Power Company _____

b. Distance to nearest existing electric service _____

c. Is natural gas available? _____ Company _____

d. Is municipal water available? _____

e. Is municipal sewer available? _____

11. ESTIMATE BUDGET FOR SITE:

Purchase price	_____
Est. Development Costs	
Utilities	_____
Other	_____
TOTAL	_____

CHAPTER 6 – SCHOOL DESIGN AND CONSTRUCTION CONSIDERATIONS

General Principles of School Architecture: Location, Style, Construction, Size, Light, Ventilation, Temperature, Seats and Desks for Scholars, Arrangements for Teacher, Apparatus
From, School Architecture or Contributions to the Improvement of School-Houses in the United States, Henry Barnard, Commissioner of Public Schools in Rhode Island, 1849

School design is ever changing and all who participate in the planning of a school building should keep abreast of the latest developments in the field. Ignoring this may mean that the product of the planner's efforts can soon be outdated. The new ideas of today often become the accepted practices of tomorrow, and as concepts change, it is important that consultants, designers and the building committee be sensitive to construction trends and practices and adopt those which show promise. These changing practices involve materials and construction methods as well as management and contracting practices. In making judgments about a particular method or practice, the building committee must be careful that they do not determine that a favorable outcome was the result of a particular practice unless they are completely sure of that conclusion. For example, it would be a mistake to determine that a design-build contract resulted in a lower cost due to the type of contract when in fact lower quality materials were used. This chapter will suggest the nature of some of the changing conditions that influence school design and construction.

CONSTRUCTION VARIABLES

There are three variables that are at the heart of all decisions concerning construction. It is important that everyone involved have a thorough understanding of these variables and how changes to one variable affect the other two. The three variables are cost, time, and quality. A district should set a desired quality level and then expect to take the time and spend the money necessary to reach that level. If on the other hand, the district starts with a maximum cost and then locks into a particular schedule, it should be no surprise that the resultant quality may be less than desirable.

Cost

When a project is complete, the cost will have been the total of the costs of labor, materials, profit, and overhead. Regardless of the type of contract or method of construction delivery, the final fee paid to the design and construction contractors will consist of those four components and no others. Until the work is complete, any references to cost will be estimates and therein lies the difference between one contract and another for the same work. There is a risk involved about the accuracy of the estimate. The contract will establish who accepts that risk and the cost associated with the risk, although it will not be spelled out quite so clearly. Rest assured however, that if the school district expects the contractor to accept all or most of the risk, there will be a price associated with that. On the other hand, if the district is willing to accept a larger share of the risk, and things go poorly, the end result may be significantly less than the school facility that was envisioned when the project began. Obviously, the accuracy of estimates is critical and accurate estimates take time to develop. Cost is also affected by construction market conditions that are usually beyond the district's control. The availability of craftsmen and the prices they charge are affected by the amount of ongoing construction work in the area. The cost of materials is affected by the law of supply and demand, by the cost of manufacturing, and by the cost of transportation. In some cases districts may be able to schedule projects to take advantage of a lull in construction work. In other situations a district may be able to negotiate a favorable guaranteed price for materials early in the project.

Time

There are many considerations which affect the time it takes to complete a construction project. Some of these are within the control of the school district and others are not. As a general rule, anything intended to shorten the time span will lead to additional costs and may lower quality. The following list indicates several important considerations, but there are often others in a particular project:

a. Desired completion date and its degree of flexibility

b. Completeness of design drawings and specifications
c. Choices for structural and mechanical systems
d. Time required to obtain permits
e. Lead time for ordering materials
f. Problems with availability or delivery of materials
g. Method for selecting sub-contractors
h. Availability of sub-contractors and equipment
i. Number of workers on site at any time
j. Number of days per week and hours per day that work is done
k. Number of tasks that can be performed simultaneously
l. Number and frequency of change orders
m. Lead time for required tests and inspections
n. Amount and difficulty of site development work
o. Degree to which occupants restrict the ability to perform work
p. Need to remove hazardous materials, especially if unexpected
q. Weather

Quality

There are two components to construction quality: quality of materials and quality of craftsmanship. You must have high levels of both to have a good quality result. The simple fact is that higher quality costs more than lower quality. Good quality also requires enough time to do the job right. Even the best craftsmen make mistakes when they are in a hurry or tired from overwork. The following steps can help produce high quality results:

a. Insist on a detailed, integrated, whole-building design
b. Develop well written, complete, tight specifications
c. Take care when using standard specifications or other information from other projects
d. Select systems, components, and materials:
    - From known reputable sources
    - That use proven technology
    - That are durable and easy to maintain
    - That meet desired performance requirements in all expected conditions
    - That are energy efficient
    - With low levels of volatile organic compounds or other toxic materials
d. Select reputable contractors and sub-contractors of proven ability
e. Minimize owner requested change orders
f. Allow and plan for flexibility in the completion date
g. Employ a competent clerk of the works full time
h. Insist on following manufacturers' instructions
i. Avoid fast track schedules
j. Do not use a warranty or guarantee as a substitute for good quality

ECONOMY IN SCHOOL CONSTRUCTION

With today's rising costs, it is often disheartening to plan new school projects. Funds for building programs are always limited, and it has become increasingly difficult to obtain them. Many aspects of the cost of construction such as timing, material shortages, and labor costs, are not easily controlled.

Since some costs are beyond control, it is extremely important to be aware of those expenditures that can be controlled by good planning. The planning team, educator, and architect, by examining the following areas, can get the best educational facility available with the limited educational funds.

a. Space in the building – Plan to build what is needed, no more and no less. A careful distinction must be made between needs and wants. Consider every proposed space and ask the question,

"How many students will use this space how many times per week?" If the answer is few students or not very often, you should consider eliminating that space or possibly combining it with another space. Take care that quality is not traded for additional space.

b. Quality of material that is selected. Cheap materials are not always economical; on the other hand, expensive materials are not always "quality". A balance should be achieved; one that fits the budget, does not take excessive erection time, solves maintenance and insurance problems, and stays within the desired environmental and educational program.

c. Consideration for future additions. If future additions are expected, better provisions can be made during the initial design and construction than at a later time. This might mean actual construction or merely advanced planning. Adding small additions every few years will cost more in the long run than building everything at one time. Many districts will build core facilities for a larger enrollment than the educational spaces. This can be a good practice to help control costs, but it does not make economic sense if the difference is only one or two classrooms.

d. Design Control has to do with the shape into which design molds the building, i.e. the extent of the perimeter wall, the volume of the building, the maximum use of standard sizes, and items, etc. There are important differences in the cost of various structural materials such as steel and concrete. Generally speaking a multiple story building is less expensive than a single story building. Flexibility is important. The building is expected to be in use for 50 years or more and must be able to adapt to changes in program and program delivery. Input from the staff is essential, but care must be taken to avoid excessively customizing space to suit a particular program or staff member that may be here today and gone tomorrow.

e. Amount and extent of exterior development. This is work that is done outside the building footprint. Again, we suggest that only as much as is necessary be done.

f. Start site work early. Once the general layout has been established and the location of the building and other major structures identified, site work can usually begin.

g. Pre-order materials that have long lead times. Some construction materials such as structural steel must be ordered 3 to 4 months in advance. By ordering these items as soon as they have been specified, delays waiting for materials can be avoided.

There is no magic in good, sound, logical cost economy. Economy simply requires an understanding of the problems, careful analysis, proper techniques, and a logical approach at priority cost targets.

The initial cost of materials should be balanced against durability and the cost of maintenance. For example, high-grade materials are more expensive at the outset, but may save thousands of dollars in maintenance over the years. It is also important to ascertain the effect on insurance rates which may result from the use of various materials and equipment. Insurance premiums will no doubt be less for a building constructed of fire-resistant materials and equipped with a sprinkler system than one which is not. Heating costs will be lowered by adequate insulation. These are but a few instances where savings can be realized by careful study of every component of the building. Some practical suggestions, both general and specific, for achieving economies are presented below. While no single one may save a great deal of money, substantial savings may be realized by using as many as possible.

Thorough planning is the basis for an economical building program. It is important to have sufficient time for a thorough study of each step in the building process and for the preparation of specifications, drawings, etc. by the consultants. Clear lines of communication between the architect, the school board, and the administrators, must be maintained at all times. Changes, delays, and indecision result in additional costs. The architect and other professionals involved should have a timetable for the project that will give them adequate time for programming, design, preparation of documents, etc., and provide for an orderly progression of events. As plans for the building materialize, the cost estimates should be reviewed

periodically. The committee should study codes, regulations and standards to consider the use of money-saying innovative methods.

These are several specific ways of economizing during the planning stage. The site should be appropriate for the development of an economical building. If land is expensive, or cannot be acquired, a multistory building might be a wise choice. If growth is expected in the school population, it might be wise to consider overbuilding at the outset. The possibility of cooperation between several neighboring communities in planning and construction should be kept in mind. Choosing a time when contractors are not busy may result in lower bids and attract a larger number of bidders. Trends in interest rates should be watched, so that money for the project may be borrowed at most favorable rates.

With regard to the design phase, there are several general considerations that will result in economies, such as overall simplicity in design, minimal use of exterior perimeter walls, and avoidance of large areas of glass. If several schools with similar requirements are to be constructed, it may be advantageous to use the same design for all.

The concepts of modular planning, the use of prefabricated assemblies, and other techniques should be considered. It is also important to select a structural system that will permit a quick closing-in of the job, especially in our New England climate. Inside the building, space arrangements should be designed for utmost efficiency, keeping the ratio of gross area to net functional square footage as low as possible. Inefficient uses of space in corridors, circulation space, and lobbies, should be kept at a minimum.

Wherever feasible, areas should be designed for multipurpose use, at the same time keeping in mind the educational specifications. All mechanical, electrical, and plumbing systems should be easy to control and maintain. If the concept of flexibility is incorporated into the original design, it will result in savings later, should changes have to be made in the structure.

In the preparation of the educational specifications, economies may also be affected by a careful study of the curriculum. Year-round utilization of school buildings for both school and community programs is encouraged, including some possible income-producing usage.

The wide variety of movable equipment and furnishings available in today's market will necessitate close scrutiny by the committee to choose the most appropriate items to meet educational specifications.

Other general economy-promoting factors are flexible state and local standards and codes. In the area of bidding, all documents submitted to a contractor for bid should be complete, concise, accurate, and free of confusing language that might limit or discourage competition. Bidders should be allowed enough time to develop cost estimates and submit accurate bids.

CHAPTER 7- BUILDING MATERIALS AND CONSTRUCTION PRACTICES

"…problems of lighting, heating, and ventilating schoolrooms are far more complex and difficult than those connected with lighting, heating, and ventilating a living room at home."
From American Schoolhouses, Professor Fletcher, B. Dresslar, University of Alabama, 1911

This chapter will discuss many of the methods used to construct modern school buildings and the choices that are made by owners and designers. There are many choices to be made about the architectural style and the materials to be used. Each has advantages and disadvantages. None is ideal or perfect. All can result in a good quality building if the job is done right. The important thing to remember is that a quality facility results from good design completed by a competent design team, from good quality materials installed by qualified craftsmen, and from proper operation and maintenance by a trained facility staff with the necessary resources to do the job.

As was stated in Chapter 4, a school building is designed by a team of professionals and the owner's representatives. The process of Integrated Design helps ensure that this is indeed a team effort. No decision should be made by any one member of the team without consultation with the other people involved. The final design should fit all the components into a building where all the systems work together to meet the owner's intent and to optimize the efficient performance of each system to produce a durable, healthy, comfortable, and economical building that supports the educational program.

STRUCTURAL SYSTEMS

There are several possible choices for the basic structural system of a school building. The most common types are structural steel frames and load bearing masonry. Structural steel frames create a skeleton for the building consisting of steel posts and beams which support the weight of the building and any other outside forces such as wind, snow loads, movement of the ground etc. The same is accomplished by concrete elements in a load bearing masonry structure. In some cases the vertical parts of the structure are made of reinforced concrete while the horizontal members may be steel beams, steel trusses, or precast concrete beams. Fire code restrictions have virtually eliminated the use of wood framing in large commercial buildings such as schools. Light gauge steel frames have replaced wood frames in many types of structures. In light gauge steel construction the walls consist of closely spaced steel studs while horizontal spans are usually made of light steel trusses to support upper floors and roofs.

Tilt-up concrete construction and modular pre-cast concrete are two methods that use the exterior walls to form the basic structural systems. These methods are popular in other parts of the country, but are not yet widely used in New England. Both methods provide very durable facilities at relatively low cost and generally can be built in less time than more traditional methods.

ROOFS

The roof is perhaps the most important component of the building. The roof is technically part of the building envelope which is described below, however this manual will address the roof separately because of the importance of this building component. The roof interacts with the outside environment more than any other part of the building and is most important in keeping the inside environment comfortable. The roof can also be the source of the majority of future building problems if it is not properly designed and constructed. Like all other components of the building, roofs require periodic inspections and maintenance. No roof is indefinitely weatherproof. Most roof problems result from the failure to detect and correct small problems before they become large ones. Infrared analysis of existing roofs can help identify leaks and places with inadequate insulation. When conducting renovation projects, districts would be wise to have an infrared analysis done at the beginning of the planning phase.

There are three basic types of roofing systems commonly used in school buildings and several different roofing materials. Many school buildings have roofs that are combinations of several of these basic systems and materials. The following paragraphs discuss the most common roofing systems and materials used in

schools in New Hampshire. There are others that are used less frequently and are not described in this manual.

Roofing Systems

Pitched Roofs

Pitched roofs have the advantage of preventing snow or water from accumulating on the roof. Many people also find a pitched roof to be more aesthetically pleasing than a flat roof. Pitched roofs are built using trusses or rafters, with the latter being more expensive. If the roof is built with rafters, the area immediately beneath the roof, or attic, can be used to place mechanical equipment or it may be used for other purposes. When trusses are used, the space beneath the roof is generally not usable. One thing to remember is that a steeper slope will shed water and snow more quickly, but will also require more roofing materials and therefore will be more expensive. Pitched roofs are most often surfaced with metal panels or asphalt shingles. Other materials are available, but not commonly used in New Hampshire schools.

Low sloped roofs

A low sloped roof is a roof having a pitch of less than 2:12. Some would say that these roofs have the advantages of both pitched and flat roofs. That may be true, but they also have most of the disadvantages. Snow will accumulate on these roofs just as on a flat roof. Water however will run off unless a depression somehow develops in the roof. Low slope roofs are generally supported by trusses. Low slope roofs are most commonly surfaced with a membrane or metal panels.

Flat Roofs

Flat roofs are generally less expensive to install than pitched roofs. Flat roofs are not really flat. They have a very low pitch, usually at least 0.25:12 to allow water to run toward the drainage system. Most often the pitch of a particular area of the roof will be directed toward one specific drain. Flat roof surfaces are usually surfaced with synthetic membranes or built up roofing. Some people say that flat roofs should not be used in New Hampshire. The primary reason for this feeling is due to the accumulation of snow on a flat roof which can be a problem. Ponding of water can also occur when the roof does not drain properly and can lead to problems. The real issue is that flat roofs require more attention than pitched roofs. Snow must be removed if an excessive amount accumulates. The maintenance staff must know the design snow load for the roof and they must know the depth of snow that can safely be allowed to remain on the roof. Roof drains and scuppers require regular inspection and cleaning to ensure that water does not remain on the roof. If properly maintained, a correctly designed and installed flat roof works just fine. Flat roofs have the advantage of allowing mechanical equipment to be installed on the roof, rather than taking up space inside the building. The equipment is often installed directly on the roof in its own weatherproof container. Occasionally, designers will include a penthouse, which is a small enclosed structure in which the equipment is installed to provide better protection from the weather. This can be important when interior space is limited. It can also lead to damage from people walking and working on the roof. For that reason it is important to install walkways, usually made of concrete squares known as pavers, which enable workers to get to the equipment without walking directly on the roof surface. Contractors working on roof mounted equipment should always be supervised.

Roof Surfacing Materials

Built up Roofs

Built up roofing has been in use for more than 100 years. These roofs consist of several layers of a fabric material coated with asphalt or coal tar with a final surfacing of gravel, slag, or mineral granules. Leaks are often difficult to locate in these roofs because holes are not easily visible.

Membrane Roofs

Synthetic membrane roofs have been common in the United States since the 1970s. There are a number of different materials that are used. Three of the most common in use today are Ethylene-propylene-diene terpolymer (EPDM), Polyvinyl chloride (PVC) and Thermoplastic polyolefin (TPO). EPDM, which is a rubber like material, has been in use for about 40 years. It has a good record of performance and contractors are very familiar with its installation. PVC has been in use for more then 30 years. Like EPDM, PVC is familiar to most roofing contractors. PVC is not the best environmental choice because it contains chlorine which is bad for the environment during the manufacturing process and after the disposal of used PVC materials. TPO came into the roofing market around 1990 so it is relatively new. Its long term durability is not really known at present.

Membranes also come in several different thicknesses and different colors. In selecting a membrane consider: water resistance, fire resistance, ultra-violet (UV) resistance, thickness and uniformity of thickness, reinforcement, flexibility in cold temperatures, and long term performance. The primary advantage of membrane roofs is their relatively low cost and ease of installation. Membranes have a significant disadvantage because they are easily punctured by debris, tools or other sharp objects. Snow removal on a membrane roof is a tricky proposition. Metal shovels or worse, snowblowers, will almost certainly damage the membrane. The seams between two pieces of membrane are a primary concern. If the seams are not joined and sealed properly, the roof will leak. Heat welded seams will generally hold better than glued seams. Care must be taken to ensure that seams are joined at the correct temperature.

The three methods of membrane installation are: fully adhered, mechanically fastened, and ballasted. Fully adhered membranes are generally preferable to the others. Fully adhered membranes are glued directly to the roof deck or insulation. Fully adhered membranes cannot be installed in cold weather which is a limiting factor. A mechanically fastened, single ply membrane on a flat roof is probably the least expensive type of roofing, but it is also the most prone to problems. Mechanically fastened membranes are connected to the deck along the edges by large screws. If a tear develops in the membrane, the entire membrane can be torn off the roof by a high wind. When installing a mechanically fastened roof, care must be taken to ensure that the correct fasteners are used, with the proper spacing. Installers must ensure that the fasteners are screwed into a solid base. This is particularly important when installing a membrane over an old roof. The fasteners must be long enough to reach into solid material, not rotten wood. Ballasted membranes are no longer common. Ballasted membranes are held in place by a layer of small stones. Leak detection is a problem with ballasted membranes because the holes are not easily visible. Major repairs or replacement of ballasted membranes usually require removal of the ballast which is not easy.

Metal roofing

Metal roofing has been in use for many years. Different metals and different methods have been developed to improve on these systems. There are two basic types of metal panels currently in use, structural and architectural. Architectural metal panel systems are used only to shed water from the roof and can be used only on pitched roofs with a slope of at least 3:12. Structural metal panels are designed to hold the weight of accumulated water or snow and can be used on low sloped roofs. The metal panels are joined at their edges by screws with gaskets or sealants in the joints for weatherproofing. Generally, the screws extend into the roof deck to hold the panels in place. The most commonly used metal system today is the standing seam metal roof where the panels are joined in a seam that is raised about two inches or more above the main surface of the panel. This keeps the joint above the water as it runs off the roof. Metal roofs are relatively expensive, compared to other systems, but they last much longer and generally require less maintenance. Expansion and contraction due to temperature changes can be a concern and can cause the fasteners to work loose. If a seam pulls apart, high wind can tear off an entire panel. The metal panels can be punctured by a heavy object or a sharp object driven by very high winds. Snow and ice slide off metal roofs very quickly which poses a hazard to people on the ground. This can be mitigated by installing ice stops on the roof and by restricting access to the area immediately below the edge of the roof, but the concern will never be completed eliminated.

Asphalt or fiber glass shingles

Asphalt or fiberglass shingles on a pitched roof is the most common roof system used on residential construction in New Hampshire and is often used on non-residential structures. This is a very good system for small buildings because it is economical and provides good protection. This method however, is labor intensive. In order to obtain sufficient pitch over a large span the roof surface must be proportionally larger and requires so much material and labor that it becomes economically infeasible to use shingles on large buildings. Asphalt roll roofing is also available and is often used on low slope roofs.

Roof drainage

Uncontrolled water is the enemy of buildings. The roof is supposed to keep water outside the building. To do so, the water that falls on the roof in the form of rain or snow must be removed to places where it can be controlled and taken away from the building. Rain and melting snow quickly flow directly to the edge of a pitched roof. Designers may then collect the water in gutters and down spouts which direct it into the site's storm water drainage system. In some cases, the water may be allowed to flow off the roof directly onto the ground. In those cases it is critical that the flow be directed away from the walls and foundation of the building. This is accomplished by extending the eaves of the roof and by sloping the ground at the base of the walls away from the building. Flat roofs are more of a challenge. Many older flat roofs are surrounded by a parapet, which is a low wall along the edge of the roof. Scuppers are holes cut through the parapet to allow water to run off the roof. Roof drains may also be used which collect water in pipes, similar to exterior downspouts which then take the water to the storm water system. This is particularly common on very large flat roofs. Whenever storm water is brought into the interior of the building by a roof drain system, the designers must plan for access to repair leaks in the drain pipes and they must also deal with the noise produced by water in the pipes. Drains and scuppers must be kept clear of leaves and other debris.

In very high performance buildings, water collected from the roof may be used to augment the domestic water system for irrigation, fire protection, flushing plumbing fixtures, or similar purposes where potable water is not required.

Many large buildings have rather complex roofs that may be combinations of several of the systems discussed previously. Designers and owners should carefully look at the places where different systems or different roof planes come together. Thought must be given to the direction that water will flow at those locations. Water must not be allowed to collect in one spot with no place to go or to flow under a layer of roofing material.

Special attention must be given to the edge of the roofing surface and to any location where a pipe or other object comes through the roof. The design drawings should include detailed drawings for these areas which show how flashing or other building materials are to be installed to prevent water from getting under the roof surface material. The owner's representative during construction should carefully inspect all of these locations to ensure that they are built correctly. Common sense and attention to detail are required.

Warranties

Warranties are not insurance policies nor are they substitutes for quality construction. Many building owners are given a false sense of security by the length of their roof warranty which in reality provides only limited coverage in the event of a failure. Most warranties will not guarantee against leaks. At best they will promise that the manufacturer or installer will repair leaks and replace material as necessary. Warranties tend to be reactive rather than proactive and frequently include restrictions and limitations designed to protect the manufacturer. Many warranties will be voided if the owner cannot provide documentation that maintenance has been performed in accordance with the manufacturer's recommendations. Certification from the manufacturer that the roof has been installed correctly is a good practice as is requiring proof from the roofing sub-contractor that the installers have been trained by the manufacturer and that they have installed the particular type roof previously. Remember, if you have to use the warranty it means that something was not done right. You really do not want the contractor to have to come back to fix a problem that should not have developed in the first place.

Cool Roofs

Many roofing materials are naturally black or dark gray in color. Some people feel that dark colors help heat the building in cold weather, however if the roof is properly insulated, very little heat will transfer through the roof to the interior when the outside temperature is below 40 degrees. On the other hand, dark colored roofs can get quite hot in the summer months. On a day when the outside temperature is 85 degrees, the temperature of the surface of a black colored roof can reach 140 degrees. If air handling equipment is mounted on the roof, as is often the case, superheated air will be drawn into the ventilation system and spread throughout the entire building. White or light colored roofs will help prevent this situation and will last longer, although their initial cost is slightly higher than most black roofing materials.

Green Roofs

Green roofs involve the planting of vegetation on the roof. This environmentally conscious practice is of great value in urban areas where it can help reduce the effect of heat islands caused by dense masses of asphalt and masonry that are found in cities. The effect of a green roof can be very attractive and can provide a nice garden-like atmosphere for outdoor activities. The decision to build a green roof however, cannot be made on a whim. The owner of the building must be committed to building a high quality roof structure and to investing the necessary resources to maintain the roof for the life of the building.

BUILDING ENVELOPE

Wall Systems

The average person does not consider a wall to be a system or think much about what goes on inside the wall of a building. In reality walls are complex, dynamic assemblies that must be properly designed and built to provide a healthy, comfortable environment for learning. The wall system consists of exterior cladding, sheathing, insulation, moisture and air barriers, and interior coverings. In some cases, a wall system maybe part of the structural frame. In other cases, structural members maybe imbedded in the walls. Plumbing, HVAC ducts, and all types of wiring may also be found inside the walls. Like roofs, infrared analysis of existing wall systems can provide valuable information for planning a renovation project. In renovation projects that involve work on the wall systems there will be frequent discoveries of previously unknown pipes, electrical wiring, and asbestos. These surprises should be anticipated by a plan and contingency budget to handle them as they arise.

The most common exterior cladding found on school buildings in New Hampshire are masonry products like brick or concrete, vinyl siding, wood siding, or Exterior Insulation and Finish Systems (EIFS). All have certain advantages and disadvantages. Brick is probably the most common because it is attractive, often matches surrounding architecture, and is durable. Concrete panels and split faced concrete block are alternatives to brick that are generally less expensive, easier to maintain, and just as durable. Another method of using masonry for the exterior walls is known as tilt-up concrete construction. In this system concrete slabs are poured on site, raised into position, and fastened together to form the structure. Openings for doors and windows are created when the slab is poured. This method is common in other parts of the country, but has not yet gained popularity in New England. Vinyl, metal, and wood siding are sometimes used on certain portions of buildings and occasionally on entire buildings. Siding is generally less expensive and easier to install than masonry. Wood siding requires continuous painting or staining. Vinyl siding may fade in color, and is easily damaged. EIFS refers to a family of products that are sprayed over a reinforcing mesh and which resemble stucco when finished. Metal panels, vinyl panels, and cementitious board are also occasionally used for exterior cladding.

Moisture will penetrate all types of cladding. A moisture barrier is required behind the cladding to prevent the moisture from passing further into the wall system. Moisture barriers may be a layer of felt paper, polyethylene sheeting, or other impermeable material or they may be provided by the covering on rigid insulation. The seams between pieces of rigid insulation must be taped to provide a continuous barrier.

Moisture collected on the moisture barrier must then be drained to the outside. In masonry construction, an air gap must also be left between the cladding and the moisture barrier. Moisture is then drained from the wall through weep holes at the bottom. Particular attention must be given to the installation of the moisture barrier around windows and doors, the through wall flashing at the bottom of the drainage plane, and at joints between horizontal and vertical surfaces such as the eaves. Moisture barriers and flashings must overlap in a direction which keeps water out of the building.

Properly installed insulation is essential for keeping temperatures at the desired levels. Although primarily thought of as a means of reducing energy costs, insulation plays an important role in keeping the building healthy. Cool surfaces become locations for the collection of condensation which may lead to mold growth. Insulation can help ensure that condensation only occurs in places where the water can be drained out of the building. When fiber glass insulation is used, formaldehyde free insulation should be specified. Cellulose insulation should never be used as it will provide great food for mold. When polyurethane foam insulation is used, it is recommended that there be no batt insulation placed between the framing studs.

Many states (New Hampshire is not one) have added a requirement for a continuous air barrier to their building codes. The air barrier is intended to limit the uncontrolled entry of outside air into the building. This helps reduce heating bills and to keep the building from becoming excessively dry during the winter months. Caulking, gaskets, and weather stripping are used around all penetrations of the building envelope and at all joints. Although not required in New Hampshire, this practice is strongly recommended.

Masonry cladding must be backed by a solid structure. This is most commonly done using Concrete Masonry Units (CMU), also called concrete blocks or cement blocks. CMU walls are insulated by fastening rigid insulation panels directly to the concrete. As was mentioned above, the joints between the insulation sheets must be taped. A less common method is to back the masonry with a light gauge steel frame. This second method is not recommended. There are many problems associated with the differences in the deflection of steel and masonry. Many schools that were built using this method have had serious structural problems. The Department of Education recommends that districts use vinyl, metal, or wood siding rather than brick veneer with light gauge steel frames.

If light gauge steel walls are used to back masonry cladding, contrary to the department's recommendations, great care must be taken to reduce opportunities for mold growth. The metal studs must be of sufficient gauge and properly braced to not exceed the Brick Industry Association's recommended deflection limit of L/720. Rigid or foam insulation on the exterior side of the steel studs is a must to prevent thermal bridging. Paper faced gypsum board or wood sheathing are poor choices as both provide a food source for mold. Even so called exterior gypsum board will promote mold growth. Cement board or fiberglass faced gypsum board should be used for sheathing on the outside of the metal studs. If foam insulation is used, the thickness of the foam should provide an adequate amount of insulation so that no batt insulation is required between the studs. The masonry ties must be long enough to reach through the insulation to the masonry while providing an adequate air space behind the masonry for drainage. The ties should also be of heavy gauge galvanized steel that will resist rust. Only ties recommended by the Brick Industry Association should be used. All penetrations of the wall system must be properly sealed to keep out as much moisture as possible. Finally, there must be an adequate number of properly constructed weep holes to drain whatever moisture does penetrate into the wall cavity.

Vinyl, metal, or wood siding and EIFS are normally used with light gauge steel frames. Sheathing must be installed on the outside of the frame. Plywood, covered by a moisture barrier, is the preferred material for sheathing. Particle board, chip board, or Oriented Strand Board (OSB) should be avoided because it contains formaldehyde and is also more likely to support the growth of mold. Light gauge steel walls are insulated by placing fiber glass batt insulation between the steel studs and rigid insulation or spray on foam on the exterior side of the studs. The rigid insulation or polyurethane foam is necessary to prevent the transfer of heat through the steel studs due to thermal bridging. The R-value of a steel stud wall with only batt insulation will be less than one half of the R-value of the insulation itself. Many contractors, who are familiar with construction of wood frame residential structures, are not aware of the need for insulation on the exterior side of the studs when using light gauge steel construction. Be sure to specify only formaldehyde free insulation.

The inside surface of exterior wall systems is usually gypsum board or plaster. Vinyl wall coverings are not recommended as they can trap moisture inside the wall system which can lead to the growth of mold. With CMU construction, the concrete blocks themselves are sometimes painted as the interior surface.

Windows and Doors

Windows and doors are essential parts of the building envelope, but they are also places where the integrity of the envelope is broken in more ways than one. A number of factors need to be considered in making the selection of the type of window or door to be used: operating characteristics, security, heat gain/loss, comfort, condensation, shading, noise/acoustics, vandalism. All of these can be satisfactorily addressed within the range of windows and doors available today.

The National Fenestration Rating Council has established a rating system to measure how well windows and doors help keep heat out in the summer and cold out in the winter. The categories are as follows:

a. Visible Transmittance. Measures how much light comes through the glass. The range is 0 to 1. Schools should seek to have the highest level possible.

b. Solar Heat Gain Coefficient. Measures the amount of solar heat gain through the glass, in other words, how well the product blocks heat from the sun. The range is 0 to 1. Low levels are desirable.

c. U-Factor. Measures how well the glass prevents heat from escaping. The range is 0.20 to 1.20. Lower ratings are better. The recommended U-factor for cold climates is 0.35 or less.

d. Air Leakage. Measures the amount of outside air that will come through the window. The range is 0.1 to 0.3. Lower numbers mean that the product is more effective at preventing air from coming through.

e. Condensation resistance. Measures how well the window resists the formation of condensation. The range is from 1 to 100. Higher numbers provide better resistance.

Low-emissivity (low-e) glass has a special coating applied that allows light to come through, but reflects much of the heat that otherwise would flow through the window into or out of the building. The rate at which a window lets heat flow through is expressed by the “U-factor.” The lower the U-factor, the more energy-efficient a window is. Double-pane windows with an inert gas such as argon between the panes also will enhance a window's ability to keep heat from entering or leaving a building.

Another way to upgrade the energy efficiency of a window system is to apply window film to the glazing. Low-e coatings are applied while a window is being made, while film can be applied to existing windows. The film can bolster safety and energy efficiency. It not only will reduce the amount of solar heat and ultraviolet rays that penetrate the building, but also will make the window more shatter-resistant. When such film was introduced years ago, its effectiveness often was undermined because the film was too reflective and could be scratched easily, but the latest products do not succumb to those problems.

The U.S. Department of Energy's *Energy Design Guidelines for High-Performance Schools* offers these guidelines for choosing appropriate window glazing:

- For windows oriented east and west and not externally shaded, the best choice is to use a tinted glazing with low-e or low-e with argon.
- If a window is north-facing or well shaded by overhangs or other building elements, tinting is not recommended.
- For windows close to the floor, comfort becomes more critical, and low-e windows are a good choice.
- If windows are above light shelves or in roof monitors as part of a daylighting strategy, the best choice typically is clear double glazing or clear double glazing with argon.

In addition to the type of glass installed, the frame used in a window system can affect its durability and energy efficiency.

Window frames are available in metal, wood, vinyl, vinyl clad over wood, composite, and fiberglass. Metal frames conduct the most heat and must have a thermal break for good performance. Insulated vinyl and fiberglass frames have the lowest U-factor.

In historical buildings, it is often important to provide new windows which match the appearance of the original frames. In most cases, modern high quality windows with a historical look can be obtained.

Air leakage and condensation resistance are two other factors to consider. Windows and doors should form a tight seal when fully closed. Condensation on glass can allow moisture in places where it will contribute to the growth of mold. Condensation resistance is indicated by a number from 0 to 100 with the higher number being better than a lower number.

Door hinges, locks, and opening hardware must be chosen with durability and security in mind. Doors take a great deal of abuse in normal operations and are usually the first target of an intruder trying to break into a building. The ADA requires that interior doors must open with no more than 5 pounds of pulling or pushing force. Although not required, the same is recommended for exterior doors. A small child should be able to open the door without assistance.

HEATING VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS

To achieve a high performance design, it is very important to integrate the HVAC system with the building envelope and lighting systems. Integrated design creates opportunities for greater comfort, lower initial costs, easier equipment maintenance, and lower operating costs. The most commonly used HVAC equipment is discussed below. Some systems such as electric heat, steam heat or forced hot air furnaces are not described as their use in school construction is limited. In choosing HVAC systems, both initial costs and operating costs should be considered. Of all the components of a building, the HVAC system is the place where operating costs will most quickly overtake any perceived savings in initial costs.

Heating Systems

Boilers

Nearly all schools in New Hampshire are heated by hot water. Different equipment may be used to distribute the heat into the individual spaces, but it usually originates in a boiler. Boilers may be fired by oil, gas, wood, coal or a combination of more than one fuel. Some are designed to switch between fuels based on the cost and/or availability of a particular fuel type. Such a system can allow the school district to take advantage of the most favorable costs for a particular fuel as they develop over time. Wood fired systems can reduce heating costs by as much as fifty percent. High efficiency boilers should be installed to reduce fuel consumption. At least two boilers should be installed. That allows the use of a smaller boiler at times when it can sufficiently handle the requirements for hot water and it helps prevent the total loss of heat if one boiler goes down. Domestic hot water for the kitchen, washrooms and other locations can be provided by the boiler during the heating season however, a secondary water heater is needed for times when the boilers are not in use. Boiler installations must be approved by the NH Department of Labor.

Hydronic Heat Distribution Systems

Hot water from the boilers is distributed to the spaces to be heated in copper pipes. The piping is normally routed along the exterior walls of the rooms. Within each room there will be mechanical equipment to distribute the heat throughout the room. These systems are collectively known as hydronic heat systems. The most common system uses fin tube units which are a series of thin metallic fins along a length of the hot water piping which then radiate the heat into the surrounding air. These units are usually located along the outside walls of the room close to the floor. Radiant heat panels use smaller tubing coiled in a panel which may be mounted in the ceiling, or along the walls of the room close to the ceiling. Radiant heat tubing may

also be embedded in the floor. Unit ventilators draw air from the outside of the building through the exterior wall and across the hot water pipes. The heated air is then blown into the room by a fan. Unit ventilators are discussed further under ventilation systems.

Gas Fired Radiant Heaters

Large open spaces with high ceilings such as workshops or gymnasiums may be heated with gas fired radiant heaters. These units can be noisy and are not aesthetically pleasing, but they are cost effective in the appropriate areas. These units require relatively low maintenance. The initial cost is slightly higher than average, but they may be quite cost effective for large spaces when energy use is considered.

Packaged Rooftop Systems

These units are complete self contained systems that are usually mounted on the roof. They may be gas fired or electric. They may provide both heat and cooling. Outside air is heated or cooled in the unit then ducted into the building. Return air may be recycled through the unit, although 100% fresh air is preferable. When used for cooling, the units may include economizers which use the temperature of the outside air to help reduce the amount of cooling that is necessary. Packaged units have relatively low initial costs, but require extensive maintenance and use higher than average amounts of energy.

Ventilation

All schools must be ventilated to remove carbon dioxide, other pollutants, and odors. The state mechanical code describes the required rates of air exchange. The nationally accepted standard is ASHRAE Standard 62. For most spaces in a school facility, the air exchange rate should be 15-20 cfm/occupant. Natural ventilation is preferable when and where possible. Operational windows are recommended. Since natural ventilation cannot provide sufficient air exchange, particularly during the winter, mechanical ventilation systems are necessary. In choosing a mechanical ventilation system there are a number of factors to consider:

1. The system must provide a sufficient rate of air exchange.
2. Recycling return air can reduce heating costs, but it may lower air quality.
3. The amount of maintenance required and access to the equipment for maintenance are very important considerations.
4. The amount of energy, primarily electricity, used by the system is important.
5. Systems which do not adjust the air flow based on need waste energy.
6. Many systems are noisy.

Variable Air Volume (VAV) Systems

Probably the most common mechanical ventilation system used today in large multistory buildings is the Variable Air Volume (VAV) system. A central supply fan sends air through a system of ducts to VAV boxes throughout the building. The airflow to a particular room or group of rooms is controlled by the VAV box which varies the airflow usually in response to temperature. More up to date systems use carbon dioxide monitors to control the air flow rate. Hot water heating coils may be included in the system to preheat the air before sending it into occupied space. As fresh air is pushed into a room, the stale air must be exhausted out of the room. The exhaust air may be routed through ducts or through the space between a suspended ceiling and the roof or the floor of the next story which is known as a return air plenum. In many systems the some of the exhaust air is returned to the system and mixed with fresh air to be recycled. This reduces the amount of air which must be heated in cold weather and saves energy. This process may not remove all the pollutants from the recycled air. Better systems recover the heat from the exhaust air but do not mix stale air with fresh outside air.

Displacement Ventilation Systems

Displacement ventilation systems bring warmed or cooled fresh air into the room close to the floor at a low velocity and exhaust near the ceilings. The air enters the room at a lower temperature than the air in the room. As the air is further warmed by heat sources in the room such as human bodies, computers, or lights it naturally tends to rise. As the air rises toward the ceiling, contaminants, including germs spread by breathing, sneezing, and coughing, also rise out of the breathing zone which creates a healthier environment in the room. Displacement systems use physics rather than mechanics to move the air and hence tend to have lower operating costs than other systems. A highly advanced displacement system which uses 100 percent outside air, dehumidification, and carbon dioxide monitors to regulate the amount of air exchange can provide a very comfortable, healthy, and economical indoor environment, but it does require well trained operators.

Unit Ventilators

Unit ventilators were mentioned above as one of several types of heat distribution equipment. Unit ventilators are a system frequently found in hotel rooms and are also very common in school buildings, primarily because of their relatively low initial cost. Unit ventilators provide both heat and fresh air to each individual room, and can be used to provide air conditioning. One of the attractive features of a unit ventilator is that it allows the occupants of each room to adjust the temperature in each room individually, but unit ventilators have several drawbacks:

(1) Poor air and heat distribution. Fresh air is brought into the room at one location along a side wall. It is difficult to evenly distribute the air throughout the room. Frequently the students seated close to the unit ventilator are too hot while those on the other side of the room are too cold.
(2) Unit ventilators are noisy and become more so over time as parts wear and fans become unbalanced.
(3) The air intake, at least on the first floor level, occurs very close to the ground which means that pollutants like pollen, mold spores, or vehicle exhaust can be drawn into the room. Since every room must have its own intake, it is difficult to place the intakes away from the bus parking area or other sources of pollution. Only average rated filters for removing contaminants from the air are made for installation in unit ventilators.
(4) Students or teachers may place objects on the units which block air flow into the room or damage the equipment. They may intentionally block the air flow because of the draft it creates.
(5) Significant maintenance is required on these systems.
(6) The mechanical equipment is located within each classroom which means that maintenance cannot be performed while class is in session.
(7) Unit ventilators are not energy efficient. The fans use a great deal of electricity.

The Department of Education does not recommend the use of unit ventilators in school HVAC systems. The U.S. Department of Energy Best Practices Manual says that almost any other system is preferable to unit ventilators.

Air Conditioning

Air conditioning is becoming more common in New Hampshire schools than in past years. Some districts choose to cool the entire building. Others provide cooling only to certain areas such as the library, computer labs, offices, and cafeteria. Air conditioning is costly to install and to operate so the decision cannot be made lightly. Other methods of cooling the building should be considered and integrated with any mechanical cooling systems if these other methods are found to be insufficient by themselves. Some of these methods include locating areas that require lower temperatures on the north side of the building, shading with vegetation, awnings over windows on the south side of the building, dehumidification, and installation of a cool roof as described previously.

There are primarily two types of air conditioning systems in use. Chilled water systems are commonly used to air condition an entire building. In these systems, water is cooled to the desired temperature and distributed through the building in piping similar to hydronic heating systems. It is possible to use the same

distribution piping as is used by the heating system in what is known as a two pipe system, but separate piping, known as a four pipe system, is preferred for better performance and ease of maintenance. The other common type of air conditioning system is to use packaged rooftop units which force air cooled by a compressor into the building through distribution ducts. Chilled water systems are often fueled by natural gas or propane and are therefore less expensive to operate than other systems which use considerable amounts of electricity. Both systems can benefit from the use of economizers which use the outside air to help cool the indoor air when temperature and humidity conditions are right.

Geothermal Systems

Geothermal systems, also known as ground source heat pumps, use the natural temperature of the earth to help heat buildings in winter and cool them in summer. Because the temperature of the ground remains relatively stable, it is cooler than the outside air in the summer and warmer in the winter. Water is pumped through a below ground loop of piping to exchange heat either to or from the earth depending on the season. These systems are expensive to install, but can achieve relatively quick paybacks by reducing the costs of energy needed to operate the building's cooling and heating systems. In most cases, geothermal systems are not economically viable unless used for both heating and cooling.

Solar Systems

The energy of the sun can be used to heat water or produce electricity. Many schools have solar panels which augment the building's heating or electric systems while providing an opportunity for education. As this technology advances over the next few years it should be able to provide a greater amount of the building's energy requirements.

Controls

The most effective and efficient buildings utilize automated control systems which integrate all components of the HVAC system. Control systems go by many names such as Direct Digital Control (DDC), Energy Management Systems (EMS), Energy Management and Control Systems (EMCS), and Building Automation Systems (BAS) to name a few. They all have in common the use of computerized systems to monitor and adjust temperature, humidity, air quality, and energy use. More sophisticated systems can also control lighting and security and can alert the staff to problems. These systems can also record information that can be used to diagnose problems and manage the facility operations. The degree to which controls should be automated depends on the size of the facility, the types of systems in use, and the skills of the staff.

FLOORING

Carpet

Carpet is frequently used in administrative offices and libraries. Occasionally districts consider carpet for use in classrooms. The decision to use carpet in classrooms must be accompanied by a commitment to perform adequate maintenance and to replace the carpet when it becomes necessary. Old worn carpets that have not been adequately maintained are a primary source of contaminants leading to poor indoor air quality. Torn and/or poorly adhered carpet can also create a tripping hazard.

The basic types of carpet are:

Acrylic: A synthetic carpet with the look and feel of wool.
Wool: More costly than synthetics with a plush look and feel.
Polyester: Considered easier to clean than wool while having a similar look and feel.
Olefin: A synthetic carpet that is considered easy to clean and often is used in indoor/outdoor settings.
Nylon: The most popular carpet in the U.S.; considered very wear-resistant and generally good for high traffic areas.

Carpet in schools should be fully adhered to the floor. Tacking strips that are commonly used to install residential carpet are not appropriate for schools. When ordering carpet, specify anti-microbial, loop pile carpet with solid backing. Require that the product have the Indoor Air Quality carpet testing label. Carpet with this label has been tested for volatile organic compounds (VOCs) to ensure that it will not exceed established emission levels. Vinyl (non-PVC) backed carpet is strongly recommended by the Department of Education. Vinyl backing is not susceptible to mold growth and prevents water from leaking through the carpet. The chlorine in PVC may produce a toxic gas during a fire and the manufacturing process for PVC and disposal of used PVC materials are not good for the environment. For those reasons, other types of vinyl are preferred. Carpet must also meet the flammability requirements of 16CFR1630 (Code of Federal Regulations). Do not use cut pile or underlayment. Sufficient time must be allowed before occupancy of spaces with new carpet to allow off gassing from the glues used to manufacture the carpet and to install it. Ensure that contract documents specify the necessary conditions for the floor to which the carpet is to be glued and that the installers follow the manufacturer's instructions. The manufacturer's maintenance instructions should be obtained and provided to the school maintenance staff.

Vinyl Composition Tile (VCT)

Vinyl Compostion Tile (VCT) or sheet vinyl are commonly used in high traffic areas such as classrooms, hallways, and cafeterias. VCT is durable, water and stain resistant, easy to install and relatively inexpensive. Off gassing will also occur as with carpet. VCT is water resistant, but is not the best choice for areas where large amounts of water are expected like kitchens and washrooms. As with carpet backing, it is preferable to use a vinyl product that does not contain chlorine.

Linoleum

Linoleum is an old flooring product that was largely replaced by vinyl, but is now making a comeback. Linoleum is made of natural materials through a process that is much easier on the environment than vinyl. Linoleum has another advantage over VCT in that it becomes harder with age. Newly installed linoleum has a strong odor that may be offensive, but is not toxic.

Quarry Tile

Quarry tile is a strong, hard surface that is commonly used in kitchens, lobbies, or other spaces where heavy items may be dropped or moved on the floor and where high amounts of water are expected.

Ceramic Tile

Ceramic tile flooring is used primarily in washrooms due to its durability and water resistance. Ceramic tile comes in a wide variety of colors which can be used to create artistic patterns. Ceramic tile is labor intensive to install.

Resinous Epoxy

Resinous epoxy flooring is used in places where large amounts of water are expected such as kitchens, locker rooms, or laboratories. It is essentially water proof. It also provides a non-skid surface in these wet areas. Resinous epoxy flooring must be installed by trained craftsmen under the proper conditions. The epoxy will not adhere if installed at the wrong temperature or onto a surface that has not been properly cleaned.

Gymnasium Floors

Gymnasium floors are normally made of hard wood designed specifically for gym use. There are four grades of quality in gym flooring to choose from. Grade 3 is recommended for elementary and middle schools and grade 2 for high schools. VCT is suitable in elementary schools or in multi-purpose rooms. Hard wood sprung floors are preferred for dance instruction. Weight rooms and other special purpose or multi-use rooms will often use a rubberized flooring.

Unfinished Concrete

Floors in storage areas, mechanical rooms, loading docks, and shops are normally unfinished concrete. The concrete should be sealed to prevent absorption of water or other liquids. A non-skid surface should be applied where slipping is a concern.

Other(terrazzo, cork, stone)

There are other flooring materials that are occasionally used in schools for decorative purposes or for other specific uses. These materials can be very expensive and may require special maintenance methods. The aesthetic value may not justify the cost.

CEILINGS

Suspended acoustical tile ceilings are beginning to give way to higher ceilings in many schools. There are several advantages to higher ceilings. They improve lighting and air quality. They also give the impression of more room. The disadvantage is that the amount of space to be finished is greater and you are generally not able to hide wiring and mechanical equipment above the ceiling. Designers now frequently leave duct work and conduits exposed when high ceilings are used. Even high ceilings require acoustic treatment, especially in spaces with a hard floor surface.

INTERIOR LIGHTING

The following information on lighting is provided by the National Clearinghouse for Educational Facilities.

Lighting is and always has been an important factor in designing and operating schools. Until the 1950s, natural light predominated as a means of illuminating most school spaces. Classroom design was based in large part on time-honored relationships between window sizes and room dimensions. As electric power costs declined and designers began to take advantage of the increased flexibility provided by electric lighting, daylighting took a secondary role. Now, highly energy efficient windows and skylights and a renewed recognition of the positive psychological and physiological effects of daylighting allow a healthy and economical mix of natural and electric illumination in new and renovated schools.

Daylighting

Simply adding windows or skylights to a classroom is not necessarily responsible daylighting. Poorly designed daylighting, as with poorly designed electric lighting, can create visual discomfort and disabling glare. Incorrectly placed daylighting can introduce undesirable solar heat gain, causing discomfort and increasing ventilation and air conditioning loads and energy use.

Good daylighting design requires understanding a building's local climate and use patterns and the location, placement, and shading of windows and skylights relative to their solar orientation. A good daylighting system provides:

- balanced, diffuse, glare-free daylight from two or more directions;
- sufficient light levels for the tasks in the space;
- operable shading devices to reduce light intensity for audio-visual programs and computer work;
- windows for interest, relaxation, and communication with the outdoors; and,
- exterior shading devices as needed to minimize solar heat gains during the cooling season.

The concept of cool daylighting is a systematic approach to design that ensures that the daylight is controlled through a combination of glazing systems (such as low-e glass), shading systems, and architectural design. The result is a building that uses significantly less energy than an ordinary school by simultaneously reducing electric lighting and cooling loads. However, to be effective, daylighting must be supplemented by electric lighting that can be dimmed in response to daylight levels.

There is a side benefit to daylighting: by turning off the electric lights when they are not needed, the life of the electric lighting system is extended and maintenance costs are reduced. A simple automatic photo-control system can switch off one, two, or three fluorescent lamps per light fixture, depending upon the amount of daylight present. By reducing the use of the electric lights by 50 percent, their life span will be doubled and associated maintenance costs cut in half.

Daylighting can be effective and energy efficient for almost all school spaces, including classrooms, cafeterias, offices, shops, gyms, corridors, locker rooms, and study halls. Some daylighting approaches, especially top lighting (skylights), can be added to existing buildings. For instance, many gyms could easily employ simple, reliable commercial skylights that would allow lights to be turned off during much or all of the day. This saves energy and reduces the cost of maintaining the electric lighting system, a significant expense.
Although daylighting design for classrooms can be as simple as installing good windows, the best designs often employ clerestories and other more complex lighting devices such as light shelves. Remember, windows that provide a view can also introduce glare. Windows also introduce side light, which usually is not as good as top light for illuminating tasks.

The recommended standard for daylighting is to achieve a two percent minimum daylight factor of uniformly distributed daylighting with no direct sunlight penetration in 75 percent of all classroom space. The daylight factor is expressed as a percentage of daylight at the task level, measured in foot candles or lux, to the total amount of outdoor daylight.

In summary, daylighting is beneficial to student learning in addition to simply being pleasant. Employed correctly, daylighting can dramatically cut electric lighting, energy, and maintenance costs. The resultant energy savings can, in the long term, offset the increased costs of adding daylighting while increasing comfort and student performance.

Electric Lighting Choices

Even if the school is well daylighted, an electric lighting system is needed for inclement days, early and late winter hours, and evening classes. The challenge is to provide a lighting system that is energy efficient, has a long life, and requires minimal maintenance.

Lamp Technology. For the greatest energy efficiency and best color rendering, school lighting should employ either fluorescent T-8 or T-5 linear lamp technology with electronic ballasts. The latest T-8 lamps, called second generation, produce more than 10 percent more light per watt than the original T-8 lamps and 50 percent more light per watt than the old T-12 lamps (still the most commonly used lamps in older schools). The second-generation T-8 lamps are currently about 30 percent more expensive than ordinary T-8 lamps, but their superior color and light output are worth the cost and they last about 20 percent longer. T-8 lamps can be easily retrofitted into existing lighting systems.

T-5 linear lighting systems are best suited to new schools or schools undergoing major remodeling. They are most effective when used for suspended uplighting, direct-indirect pendant lighting, cove lighting, under-cabinet lighting, or in specialized applications. Because the T-5 lamp and ballast system is more expensive than the T-8 system, the two systems should be compared to determine which best meets a school's needs. The T-5 HO (high output) lighting system is rapidly gaining prominence as the preferred lighting system for gymnasiums and other spaces with high ceilings.

Compact fluorescent lamps should replace incandescent lamps in downlights, wall bracket lights, and utility lights. Because of improvements in low temperature performance, compact fluorescent lamps also may be used for some exterior lighting applications such as canopy downlights, utility wallpacks and some types of security lighting.

High intensity discharge (HID) lamps should be used primarily outdoors (in parking lots, athletic fields, and high-wattage exterior lights) and for a few interior applications. Metal halide lamps are strongly

recommended (as opposed to high-pressure sodium) for their good color rendering and white light, which provides better night vision. Until recently, HID lamps were used in gyms and other spaces with high ceilings. With the advent of T-5 HO and multiple compact fluorescent lamps, however, indoor applications for HID lamps should be chosen carefully and only after weighing a fluorescent alternative. The reason is simple: fluorescent systems generate more light per watt and provide superior color. The exception is high color-rendering ceramic metal halide lamps. These new lamps are not nearly as energy efficient as fluorescent lamps, but they are the most efficient source for display lighting and a few other specialty applications where color rendering is important.

There are very few applications for traditional tungsten sources of any kind. The short lamp life and low energy efficiency of tungsten lamps make them a poor choice. They should only be used in theaters, art galleries, and in spaces where dimming is important, such as multipurpose rooms. The latest halogen IR (infrared) lamps should be specified, for they produce light about 33 percent more efficiently than ordinary incandescent lamps.

On the horizon, new light sources such as light-emitting diodes (LEDs) and induction lamps may ultimately change the way we approach lighting. The only current practical application of LED technology, however, is for exit and directional signs, and induction lamps are cost effective only when used in places that are difficult and costly to maintain (induction lamp life is generally five times longer than the best fluorescent lamps). A few other sources might be considered for special applications, such as cold cathode lighting, neon, and fiber optics, but, if used extensively, these sources will generally prove to be costly and comparatively inefficient.

Lighting Fixtures (luminaires). Much of the lighting equipment used in schools is, and should be, commercial grade, similar to the equipment used in offices, stores, and other kinds of commercial buildings. When choosing lighting systems and fixtures, think about efficiency, glare control, durability, cost, and maintainability, for which there are many cost-effective choices. New lighting trends to consider:

- **Suspended Indirect Luminaires** are recommended in classrooms. Suspended indirect luminaires with relatively low-cost sheet metal bodies have become reasonably competitive with recessed troffer lighting. Indirect lighting provides a superior quality of light by illuminating the ceiling, which redirects light downward uniformly and without glare. However, to use these lighting systems, ceiling heights should be at least 9 feet 6 inches, and walls and ceilings should be a light color.
- **Direct-indirect Luminaires**, which are more efficient than indirect luminaires alone, work well in classrooms. They are slightly more expensive to install, but high performance direct-indirect lighting expends about 20 percent less energy for the same light levels as indirect lighting alone. A ceiling of at least 9 feet is needed, and walls and ceilings should be a light color.
- **T-5 HO Systems with Specially Designed Reflectors** are the most efficient and economical systems for use in gyms and other spaces having high ceilings. These systems permit multiple-level switching and other control options that do not work with traditional HID lighting systems. Multiple compact fluorescent lamp luminaires and metal halide industrial luminaires also may be used, depending on ceiling heights and other factors.
- **Fluorescent and Compact Fluorescent Vandal-resistant Luminaires** are available in architectural styles that look pleasing, even when the school is built to withstand rough service.
- **Several Other Efficient Fixtures** are available, such as the recessed indirect troffer that works well for corridors and other spaces.

An Energy Efficient Lighting Plan

By following the six steps below, it is possible to design lighting systems that use half the energy conventional designs used just a few years ago:

1. Use daylighting strategies throughout the school. Design the electric lighting so that lights can be adjusted in response to changes in daylight levels.

2. Select the best light source suitable for the application. Considering the excellent color quality available from modern fluorescent and compact fluorescent lamps, there is rarely a need to compromise. In a

few cases, however, a good design might use a small amount of tungsten lighting or HID lamps. Carefully weigh all options before choosing.

3. Use the most efficient luminaires. For instance, modern direct-indirect luminaires are 85 to 90 percent efficient, as compared to the 60 to 70 percent efficiency of older styles. Many of today's luminaires are open bottomed, which minimizes dirt accumulation and assures good lighting performance even when maintenance is reduced.

4. Use luminaires that produce a good coefficient of utilization (CU). The CU takes into account the way a luminaire works within a particular space. This is especially important with indirect lighting systems, which have an excellent CU in a room with a flat ceiling 10 feet above the floor but have a reduced CU at higher ceiling heights.

5. Design using the latest recommendations of the Illuminating Engineering Society of North America (IESNA). The IESNA Lighting Handbook, 9th Edition, contains new recommendations for lighting levels (footcandles or lux). These levels and their applications can result in lower energy use when properly applied. See also IESNA's *Recommended Practice for Lighting for Educational Facilities* (IESNA).

6. Use modern lighting controls throughout the school. With electronic dimming ballasts, fluorescent dimming is quiet, flicker-free, and energy efficient. Automatic fluorescent dimming can be employed in every room with adequate daylighting, although this option is more expensive. Other types of modern lighting controls, including motion sensors and energy management systems, should be used to reduce operating time. Remember, the amount of money spent on energy is the power (kilowatts) of the system multiplied by the time it is operating (hours) and the price of electricity. Modern lighting controls save money by reducing the time that lights are used unnecessarily.

A high performance school should have a maximum lighting power usage for interior lighting of less than 1.2 watts per square foot. When combined with effective lighting controls, the total energy use of a high performance school is much lower than in ordinary schools. And when daylighting is used properly, schools can operate with very little lighting power under most peak conditions.

INTERIOR WALLS

Interior walls are generally constructed of concrete masonry units or gypsum wall board. The choice of wall board over concrete blocks can significantly lower the cost, however, the durability of wall board must be considered. Impact resistant wall board is available, but it still does not have the durability of concrete. A compromise is to use concrete for the lower half of the wall and wall board for the upper part. Another common practice is to include a wainscoting of ceramic tile or other hard material that can help reduce the daily wear and tear on the walls. Light colored paints are usually the best choice for wall covering. Vinyl wallpaper is not recommended because it can trap moisture inside the wall board leading to the growth of mold and other problems. Interior walls in washrooms, kitchens, or other areas with high levels of moisture need to be constructed, or at least covered, with water resistant surfaces.

OUTSIDE GROUNDS

Parking and Vehicle Traffic

The NH Code of Administrative Rules, Ed 321.03 requires that there be access for emergency vehicles from at least two directions. Local emergency officials may also desire that there be access completely around the building. The local fire and police departments should be consulted early in the design to discuss emergency access and concerns.

Administrative Rules Ed 321.12(j) require that parking spaces be provided for 100% of the school staff and 75% of the students who are eligible to drive. Insufficient student parking at high schools can lead to major problems with the neighbors.

Parking areas and walkways must meet the requirements of the NH Barrier Free Access Code and the Americans with Disabilities Act (ADA).

The layout of access roads, driveways, walkways, and parking lots must be given careful consideration. Ideally, bus traffic, parents, staff, and student drivers will be kept separate. The routes for each must be clearly marked. At a minimum, buses should be kept separate from cars. Drop off areas should not require children to cross lanes of traffic.

Access for delivery vehicles and refuse trucks should be direct and should avoid parking lots and drop off areas. It should also be clearly marked and as direct as possible. It is best that there only be one delivery route and one central delivery point for the entire building.

Parking and access to the building for public events should be considered in developing the site plan. This includes planning for events after normal school hours as well as those which may take place while school is in session such as voting. Access and parking for events at athletic fields must also be planned.

Playgrounds

Elementary schools should have playgrounds for use by school children. In many cases playgrounds will also be used by the community during non-school hours. There are a number of sources of information about appropriate playground apparatus, recommended surfacing materials, and general safety concerns. One of the most widely used references is the *Handbook for Public Playground Safety* published by the U.S. Consumer Product Safety Commission (CPSC), phone (800) 638-2772. The handbook can be downloaded from the commission website at www.cpsc.gov. Another source of considerable information is the National Program for Playground Safety located at the University of Northern Iowa, phone (800) 554-7529, www.playgroundsafety.org. The national program offers training courses and provides a number of written guides. Large districts may want to consider sending a staff member to the program's training to become a certified playground safety inspector.

Many playgrounds are constructed by parent groups, who will often conduct fund drives to obtain the necessary resources. These efforts are commendable, but the district must ensure that all work meets the necessary codes and safety standards. The company that provides the district's liability and property insurance should be contacted for advice. Some insurance companies have certified playground inspectors who will assist client districts at no charge. The school maintenance staff should be part of the planning group. Consideration might also be given to having children participate in the planning.

Recommended steps in designing playgrounds:

1. Plan for the developmental needs of children in varying age groups.
2. Plan for children with disabilities as required by the ADA.
3. Research the availability of playground apparatus. Obtain catalogs from several vendors.
4. Ensure that all apparatus considered meets the safety guidance from the CPSC.
5. Evaluate the maintenance requirements and durability of apparatus.
6. Determine the appropriate apparatus to be installed and the source of each item.
7. Seek assistance in developing the layout of apparatus.
8. Determine the type of surfacing materials to be used.
9. Consider security and lighting requirements
10. Follow manufacturers' instructions for installation and maintenance.
11. Plan for future replacement of apparatus.

Athletic Facilities

The requirements for outdoor athletic facilities must be identified early in the planning process. Guidance for specific field dimensions, surfacing, and layouts can be obtained from the NH Interscholastic Athletic Association (NHIAA). The NHIAA can be reached at (603) 228-8671. Designers should verify that competition fields meet the NHIAA requirements. There should be a sufficient number of competition fields

for each of the sports in which the school intends to field teams in each season. Additional practice fields may also be required. Planning should also include use of these facilities by the physical education program and community groups.

Consideration must be given for parking, spectator seating, crowd control, security, concessions, and press boxes, especially for large high schools. Access for emergency vehicles is an important planning issue. The design team must know if night games are planned.

Artificial turf may be a consideration. The initial cost may be offset by the reduced maintenance cost. School Building Aid however, is limited to the cost of a natural turf field.

In many cases other athletic facilities are available within the community. Their use should be considered during the planning process.

Thought should also be given to expansion for new sports or additional teams in the future.

Landscaping

The first goal of the landscaping plan should be to disturb as little of the natural setting as possible. Careful siting of the building and peripheral facilities is key. Maintenance requirements should also be considered. Designers should choose native vegetation for landscaping. Not only will native trees and shrubs blend better with the surroundings, but they will require less maintenance. The choice of evergreens or deciduous trees also effects maintenance. Properly placed shade trees can help reduce solar glare into classrooms and can keep cooling costs down.

Storm water control is the next major issue. The easiest and least costly method of controlling storm water is to construct detention ponds to collect the water until it evaporates or is absorbed into the ground. Detention ponds however are hazardous, unsightly, and take up valuable real estate. Detention ponds are not intended to hold standing water for very long, but they often do. Detention ponds will be an attractive nuisance to school children as well as those from neighboring residential areas. Liability is an issue. If used, detention ponds should be fenced. Careful landscaping can help minimize the amount of water that must be captured and may allow the water to run off into drainage swales or other areas acceptable to the Department of Environmental Services who must approve the drainage plan. Underground systems are another alternative to detention ponds.

Communities go to considerable expense to provide potable water for drinking however, much of it is used for purposes other than human consumption that do not require treatment. Storm water can be collected and used for irrigation of lawns and play fields, for fire protection, or even for flushing toilet fixtures.

Grass will require considerable labor for mowing and water for irrigation. Broad lawns may look nice, but they are costly and unnecessarily disturb the natural environment. Limiting the amount of grass will also minimize the amount of fertilizers that are used which saves money and helps protect the environment. Avoid planting grass on small traffic islands or similar small spaces because it is very hard to maintain in such locations.

Landscaping can also impact security. Shrubs can provide hiding places for intruders. Do not plant shrubs close to the building. Also avoid planting shrubs or larger trees where they will block direct observation of playgrounds and parking lots. Poorly placed shrubs can block lines of sight for vehicle and pedestrian traffic. On the other hand, vegetation can help provide a buffer between the school and neighboring properties for both noise and light.

Exterior Lighting

High intensity discharge (HID) lamps should be used outdoors in parking lots and athletic fields. Metal halide lamps are strongly recommended rather than high-pressure sodium for their good color rendering and white light, which provides better night vision. Exterior lights may be controlled by a timer switch or photo cells.

The decision should be based on an analysis of security concerns. There may be no need to have the lights on at 3:00 AM if no one is using the building and security threats are minimal. In that case, a timer is a better choice than photo cells. A combination may be the most effective solution. Motion detectors are an option, but they may be activated by animals, traffic, or other sources that are not a security concern.

A major consideration with exterior lighting is the effect on neighboring property. Lights must be directed to adequately light the school property yet avoid disturbing the neighbors. The designers should produce a lighting plan that indicates the intended coverage. The actual effects must be verified after installation. Close coordination and cooperation with the neighbors can help smooth this process.

COMMUNICATIONS AND EDUCATIONAL TECHNOLOGY SYSTEMS

Telephone, television, data, intercom, and public address systems are among the common communications systems found in most schools. The NH Code of Administrative Rules Ed 321.20(d) lists standards to be followed for communications cabling and wiring. This technology is advancing rapidly. Today, wireless networks are replacing the hard wired systems of the past, although current technology has not eliminated the need for wired networks for video, printers, and large file applications such as CAD. Today's technology allows the use of various media over one network such as Voice Over Internet Protocol (VOIP). It is possible to use the same network for telephone, data, and video services.

Every school district is required to have a technology plan. A copy of the district technology plan should be provided to the architect and design team at the beginning of the project. The project may provide an opportunity for the district to review and update its plan, particularly if it has not been looked at in awhile. A careful plan must be developed to identify the needs of the users and how they will use the systems to be installed in a new school. The NH School Technology Planning Guide (at www.nheon.org/oet/tpguide) contains a status list of approved plans along with many more planning resources.

The board may wish to establish a technology sub-committee to make recommendations about systems and equipment. The process for making decisions about the systems and equipment to be included must be clearly established and followed. It is easy to get trapped into buying the latest gizmos that may be of little or no value for a particular program or group of users. The goal must be to match the needs of the users rather than try to get as many technological features as possible. Like in many other aspects of a school facility, flexibility is important in the area of communications. Decisions on what equipment to buy should be delayed until the end of the design phase due to rapid changes in technology. Districts using plans that were developed several years in the past should take care to update the technology equipment to be purchased. Upgrades of hardware and software should be expected within five years or less, given the speed at which this technology is advancing.

Equipment cabinets and mechanical rooms should be designed in such a way that it is easy to access, maintain, and replace equipment. Where wired networks are used, it should be easy to remove a length of wire or cable and to install a new one. The fire code no longer allows abandoned wiring to be left in ceiling plenums. Removal of old wiring must be included in the planning for renovation projects.

The rapid growth in the use of networked computers has made planning for data networks an integral and very important part of designing school facilities. Data networks must be designed to enable simple and flexible expansion of the network in the future. It is essential to have an expert in data networks plan a system that will meet the needs of the school. Planning, as well as installing, data cabling requires a different set of knowledge and skills than that for electrical wiring. Data network planners should consider the amount and type of data which will be sent over the network, the speed at which it needs to be transmitted, surge protection, and interference which may impact data transmission. The type and quality of cable and equipment used are critical to the success of the network. In areas where cable will be run through conduit, it is crucial to ensure that the conduit will be large enough to handle future wiring needs. Sufficient data jacks must be installed for present, as well as future, needs. Almost all computer and audio/visual equipment needs electrical power. Ensure that an adequate number of electrical outlets are installed at locations where computers, printers, or other equipment will be used. This may include floor

mounted outlets or outlets mounted high on a wall. It might also be wise to install power and communications wiring in storage rooms or other areas that may eventually be used for other purposes.

The television distribution system uses multiple channels to distribute cable and/or satellite programs, play back video programs, and provide for local origination of programs throughout the building. This system may originate in the library facility and extend to all classrooms and other instructional areas throughout the building. Cabling should be installed which connects all instructional areas to the "head end" of the system. The cable jack(s) in each of these areas should be installed on the wall based on the location of the television monitor receiving the signal (for example, on a cart or wall mounted). Consideration should be given to the number and placement of cable and/or satellite drops that will come into the building at the "head end" of this system. The design and installation of the television distribution system should be completed in consultation with local cable company representatives and those who specialize in this area in order to acquire a system which meets the needs of the individual school program and takes into account different wiring methods and special equipment needed such as modulators, amplifiers, and splitters. Special features, such as a media retrieval system may be planned for the building and should be incorporated into the planning of the television distribution system.

When building or renovating a school that will include significant amount of new technology, districts should consider building a prototype classroom for staff development before the construction is complete. The staff can be trained in advance on the new systems and be ready to function in their new classrooms on opening day.

Assistance, and possibly funding, is available from the Department of Education's Office of Educational Technology whose website is http://nheon.org/oet/.

MAINTENANCE MANAGEMENT SYSTEMS

There are a variety of computer based and internet based systems available to automate the maintenance management process. Systems can be as simple as one that provides electronic work orders to one that notifies the owner when preventive maintenance services are due and analyzes energy usage to identify problem equipment. A simple system may cost a few hundred dollars while a complex system can cost thousands of dollars. Districts that do not already have a system should consider including the purchase and installation of a maintenance management system in every construction project. One of the most tedious aspects of starting a new system is the initial input of information about the building equipment. This can be included in the construction contract so that the system is ready for immediate use when the district takes control of the building. Staff training should also be included in the contract. These systems can help ensure that scarce maintenance resources are used for optimal results. The historical data that they produce can be very useful in preparation of future budgets.

CHAPTER 8 – THE CLASSROOM

"The young spirit loves the free air and the cheerful day; and when confined, as for some six hours it must be, the confinement should be as little unnatural and unwholesome as possible. The cheapest medicine for the body is good air and plenty of room; and the most indispensable pre-requisite to sane thought is a beautiful and happy place to think in."

From the Report of the Commissioner of Common Schools to the NH Legislature, June 1847

Classrooms are the center of education in our school buildings. All other spaces exist to support or complement the learning activities that take place in the classrooms. The physical arrangement, layout, and materials used in the construction of classrooms demonstrate the community's view of the importance of education to the children. Today's classrooms must be flexible and allow for learning to occur in a variety of ways. Gone are the days when teachers stood in the front of the room before students seated in neat rows of desks.

The majority of classrooms in any school, particularly in elementary schools, will be the type defined as "General Purpose Classrooms" in Part Ed 321 of the NH Code of Administrative Rules. This chapter will specifically address requirements for general purpose classrooms, although many of the concepts will hold true for the more specialized educational spaces that are addressed in Chapter 9.

Most importantly, classrooms must be adaptable. One room may be used to instruct in several subjects or for several grade levels in the same day. Use of rooms may change as programs and enrollment levels change from one year to the next. Finally, the methods of program delivery will undoubtedly change in the future, but the basic features of the classrooms, once built, are not likely to change for many years.

SIZE AND DIMENSIONS

For many years, the State of New Hampshire has required that general purpose classrooms contain a minimum of 900 square feet of space in elementary and middle schools, and 800 square feet in high schools. Those minimum standards have been retained in the most recent update of the Administrative Rules for School Construction, Ed 321.

Classrooms should be basically rectangular in shape with a length to width ratio no greater than three to two (3:2). Ceiling height should be a minimum of nine feet. Sloped ceilings are becoming common in many schools. Higher ceilings give an impression of more room, even if it means that duct work may need to be exposed.

Many schools like to equip at least some classrooms with retractable walls that allow teachers to open two standard size rooms into one very large space. When selecting such moveable walls, specifiers need to ensure that the moveable walls will prevent the transmission of sound between rooms when in the closed position. It is also important that these walls be durable and easy to move.

LIGHTING

Classrooms must be located along an outside wall for two reasons: first, the fire code requires windows that can be used for rescue if necessary (Chapter 12) and to maximize daylighting (Chapter 7), the ceiling and the wall space above the 6'8" level are part of the lighting system and should be white in color.

Windows should include clerestories and light shelves which will reflect daylight off the ceiling and deep into the room. Skylights are recommended close to the wall opposite the windows, if the budget will allow their installation.

Pendant type, fluorescent electric light fixtures are preferred which provide a combination of direct and indirect light. The teacher should be able to control the light fixtures to provide all direct or all indirect light. The electrical code requires that controls be provided to allow the reduction of light by at least 50 percent,

but the department of Education recommends that controls allow the reduction of electric lighting to both the one third and two thirds levels. This will meet the code and provide even better flexibility for the teacher.

Occupancy sensors are strongly recommended to ensure that electric lights are not in use when the room is not occupied. Districts may also want to consider photocells which adjust the amount of electric light based on the amount of daylight.

Lighting is also discussed in Chapter 7.

HEATING AND VENTILATION

Heating, Ventilation and Air Conditioning (HVAC) systems are discussed in some detail in Chapter 7**.** Classrooms must be heated and cooled evenly to a comfortable temperature. There should be a discussion about individual room temperature controls during the planning stages. Most teachers will say that they prefer to have their own controls, but centralized systems do not operate efficiently if too many people are able to change the settings. We all know that people have different ideas about what constitutes an appropriately comfortable temperature. It is not possible to satisfy everyone in a building such as a school where few people work in one room by themselves. Well designed and properly operated systems will make the majority of people comfortable and should alleviate the feeling that each room needs its own controls.

The ventilation system must provide air exchange in a classroom at the rate of 15 cfm/occupant. This rate is required by the State Mechanical Code. In a 900 sf classroom with 25 students and one teacher that means a total of 400 cfm. Systems which use 100% fresh air are preferred. The fresh air must be brought in quietly to meet the acoustical standards of ANSI S12.60-2002 which require that background noise cannot exceed 35 dBA. This will require that fan speeds be kept low or that the air comes into the room through multiple diffusers.

ACOUSTICS

A recent study conducted jointly by Brigham Young University and Johns Hopkins University determined that students in many of today's classrooms are unable to understand 25 to 30 percent of what the teacher says. Research from the University of Florida indicates that students seated farther back than the first two rows in a classroom may miss as much as 50 percent of what is being said by a teacher in the front of the room. Furthermore, the Centers for Disease Control estimate that 15 percent of school-age children may have temporary hearing loss.

Common sense tells us that acoustics are important. The research described above proves it. Noise from outside the building, noise from the building's mechanical systems, noise from computers, and the noise from the students themselves as they rustle papers or shuffle their feet all compete with the sounds of education. Classrooms must be designed and equipped to deal with the noise challenge.

The NH Code of Administrative Rules, Ed 321.21 requires that classrooms meet the standards of ANSI S12.60-2002. Acoustic treatment of the ceiling and a limited amount on the walls should be sufficient to meet the standards except for background noise from mechanical equipment. Carpet should not be necessary to meet the acoustical standards. The best methods for meeting the 35dBA maximum background noise requirement is to locate mechanical equipment away from the classrooms as discussed previously. Otherwise, equipment must be chosen that is specially manufactured for low noise output.

INTERIOR FINISHES

As stated earlier, ceilings should be made of materials that provide good acoustics. Ceilings and the upper portion of walls should be colored white to aid in providing good lighting. The remainder of the wall surfaces may be painted concrete block or gypsum wall board. Vinyl wall coverings are not recommended as they may trap moisture inside the wall systems. Colors should be bright, but some amount of contrast is important. Flooring choices are discussed in Chapter 7. For classrooms, the choice for floors most frequently comes down to vinyl composition tile (VCT) or carpet. Linoleum is a good choice because, unlike

VCT, it becomes harder over time. Carpet should only be used if the district is firmly committed to choosing high quality carpet, keeping it clean, and replacing the old carpet when it becomes worn. Some consultants recommend using area rugs rather than carpet. The only advantage to rugs is that they are easily removed. Any type of fabric floor covering must be cleaned on a regular basis using a method that removes dirt and other contaminants. Carpet should never be used in classrooms where water or other liquids are to be used frequently.

Classroom doors and windows must be lockable from inside. An intruder must not be able to unlock a classroom door from the outside. Windows are recommended in classroom doors so that the room can be observed from the outside. Teachers should not be allowed to cover the door windows, although a means for covering the window should be available in the event of an emergency lock-down.

FURNISHINGS AND EQUIPMENT

All furnishings, regardless of source, must meet fire code requirements. Furnishings should be constructed of non-toxic materials. Specifications for furnishings should clearly state these requirements. Much of the student furniture that is available today is made of wood particle board which contains formaldehyde. Such toxic chemicals should be avoided.

Colors and surfaces of furniture should be selected to enhance natural light and to minimize glare.

There must be direct, two way communication between each classroom and the main administrative office.

Modern classrooms should be equipped to use the most recent technology available. Access to the internet is essential in every classroom. The manner of access will depend on the school's overall data systems. Wireless technology is the most advanced method today and looks to be the standard for the future. Districts would be wise to install wireless systems in new schools. If wired networks are used, there should be plenty of data drops available in each classroom. Most classrooms should have at least one network printer available. Cable television is now almost universally provided in all classrooms. If not installed initially, future installation of cable television should be planned in the design of all new classrooms. Each classroom should be equipped with a video projection system, either portable or fixed. A digital white board or "smart board" is also commonly used. All of this equipment requires electrical power, so plenty of outlets are necessary all around the room.

Individual student desks are still a necessity, but they should be able to be rearranged for individual or group work. Student chairs should be ergonomically designed, sturdy, and adjustable to accommodate individuals of varying sizes and weights.

Teachers should have a desk and chair. If the classroom is dedicated to one teacher, the desk should include drawers which can be locked. If many teachers use the same classroom and have a work area elsewhere in the building, a work table may be all that is necessary in the classroom. The teacher's desk should allow for the use of a computer with access to the school networks. Task lighting may also be necessary.

Bookshelves for reference materials should be included. Supply shelves or cabinets should also be available. These may be built-in casework or moveable units.

Appropriate containers for refuse and recycling should be provided in every classroom.

A white board or marker board of at least 32 square feet is required (Ed 321.10)

Computer work stations may be installed in some classrooms. They should be durable and comfortable. The workstations should be located to minimize glare from the windows or overhead lights.

Each classroom should have a display area consisting of a bulletin board or tack boards, display cabinets, or shelving for student work and teaching aids.

Small hand sinks are commonly installed in elementary school classrooms where science and art are taught in the general purpose classrooms. In middle and high schools these subjects are usually taught in specialized rooms which are addressed in Chapter 9, so sinks are not necessary.

Window treatments must meet the fire code requirements for flame resistance.

Generally speaking, home living room type furniture does not belong in the classroom. Teachers should not be allowed to bring furnishings into the classroom that have not been approved by the school administration and verified for fire code compliance.

CHAPTER 9 – INSTRUCTIONAL ELEMENTS OF THE SCHOOL

"First, children need an environment which encourages exploration. This environment should provide them with plenty of opportunities for taking things apart and putting them back together. It should give them a chance to create, to explore ideas, to experiment, to search for facts, and to try out processes which are new and different – at least new and different to them."

From Planning America's School Buildings, American Association of School Administrators, 1960

The core of any educational facility is where learning takes place. Learning spaces must be planned and developed on the basic premise of serving the student's learning needs; they must implement the educational specifications formulated earlier in the planning stage and provide enough flexibility to accommodate future changes in methods and procedure. The purpose of this chapter is to provide guidance for school planners in making decisions with regard to specific types of learning spaces. Curriculum frameworks, published by the Department of Education are available at http://www.ed.state.nh.us/education/doe/organization/curriculum/Assessment/CurriculumFrameworks.htm. These frameworks are not mandated for use in every school, but they may be helpful to facilities planners in designing specific educational spaces.

KINDERGARTEN

Kindergarten rooms should provide a minimum of 50 square feet per pupil. With a recommended limit of 20 pupils per group, the minimum size room would be 1000 square feet.

The room should offer a relaxed, homelike environment to encourage children to live, learn, and play together. Furniture and equipment should be child-oriented and child-sized. Portable or movable furniture offers the advantage of permitting immediate and spontaneous changes in the learning situation. Flexible arrangements should be made for regrouping the children into small clusters or large groups. Individual places should be provided for quiet, personal activities. Versatility and variety in the physical arrangement will maintain the pupil's interest and enthusiasm. It should be possible to alternate "noisy" activities with quiet periods. Groups should be able to engage in outdoor activities under supervision while others work indoors.

Shelving in the kindergarten room can be varied - some movable, some stationary, some recessed. Those units that are movable can be backed with tack board, providing a very usable combination that can also serve as dividers or partitions within the learning unit. There should be a generous amount of marker boards and tack boards, and it is important that the units be kept at the child's eye level.

Each kindergarten room should have its own washroom.

Properly controlled heating and ventilation, adequate lighting, attractively painted, easily cleaned walls plenty of storage areas, shelves, cubbyholes are all necessary elements for a suitable learning environment. Carpeting or an area rug on a section of the floor will enhance the homelike atmosphere, and acoustical surfaces on walls and ceiling will minimize noise. Each kindergarten should have an audio-visual area for listening activities, a game center, and individual carrels for independent work.

In general, the kindergarten should be designed with a view to stimulating a child's imagination. Simple, natural materials are preferable to complicated, ostentatious objects. The space as a whole should be challenging, provide freedom of movement for the restless, active child, and also permit the solitary child to pursue activities uninterrupted.

As many of the play activities will be outdoors, there should be a door leading directly from the kindergarten classroom to the outside playground.

GENERAL PURPOSE CLASSROOMS

In elementary schools, instruction in subjects other than art, music, and physical education normally takes place in a general purpose classroom as described in Chapter 8. Students in elementary school spend most of their day in one assigned classroom with one teacher. Although not recommended, in some elementary schools art and music may be taught in the general purpose classrooms by a roving teacher rather than in a special art or music room.

At the middle and high school level, students usually move around from one room to another for particular academic classes. Many subjects at the high school and middle school levels are taught in general purpose classrooms. These include English, Mathematics, Social Studies, World Languages and other subjects which do not require specialized facilities. In many high schools and middle schools each teacher has an assigned classroom which can be equipped specifically for the courses which that teacher instructs. In other schools, teachers must share classrooms. In situations where classrooms are shared, it is best to share among teachers in the same academic field if possible. Many schools today are using block scheduling which means that the students spend more time on one subject during a given day. During one block students may conduct several different activities using different learning techniques. The classroom must be adaptable to the different activities. Some basic considerations by subject are listed below:

English

Furniture should be flexible in order to accommodate groups of various sizes.

Teaching stations or carrels should be available for individual work. Sections of the room can be arranged to provide for a reference center, reading table, displays, individualized material kits, etc.

A small stage or platform for dramatics and public speaking activities might be provided in one or two rooms.

Extra marker boards and bulletin boards are necessary for English rooms.

Each room should have an audio and video recorder, CD player, lectern, and unabridged dictionary with stand.

Sufficient video projectors and a screen or surface suitable for projection should be provided.

Mathematics

Flexible design to permit both large and small group instruction is recommended for the mathematics area. If an experimental approach is used, such as the “lab” type of instruction, tables, instead of desks, might be utilized. At least one larger area should be provided for such a program. This can be accomplished by installing a moveable wall between two regular size classrooms.

If computer instruction is to be given as part of a mathematics class, provisions must be included in the design. Wireless laptops are easily accommodated without space concerns. Hard-wired desk top computers require space and computer work stations.

In a large school, a special work area for mathematics teachers similar to a seminar room could be designed with a math carrel for each teacher, library shelving for reference materials, filing and storage cabinets etc. In a smaller school, this area could be shared with other departments.

Social Studies

In order to provide for different learning methods, the room should contain a variety of printed and audio-visual resources. Interaction and action types of learning should be encouraged by the physical arrangements and supported by the materials available. Provision should be made for small group work and

discussions, either in separate small rooms or in designated areas within a larger room. Furniture should be movable to allow for a variety of working arrangements (different chair-desk combinations, tables for discussions, etc.). The different specifications will determine the number, size, and shape of tables, chairs, and other furnishings.

A small reference area may be required. Each social studies classroom should be equipped with a DVD/VCR player and video projector. Access to the Internet must be available. A wall display area for maps, posters etc. is required.

World Languages

Furniture should be movable to allow for a variety of working arrangements (different chair-desk combinations, tables for discussions, etc.) and to accommodate groups of various sizes. Provision should be made for small group work, cooperative learning, and discussions, either in separate small rooms or in designated areas within a larger room. Interaction and action types of learning should be encouraged by the physical arrangements and supported by the materials available. Sections of the room can be arranged to provide for a reference center, reading table, displays, individualized material kits, etc. In order to provide for different learning methods, the room should contain a variety of printed and audio-visual resources.

Extra whiteboards and bulletin boards are necessary for world language rooms.

Each room should have a CD player, audio recorder, video projector, and at least one computer with Internet access and printer.

Each room should have sufficient electrical outlets for simultaneous operation of several pieces of equipment and means should be provided to darken the room when necessary.

Sufficient laptop computers, video projectors, DVD players, VCRs, television sets, video recorders to serve the needs of the program on a shared basis should be provided.

LANGUAGE LABORATORIES

In addition to the classroom, most secondary schools are utilizing language laboratories to offer the student more extensive practice in listening comprehension, and speaking. Two different basic types of laboratory facilities are available for teaching foreign languages: The philosophy of the department will determine whether only one or a combination is to be used. One type of language laboratory consists of an electronically equipped classroom, where ordinary students' desks have a microphone and earphones, with a recorded program supplied from the teacher's console. One advantage of this laboratory is that the classroom can be easily reconverted for conventional methods of instruction by removing and storing the electronic equipment. A second advantage of this type of laboratory is that there are no individual listening booths to obstruct students' view of film, DVD, computer programs or other projected visual media that might be used in conjunction with audio materials. The fixed laboratory requires a separate room with permanent installations. Students sit in semi-private listening booths which are equipped with earphones; individual player/recorders enable them to change their own programs. Player/recorders may also be located in the teacher control console, which may be either on a raised platform in an exposed desk-cabinet area or in a separate glass-walled room providing visual contact between two classrooms and contain a maximum of twenty-five listening stations.

An adjacent work-storage area must be provided for all language laboratories. This area must be sound proofed to permit preparation of recorded programs and must have special ventilation due to the heat generated by electronic equipment. By the same token, special provision for ventilation may be necessary throughout the laboratory area. A single switch should turn off all electronic equipment in the laboratory except the overhead lights. In designing the laboratory area, care must be taken to prevent interference with or damage to magnetic tapes, disks, and other electronic equipment by fluorescent lamps and other electrical fixtures.

READING CENTER

Every school should have a well-equipped, attractive area to which students may go for help to become better readers. It should contain the latest equipment, a wide variety of reading materials, and a staff of specially trained reading teachers. The center should be designed to attract both college-bound students and those needing remedial instruction. Remediation loses it stigma when slow readers discover the center is also used by average and superior students. The following guidelines should be used in planning this facility:

1. Larger than usual storage space must be provided; diagnostic services and a program of corrective remedial help demand a great variety of materials.

2. Good lighting is most important.

3. Space should be provided for marker boards and bulletin boards.

4. Aside from filing and storage cabinets, the furniture should include a suitable teacher's desk and desk-chair units or tables for ten to twelve students, with the possibility of arranging the furniture for large groups or routine developmental lessons.

The reading center may be in the library-media center area, where all the necessary materials, equipment, and supplies are readily available. In this case, provision for space and furniture, equipment, and materials should be made for the reading center when planning the library-media center. The advice of reading specialists will be valuable in determining the specific needs in this field.

COMPUTER LABORATORIES

Computer laboratories are used to teach basic computer skills to all students or for elective courses in more advanced applications such as business software or Computer Aided Design (CAD). This may be an area where a teacher for a specific academic subject brings an entire class, or it may be an independent course offering. There are a few basic layouts that are typically used:

a. Install the computer work stations along the walls of the room

b. Install the work stations in rows facing one direction with a teaching station at the front

c. Other configurations such as a wireless mobile computer cart which can be moved from one room to another

If the second arrangement is used, and personal computers are to be used rather than laptops, the work stations should be of a type where the computer monitor is mounted below and viewed through the top of the work surface.

Great care must be taken in the lighting design to prevent glare. Acoustics are especially critical because of the constant noise from keyboards and printers. A raised floor will ease the work of wiring work stations and initially and for future changes. Separate temperature control for the computer lab is recommended. Cooling may be required. Electrical outlets are required wherever a computer or printer is to be located or may be located in the future.

SCIENCE

Elementary Schools

Science instruction at the elementary level is usually conducted in a general purpose classroom. In grades 4-5, science instruction may require the use of a sink with hot and cold water and GFI protected electrical outlets. There should be room for students to gather around to observe demonstrations. Display cabinets and storage cabinets may also be required. Consideration should be given to developing an outdoor classroom or environmental study site on school grounds. Internet access is a must.

Middle Schools and High Schools

At the middle and high school levels, science instruction may be conducted in separate classrooms and laboratories or in combination lab/classrooms. The recommended standards from the National Association of Science Teachers and the Laboratory Safety Institute have been adopted and incorporated into Ed 321.10(k) of the NH Code of Administrative Rules. The rules require a minimum of 45 sf/pupil in separate labs and 60 sf/pupil in combination lab/classrooms. No more than 24 students may be simultaneously assigned to one laboratory class. NFPA 45 contains specific requirements for laboratories, however the NFPA standards clearly distinguish between labs for use by students in grade 12 and below from those used at the college level or in industry. For example, college labs may substitute heat detectors for smoke detectors, but middle and high school labs may not.

Laboratories where chemicals or hazardous liquids are to be used must include an emergency eyewash and emergency shower or combination eyewash/shower meeting the requirements of ANSI Z358.1. A class B and a class D fire extinguisher should be provided in all chemistry labs. A class B fire extinguisher should be provided in all other labs. An emergency fire blanket should also be provided in all labs.

A fume hood must be available in all chemistry labs where experiments or demonstrations with the following characteristics will take place:

1. Using chemicals that are hazardous when inhaled.
2. Conducting experiments or demonstrations with strong exothermic reactions.
3. Using chemicals with high vapor pressures.
4. Working with chemical vapors that are fire hazards.
5. Using chemicals that produce an offensive odor.

Fume hoods should have an average face velocity of 100 cfm and must be able to prevent the escape of fumes when the sash is moved. The fume hood exhaust must be separate from the building ventilation system. Light bulbs in fume hoods must be sealed in vapor proof fixtures. Exterior finishes should be chemical resistant epoxy. The interior work surface must be watertight and should include a raised edge to contain spills.

There are a variety of types of lab work stations that may be configured in different ways. A choice must be made between providing one lab work station per student or one for every two students. At least one work station in each lab or combination lab/classroom must be ADA compliant. The designers and the science staff must coordinate closely to develop the lab layout because changes will be difficult once water lines, drains, and gas services have been installed. The work stations should be arranged in a manner that permits observation of all stations by the teacher. Thought should be given to the possibility of changes in the future. No lab or classroom should be excessively customized to meet the unique ideas of one teacher, who may be gone before the facility is ever used.

Labs require considerable storage and preparation space. This is often provided by a shared room between every two labs. AT least 400 square feet is recommended. Again, there is a wide variety of furniture and cabinets that can be provided to meet the needs of the science program. Chemicals must be stored properly to meet state and federal requirements for storage of hazardous materials. Guidance can be provided by the State Fire Marshal's Office.

A 2005 report from the National Academy of Sciences, *America's Lab Report: Investigations in High School Science* says:

"Because of the expense of constructing or renovating laboratory space, the design should be future-oriented, supporting a vision of the science program over a decade or more. The first step in designing laboratory space is to develop such a long-term vision for the school science curriculum. The school science supervisor, along with curriculum coordinators, other science teachers, administrators, and state and local experts, often play important roles in developing this vision.

While the design of particular facilities will vary depending on the local science curriculum, available resources, and building codes, all school laboratory facilities should provide space for shared teacher planning, space for preparation of investigations, and secure storage for laboratory supplies. In addition, past studies and current laboratory design experts agree that laboratory designs should emphasize flexible use of space and furnishings to support integration of laboratory experiences with other forms of science instruction.

Combined laboratory-classrooms can support effective laboratory experiences by providing moveable benches and chairs, moveable walls, peripheral or central location of facilities, wireless Internet connections and trolleys for computers, fume hoods, or other equipment. These flexible furnishings allow students to move seamlessly from carrying out laboratory activities on the benches to small-group or whole-class discussions that help them make meaning from their activities. Integrated laboratory-classrooms that provide space for long-term student projects or cumulative portfolios support the full range of laboratory experiences, allowing students to experience more of the activities of real scientists. Forward-looking laboratory designs maximize use of natural sunlight and provide easy access to outdoor science facilities.

Designing school laboratory spaces to accommodate multiple science disciplines could provide both educational and practical benefits. First, because undergraduate science education, like science itself, is becoming more interdisciplinary, an NRC committee has recommended making undergraduate laboratory courses as interdisciplinary as possible (National Research Council, 2003). High school laboratory facilities that could accommodate interdisciplinary investigations would help prepare students for such undergraduate laboratory courses. Second, high school students enroll in a wide variety of science courses. It might be more cost-effective to provide this variety with a few laboratory classrooms that can accommodate multiple disciplines than by constructing discipline-specific laboratory classrooms that remain unused at times."

VISUAL ARTS

Guidelines for facilities for art instruction can be obtained from the National Art Education Association, http://www.naea-reston.org.

Art students need a large lab to work with a wide variety of tools and materials. Thirty square feet of work space per pupil must be provided. Allowing the necessary area for equipment (such as looms and kilns) and for storage and display, sixty square feet per student are required. Built-in counters around the periphery of the rooms extend work storage areas in a practical manner.

Consideration should be given to locating the art room on the first floor, along the school's main corridor and have a large glass area, offering visual stimulation to all who enter the building. The art program is likely to produce high levels of noise which should not penetrate other areas of study. Noise, dust, and fumes are particular concerns. A ventilation rate of at least 20 cfm/person is necessary. A separate exhaust system is required for the kiln room if one is provided. Acoustical treatments should conform to the latest ANSI standard. Tack surfaces on walls to display student work are encouraged up to a maximum of 20% of the wall surface to comply with the fire code. Light colored wall and work surfaces keep brightness contrast at a desirable minimum. Natural light is highly desirable. A walk-in storage closet opening off the main room is a necessity. Floors should have a hard, impervious surface such as vinyl tile or sealed concrete. Carpet should never be used in art rooms.

A diversified art program requires adequate facilities for work and storage of much equipment and numerous supplies. Drawing boards, easels, paints, brushes, papers of various sizes must be readily accessible. It is necessary to have areas for work in jewelry, ceramics, weaving, sculpture by carving, modeling, casting and welding. Block and screen printing also have particular requirements. An area which can be darkened for viewing slides and films is essential. A 250 square foot darkroom is recommended if a photography program is offered. Access to a computer lab is required for instruction in graphic arts.

Other provisions:

Sinks on island with drain board
Sturdy rectangular tables with space for students to work
Comfortable chairs
Easels or sketch benches
Display case
Marker boards
Wood bench materials, tools
Kiln, wet clay storage, drying shelves
Multi-media projector
Plenty of electrical receptacles
Audio/CD/video players
Computers, printers, scanners
Cabinets for storage of paper, textiles, weaving and student work in progress, for storage of brushes, paints, ink, illustrative materials, for storage of books, films, slides, and other resources, and for storage of metals, tools and equipment for printing.

MUSIC

Guidelines for facilities for music instruction can be obtained from the Music Educators National Conference, http://www.menc.org or at http://www.menc.org/publications/books/otl.html.

A good school music department needs specialized facilities for performing groups – both large and small, vocal and instrumental; classrooms for theory, history, humanities, listening, and individualized instruction, and a music lab for composing, recording, and editing music.

The areas for chorus, orchestra and band must be especially constructed to provide for the unique needs of the program. No other school subject demands as much consideration for sound.

The volume of sound varies from individual or group lessons, small ensembles, dance or stage bands, to the 80 to 100 piece band. Yet there is need for quietness in order that the nuances of sound from tapes or recordings may be heard. Background noise must be minimized. Other classrooms require sound insulation from music.

Easily accessible storage is required for instruments, music, folios, compact discs, and tapes. Tape recorders, CD players, video players and monitors, radio and piano must be available and sometimes stored. Sufficient space for smooth traffic flow is essential.

Because the size of performing groups will vary from school to school, some rule of basic measurements can be used. National study groups recommend that the height of instrumental music room be 14 to 16 feet. There should be 25 square feet per person. Thus 2500 square feet of space is minimal for a hundred piece band. Because of the volume of band sound there should be at least 250 cubic feet per person. Yet space for choral activity is sufficient at 125 cubic feet per person.

Other concerns: location of music areas in proximity to stage – on same level preferably. A ramp for moving piano on and off stage is desirable. A door directly to the outdoors permits controlled use after school hours, as well as quick access to the marching field. The door between music room and other school areas should be double width for instrument moving.

Provision for ventilation should include humidity control to prevent instrument deterioration.

Four to six practice areas 6' x 8' with sound insulated splayed walls and glass doors for supervision should be provided.

Two or more rooms 12' x 12' are desirable for ensemble use. The music library and the music teacher's office may sometimes double for small group practice.

Music rooms require more attention to lighting because much reading is done at greater distance from the reader.

Numerous electrical outlets are essential within the music rooms for effective use or sound systems and projectors. A string of outlets can be used for public address system and lights on music stands.

DANCE

Guidelines for facilities for dance instruction can be obtained from the National Dance Association, http://www.aahperd.org/nda/template.chm or from the National dance Education Association, http://ndeo.org.

If dance instruction is offered, a suitable room must be provided. A performing area should also be available. The dance studio should be located close to the locker rooms used for physical education or it should have its own male and female changing rooms. The dance studio should include a 30 ' X 40' dance floor or at least 65 sf/student plus storage areas. The floor should be impact absorbing resilient flooring, preferably a sprung wood floor. Vinyl tile over concrete or wood is not acceptable. If dance instruction is to take place in a multi-purpose room, the flooring must be suitable for dance. If tap dancing is included, a different floor may be required. Ceilings should be at least 10 feet in height to accommodate lifts. One wall should be a mirrored wall with mirrors at least 6 feet in height along the entire wall with curtains or other coverings for times when the mirrors are not in use. The other walls should be of a light color. Barres should be installed on the wall opposite the mirrored wall unless portable barres are to be used. A ventilation rate of 20 cfm/occupant is required. The studio should have its own temperature control. The area must be well lit, with as much natural light as possible. A sound system for audio tapes and CDs is required which should have recording capability. A voice amplification system may be necessary for the teacher. Acoustical treatments according to the latest ANSI standards are necessary to enable proper functioning of the sound system and teacher instructions.

THEATER

Guidelines for facilities for theater instruction can be obtained from the American Alliance for Theater and Education, http://www.aate.com.

For instructional space, a general purpose classroom, preferably carpeted, in which furniture can be moved around, is adequate. This room should be located in an area where full volume rehearsals will not interfere with activities in the surrounding rooms. For full cast rehearsals, a larger more open space is preferable. The auditorium stage is often used as an appropriate rehearsal space.

Performance areas vary with the level from elementary to high school. Auditoriums and stages are addressed in Chapter 10. Storage for costumes and props is required at all levels. At the high school level, areas for design and construction of costumes, scenery, and props are necessary. The costume design facility may be combined with family/consumer science programs. At least 650 square feet of space is recommended for costume design. The set construction shop should be located close to the performance stage with easy access for large items to be moved onto the stage. Ideally, it will also be located close to an outside loading/receiving area where materials can be delivered and easily moved into the shop. 1200 square feet of space is recommended for the set construction shop. The shop should include a sink with hot and cold water and a painting booth. It must be well lighted and have an air exchange rate of at least 20 cfm/person. A hard surface floor of concrete or vinyl is recommended. One or two rooms totaling 600

square feet are recommended for dressing and makeup. Dressing rooms should include toilet facilities or be located adjacent to other washrooms. Mirrors, tables, seating, adequate lighting and plenty of electrical receptacles are required.

PHYSICAL EDUCATION

Elementary Schools

At the elementary school level, physical education may be conducted in a gymnasium or in a multi-purpose space which frequently doubles as the dining area for the school. The space should be approximately 70' X 100' with a minimum of 110 sf/pupil. A 20' high ceiling is recommended, although 14' to 16' is acceptable. The flooring should be resilient flooring, a hard wood gym floor, or special rubberized flooring designed for physical education applications. Wall should have a smooth, hard surface. Acoustical treatments are necessary to ensure that students are able to hear other students and the teacher at all times. There must be a space buffer of at least 7 feet between the instructional area and any stored equipment, especially dining tables which ideally fold into the wall or are moved into a storage room when not in use.

An outdoor area for physical education is strongly recommended. This may included grass playing fields, general purpose fields, an all weather surface court, or a combination of several types of outdoor surfaces.

Middle and High Schools

Physical education at the middle and high school levels is normally conducted in gymnasiums and outdoor areas that are designed and constructed for competitive team sports, although the focus of today's physical education curriculum is on life long physical fitness activities. Facilities are generally suitable for both physical education and athletics, but care must be taken to ensure that the needs of the physical education program for all students are not given secondary consideration to the requirements of the relatively few students who participate in varsity athletics. Most middle and high schools will have at least one hard wood floor main gym which is marked and equipped for basketball, and probably volleyball as well. Often the space is arranged to provide one main court with the bleachers extended and two courts when the bleachers are closed. Acoustical treatments should be provided to enable students to hear the teacher and their peers. An air exchange rate of 20 cfm/occupant is required by the mechanical code. Larger schools may have two or three gyms or one large gym that can be divided by moveable walls or screens. Some schools may also have weight training rooms and multipurpose rooms that are available for physical education. There may be a need for a general purpose classroom for some parts of the physical education curriculum. Locker rooms are addressed in Chapter 10.

Outdoor facilities for physical education may include multi-use playing fields, tennis courts, and running tracks. The New Hampshire Interscholastic Athletic Association (NHIAA) can provide the latest guidance for the layout and construction of athletic facilities.

LIBRARY - MEDIA CENTER

The library-media center should be centrally located and easily accessible from all instructional areas of the school, preferably on the ground floor. Consideration should be given to the proximity to noisy areas such as the cafeteria, gym, music or student gathering areas. A location that allows for future expansion is desirable. In the event this facility will be used for community access when school is not in session, provisions should be made for public entry from exterior areas and parking lots, as well as easy access to washrooms within the secured area.

Flexibility in design is essential to accommodate future curriculum and technological changes. The design should simplify supervision while recognizing efficient flow of traffic, to minimize disturbances. Control of exits is particularly important; the minimum number of exits required for safety and smooth traffic flow is recommended.

Acoustics

Acoustical treatments are a vital element in any library design. These treatments are used within the facility as a deterrent to an accumulation of noise factors (from patrons, equipment, fans), and as insulation from external noise factors (cafeteria, lobby and music areas.) To protect from ambient noise from outside, or from the HVAC system, consideration should be given to treatments in any area where audio-visual recordings will be taking place. Conference rooms, work, and instructional areas should be soundproofed from the main facility.

Interior Finishes

Walls should be constructed of sound-absorbent materials finished in muted, neutral colors to add visual appeal. For reasons of supervision, single floor designs are highly recommended. The facility design should eliminate any areas which cannot be seen from a single location. To enhance visual supervision, walls between patron areas and support services areas should include observation windows placed strategically. Allowing for shelving and carpeting, the windows should begin at least 45" from the floor.

Recording studios should be sound proofed and lined with sound absorbing materials to provide for better recording, without bells or intercoms. Television studios should have one wall painted light blue to provide a backdrop for filming.

Floors should be finished with aesthetically appealing, sound absorbent materials. Static free, high quality, commercial grade carpeting is recommended for most areas. Acoustical vinyl or tile flooring, which is easy to care for and non-static, is recommended for media production and project areas, audiovisual equipment maintenance and storage areas, studios, and darkrooms.

Flooring in the circulation desk area should have extra padding. In the main entrance to the library-media center, flooring may be made of other nonskid, easy to care for, attractive and durable materials; such as ceramic or quarry tile.

Neutral color flooring should be used. Dark flooring is harder to keep clean. While molding gives the walls a finished look, molding behind shelving can create gaps where items can disappear.

Ceilings should be finished with sound absorbent materials, such as acoustical tile. Ceiling material should be light and bright. Care should be taken in the placement of light fixtures, skylights and roof windows so that visibility will not be impaired by glare or too much direct light. Ceiling height should be at least nine feet to allow for full size bookcases.

Electrical Power

The electrical design of a library-media center must be an integral and early part of the planning. The number of electrical outlets installed in a library must be sufficient to meet present, as well as future, needs. Ample outlets should be included in all workspace areas, the circulation desk area, and all parts of the facility in which equipment will be used. Even though outlets may not be used in certain areas at present, it is wise to install more outlets than you think you will need. For example, consider locating outlets on walls that may initially have wall shelving. Future use of the wall space may include an activity where electrical power will be necessary. Consider special items that may require electricity, such as a security system gate. The design of the facility should specify exactly where outlets need to be located, including height from the floor. Do not rely on a plan which specifies a particular number of outlets per linear feet, since this leaves contractors the option of installing banks of outlets in one spot, rather than spacing them appropriately around a room.

Work areas where built-in counters will be utilized, such as the circulation area, should include an electrical strip installed along the full length of the wall or back of the counter. Worktables located against a wall should have outlets installed above the work surface for convenience. Equipment use areas and/or computer stations located in the center of a room must have outlets installed that are flush with the floor. Switches and

electric controls located on walls should be located conveniently, but care must be taken so that they are not hidden by shelving which may be installed at a later date.

Inform the electrical engineer early in the planning process about items that draw a lot of power and may require separate circuits, such as a laminator. Determine peak loads and interference, which may affect electrical needs. The need for surge protection and backup power supplies should be considered.

Lighting

Maximum daylighting is recommended for library-media centers. Electrical lighting should be provided by energy efficient fluorescent fixtures using indirect light. Task lighting may be needed at the circulation desk and at some work stations.

Furnishings

The quality and design of the furnishings chosen will have a strong impact on the learning environment. Each area of the library-media center has specific requirements for a wide range of furnishings including but not limited to tables, chairs, periodical display, seating for classes, as well as seating for areas of quiet study and research.

Adequate seating should be provided to accommodate a minimum of one full class in elementary schools.

Shelving choices will depend on the age range of patrons, the materials the shelves will hold and where the shelving is to be located. Care should be taken to select quality shelving that is not only aesthetically pleasing, but functional and durable. Low shelving enhances supervision.

The library-media center must be ADA compliant (See Section 8 of the ADAAG). The circulation desk, work stations and other areas must be accessible for students with physical impairments.

Space Requirements

The minimum size of a school library-media center is 40 sf/pupil for 10% of the design capacity or a minimum of 1800 square feet, as required by Administrative Rules Ed 321.10(j). Most schools will desire more space than the legal minimum. Recommended sizes for specific areas are as follows (note that the total exceeds the 1800 sf minimum required by Ed 321.10(j):

a. Circulation Desk (200-300 sf)

b. General Reading, Research, Viewing Area, and Stacks (35 sf/pupil for 10% of the design capacity)

c. Group Instruction Room (600-750 sf)

d. Electronic Multimedia Production Area (500-700 sf)

e. Office for Library-Media Center Administration (150 sf)

f. Equipment Room (500-750 sf)

SPECIAL EDUCATION

For the most part, students with special needs should be integrated into all academic programs along with the general student population. There should not be distinct spaces for special education with a few exceptions:

Some students may require physical therapy during the school day. There should be space for that purpose that provides privacy. The space must be very flexible because the needs of the individual students can vary widely. A sink and private washroom are recommended.

Another unique space for older children with special needs is a life skills area. This area is used to teach basic skills for independent living. It should be equipped and furnished with common household furnishings and appliances such as a stove, clothes washer, clothes dryer and similar items. The size of the space and the number of appliances will be based on the estimated number of students who will need this service at any one time.

Some students with special needs may require one-on-one instruction. An appropriate space should be provided.

Many districts operate a pre-school program for special needs children which will require its own space.

CAREER AND TECHNICAL EDUCATION

Career and Technical Education (CTE) in New Hampshire is delivered via a system of middle schools, high schools, Regional Career and Technical Centers, two year Community Technical Colleges and four year colleges and universities.

The Bureau of Career Development within the Department of Education oversees the development of resources that contribute to quality Career and Technical programs. These programs are designed to provide opportunities for technical and workplace skill attainment by students that allow for continuing their education or working in a pathway or job within one of the following Career Clusters:

- Agriculture, Foods and Natural Resources
- Architecture and Construction
- Art, A/V Technology and Communication
- Business, Management and Administration
- Education and Training
- Finance
- Government and Public Administration
- Health Sciences
- Hospitality and Tourism
- Human Services
- Information Technology
- Law, Public Safety and Security
- Manufacturing
- Marketing, Sales and Service
- Science, Technology, Engineering and Mathematics
- Transportation, Distribution and Logistics

Middle school career and technical related programs (Family and Consumer Sciences and Technology Education) provide the opportunity for the introduction of individual and workplace skills such as interpersonal relationships and communication as well as career exploration. Middle school facilities should provide maximum flexibility to allow for a variety of activities and future changes.

Career and Technical Education at the high school level can range from courses taken for personal development or as a foundation for further work (personal finance and accounting, family and interpersonal relations, auto upkeep and maintenance, and foods and nutrition) to career preparation programs(Pre-engineering, Biotechnology and Marketing). The design of these spaces need to reflect the educational needs of the programs (foods labs, greenhouses and computer labs) and to allow for future changes in technology and equipment.

Regional Career and Technical Center facilities must meet industry standards so that students learn the technical skills necessary in specific career areas or pathways such as Health Sciences, Auto Body Repair, Culinary Arts, Plumbing or Electrical. Design of these facilities must involve industry advisors and program faculty, and meet requirements of the NH Department of Labor and OSHA.

The following sections provide some basic guidance.

Family and Consumer Sciences.

Family and Consumer Sciences (FCS) programs provide instruction centered around Careers, Community and Family Relations; Foods, Nutrition and Wellness; Human Growth and Development; Parenting; Consumer and Resource Management; Housing and Textiles; Hospitality, Tourism and Facilities Management.

Middle School Considerations

Middle school programs offer an introduction to the CTE curriculum especially in the areas of interpersonal skills, career exploration, foods and nutrition, consumer and resource management education and personal and family development.

Suggested grade level: 6, 7, 8
Maximum Enrollment: 20-24 students
Space Allocation:
Minimum: 1500 square feet (75 square feet per student)
Recommended: 2000 square feet (100 square feet per student)

The Multi-purpose room/laboratory, with enough floor space for easy movement and flexible room arrangement, is designed around learning stations that accommodate up to four students each. Each student work station is self contained, with all necessary content resources including computer with Internet access for the following topics:

a. Food preparation and nutrition studies;
b. Career exploration:
c. Consumer education;
d. Personal and family development.

Appropriate equipment, furniture and supplies should be provided for the needs of the specific program, including tables and chairs rather than desks for flexibility. At least one of each type of work station should be ADA compliant.

There should be enough storage space to provide space for a dedicated washer and dryer; lockable storage for large equipment; ample shelving for various types of equipment. Cabinets should not exceed 72 inches in height and drawers should be deep enough to store utensils and other supplies. Additional partitioned storage suitable for student belongings and projects is recommended..

A teacher work/conference space, with an unobstructed view of the entire classroom, should be provided that can be used for student/teacher conferences, instructional preparation, and parent/teacher conferences.

High School Considerations

The high school programs offer courses that specialize in family and work focus courses including, but not limited to, Adult Roles and Responsibilities, Foods, Nutrition and Wellness, Introduction to Hospitality and Tourism, Food Science, Human Growth and Development, Parenting, Consumer and Resource Management, Interior Design and Textile Science.

Suggested grade level: 9, 10, 11, 12
Maximum Enrollment: 20-24 students

Space Allocation:
Minimum: 1500 square feet (75 square feet per student)
Recommended: 2000 square feet (100 square feet per student)
Multipurpose room/laboratory: 1600 square feet
Built-in Storage 200 square feet

Teacher Office/Conference Space: 200 square feet

Optional: 2075 square feet: All of the above plus the addition of observation space and restroom if the program offers child development (birth-age10)

The design of the total FCS department should emphasize the many content areas of Family and Consumer Sciences and be technologically driven. A minimum of 10-12 computers are recommended for the classroom space. A well thought out multi-purpose facility provides space that is adaptable for personal and family focus courses and a number of individual and group activities going on at the same time. This space can also lend itself to use in career focused courses such as:

- Child Development (Early Childhood Education)-space maybe needed for short-term observations

- Foods and Nutrition (Culinary Arts and Dietetics)-sufficient space to store supplies used in teaching nutrition and wellness, advanced nutrition and food science. The room should have one to two (1-2) well thought out kitchens that provides for teaching nutritious food preparation and nutritional science experiments and illustrates good kitchen design. One must meet ADA requirements.

- Housing and Textiles (Interior Design, Textile Science and Fashion Design)- Limit the number of domestic sewing machines; consider machines that reflect equipment used in the industry such as sergers, embroiderers and hemmers, approaching the classes from a consumerism and entrepreneurship perspective. Supplemental software in fashion design, art principles and home furnishings would be appropriate.

Storage Space should include room for a dedicated washer and dryer; lockable storage with shelves for various types of equipment and partitioned storage for student belonging and projects

Teacher work/conference space must have an unobstructed view of the entire classroom. This space may be used for conference and instructional preparation.

Technology Education

Technology Education programs provide instruction and activities which develop technological literacy for learners at the middle and high School levels. At all grade levels, the program/ course content for Technology Education should be based on:

1. An organized set of concepts, processes, and systems that is unique to the study of technology.
2. Fundamental knowledge about the historical development of technology and its effects on people, the environment, and the culture.
3. Contemporary instructional content, drawn from one or more of the following technological systems:
   - Manufacturing Technologies
   - Construction Technologies
   - Transportation Technologies
   - Information and Communication Technologies
   - Agricultural and related Biotechnologies
   - Energy and Power Technologies
   - Medical Technologies
4. Development of insight, understanding, and application of technological concepts, processes, and systems to solve future problems and needs.
5. Safe and efficient application of tools, materials, machines, processes, and technical concepts.
6. Development of students' skills, creative abilities, positive self-concepts, and individual potential in technology.
7. Development of students' problem-solving and decision-making abilities involving human and material resources, processes, and technological systems.
8. Activity-oriented laboratory instruction with students, reinforcing abstract concepts with concrete experiences.

9. Preparation of students for lifelong learning in a technological society.

Middle School Considerations

Technology Education at the middle school level offers a wide variety of activities that are introductory in nature. Most are activity based and require active, interactive and reactive spaces. In addition, most laboratories contain provisions for the limited use of hand and power tools. Storage for materials and projects is needed in addition to the working spaces. Provisions for dust and fumes created as a part of activities are also needed.

Suggested Grade Level: 6,7,8
Maximum enrollment: 20-24 students
Space Allocation:
Minimum: 1500 square feet (75 square feet per student)
Recommended: 2000 square feet (100 square feet per student)

The middle school laboratory is designed to provide spaces for activity in any of the content areas, and should provide as much flexibility as possible to accommodate a variety of units and activities during the school year. In some student scheduling arrangements specific units may be offered in rotation such as every nine weeks, while in others, semester and year long courses are found. The additional considerations listed below should be applied for all types of activities which require them. Special considerations must be made to ensure the safety and well being of the students and instructor during the activities.

High School Considerations

Technology Education activities at the high school tend to be more specialized than those found at the middle school level. The high school laboratories are also more specialized and usually dedicated toward clusters of occupationally related areas. They may contain very specialized tools and machinery as well as provisions for specialized processes. These facilities reflect the increased specialization of the activities and specific areas within laboratories and are frequently dedicated to specific processes (welding booth, spray paint booth, darkroom, etc.) Often the dedicated spaces are required to ensure the safety of those in the laboratory as well as the student doing the operations. Again, special provisions must be included for the generation of wastes, fumes, and handling of materials.

Suggested grade level: 9,10,11,12
Maximum Enrollment: 20-24 students
Space Allocation
Minimum: 1500 square feet (75 square feet per student)
Recommended: 2400 square feet (120 square feet per student)

The above recommendations are minimal. If the activities to be performed require larger spaces for machinery, or other objects (automobiles, buildings under construction, manufacturing cells, etc.), additional space may be required. Any space requirements contained in manufacturers' instructions or safety regulations must be met.

Within the laboratory there should also be provision for the required storage of materials and tools for the activities to be conducted in that space.

In addition to the laboratory spaces, there must be provision for the interactive and reactive learning for technology education courses. In some cases this may require a dedicated classroom, while others may incorporate these learning spaces in the laboratory. If more than one type of space is contained in the laboratory, provision must be made for clear observation throughout the facility.

The following are additional considerations for technology education spaces at either the middle or high school levels. The provisions depend on the types of activities conducted as a part of the planned course of study. Some provisions are critical to the safety of the students and instructor.

a. Laboratory open (active learning) areas should be rectangular.

b. Ceilings must be 12 feet high (14 feet is preferable).

c. Office space for instructors should provide for visual supervision of all activity areas being used.

d. Lockers for storage of lab clothing and personal protective equipment (double tier type lockers are recommended) should be conveniently located.

e. The electrical supply system for the laboratory must be carefully designed to provide sufficient power. Uniform coverage for moveable equipment must be supplied with electrical outlets in most of the lab area. One duplex outlet for every 10 feet of wall space (or current code requirements) should be satisfactory. Equipment must have magnetic starter switches.

f. All power and light controls should be centralized in a locked master control panel near the instructor's office or desk. A master switch must be installed to turn off all equipment simultaneously. Master switches should be placed on each wall in an unobstructed area.

g. Equipment and work stations must be arranged to prevent interference. All equipment must be installed according to the manufacturer's instructions and according to local safety codes.

h. There must be a safety zone of at least 3 feet between operating parts of adjacent machines.

i. Unless a separate classroom is set aside for the laboratory class, each laboratory should contain an area for open class discussion. The space needs include provision for tablet arm chairs (or other writing surfaces), an eight by four foot section of marker board, and a means of room darkening for projection purposes.

j. The operational level of equipment should be set at an ergonomically acceptable height for the student and the type of equipment.

k. A hand washing sink must be available and should be large enough to accommodate four or more students. The sink is to be equipped with hot and cold water.

l. Welding areas must offer special facilities for ventilation and in addition provide eye protection for all exposed to welding flash.

m. A system for proper disposal of hazardous waste must be provided where these products are used or are present. Systems which burn used motor oil are encouraged.

n. An emergency shower and eyewash, appropriate fire extinguishers (Type and capacity) and fire blanket are required where recommended by the local fire officials. An emergency shower and eyewash is required when exposure to chemicals chips or other hazards is present.

o. A dust collection system is required in all wood working facilities, or where exposure to airborne dust is present.

p. Automotive laboratories require a vehicle exhaust system. An exhaust system is recommended for all engine exhaust.

q. Recycling containers should be provided.

r. Flooring in most laboratories is sealed concrete. If other surface finish materials are provided; they must not present slipping hazards.

s. Spray booths are required for automotive spray painting. Booths are recommended for other finishing activities.

t. Storage rooms with safe shelving and cabinets are required for tools and other equipment unique to each laboratory.

u. Properly constructed and marked storage areas are required for hazardous materials. Separation between reactive materials must be provided as necessary. See NFPA 70 for guidance.

Business Education

High School Considerations

Business Education is vital for success in virtual every career. Modern educational programs include office administrative skills, the operation of fully functioning banks or credit unions, and fully functional school stores. The high school programs offer courses that assist students in gaining the skills needed to be effective citizens, consumers, workers, and business leaders. These courses include, but are not limited to, Accounting, Business Law, Career Development, Communication, Economics, Personal Finance, Entrepreneurship, Information Technology, International Business, Management, E-Business, and Marketing.

Suggested grade level: 9, 10, 11, 12
Maximum Enrollment: 20-24 students
Space Allocation

Classroom	900 square feet
Laboratories	1,600 square feet
Multimedia/Equipment Storage:	200-240 square feet

Guidelines:

- Cooling may be necessary in rooms that contain large numbers of computers or other heat generating equipment.
- The electrical receptacles should be put on circuits to enable instructors to turn off all equipment simultaneously The Master Switch should be placed on a wall in an unobstructed area.
- Indirect lighting is necessary to prevent glare problems where computers are to be used. Task lighting may b necessary if other work is to be performed at the computer work stations.
- The design of the room should allow the teacher to easily view all computer screens.
- The floor can be tiled or carpeted. If carpeted, the carpet should be static resident.
- The recommended maximum number of computers per lab is 24. The workstations include computer desks, an ergonomically-designed chairs.
- Sufficient electrical power and an adequate number of receptacles must be provided for the equipment. Th arrangement of the power sources and data outlets will establish the layout for work stations. Work stations ma be arranged along the exterior walls, clustered in groups, or in rows. If one of the latter two arrangements is used a raised floor or embedded conduits are preferable to power poles. Any ceiling wiring must meet the current lif safety code standards.
- All computers should have Internet access.
- Computers should include: high speed modems, CD drives, large hard drives (if not networked) , sufficient RAM t handle the latest software used in the industry, Write/Re-write CD drives when possible and the fastest affordabl processor with industry standard graphics and sound cards.
- The computer lab(s) should be equipped with at least one color printer, a scanner, a laser printer, a digital camer or camcorder, and the necessary software to meet the state standards (competencies) and industry standards.
- A television with a VCR, an overhead projector, a computer projector, and a large screen should be provided fo instructional purposes.
- Surge protection must be provided.
- All tables and computer workstations should have a cord management feature for safety reasons.

- Multimedia/Equipment storage space contains the equipment, supplies, and materials and should be visible from the classroom by using glass as a partition. Shelves and / or cabinets should be planned either by using long work tables or constructing storage cabinets with work space provided on top.

Many business courses can be taught in general purpose classrooms. Highly specialized business programs will require spaces that are customized to the particular activities. Programs which provide actual services to customers should be centrally located in areas frequented by students or members of the public. Programs with a large public clientele may need their own entrances from the outside and it may be necessary to separate the area from other parts of the school with security doors.

Health Occupations

Classes in nursing and other health care professions will need general purpose classroom space as well as a space designed much like a health clinic with exam rooms, treatment rooms, medical laboratory etc. The specific requirements will be dictated by the curriculum. Designers should visit local health care facilities to observe their layouts and the types of equipment used.

Agriculture and Horticulture

If a program in agriculture or horticulture is offered, a greenhouse will be necessary. This may be attached to the main school building or a separate structure. It must be large enough to handle the number of students and the variety of programs to be offered. Additional outdoor space may be required for student activities. A general purpose classroom should also be available. Storage space will be necessary for tools and equipment.

Computer Programming, Networking, Data Processing and Other Computer Skills

Classes in the various aspects of computer technology may need a repair shop and a computer laboratory as described previously. The rooms should have good lighting and plenty of electrical power. Electrical outlets should be widely distributed around the room and in the floor. Power strips along the walls at table top level are recommended. Raised flooring should be considered. Storage for equipment and tools is necessary with particular concern for security as computer equipment tends to be easily stolen.

Cinematography and Photography

Some basic photography classes may be taught by the art department as described previously. The regional career and technical centers focus on career skills in these areas. Necessary facilities include studios, editing suites, and darkrooms.

RECOMMENDED SPACE ALLOWANCES FOR NEW HAMPSHIRE SCHOOLS

* Indicates minimum requirements as specified in NH Code of Administrative Rules Ed 321. Others are recommended minimums.

The minimum sizes below are the recommended minimum amount of space for the smallest programs. In most cases the SF/Pupil number multiplied by the largest expected number of pupils in one class period should govern the total size. Spaces such as gymnasiums, music rooms etc. may also be used for co-curricular activities which may require a larger size space than necessary for academic instruction.

Subject	**SF/Pupil**	**Minimum Total SF**
General Purpose Classroom		
Elementary & Middle School	36*	900*
High School	32*	800*
Separate Science Laboratory	45*	900*
Combination Science Lab/classroom	60*	1200*
Library/Media Center (40 sf/pupil for 10% of design capacity)		1800*
Art		
Elementary	36	900
Middle/High	60	1200
Music		
Instrumental	25	1000
Choral	15	800
Physical Education		
Elementary	110	700
Middle	125	3800
High	150	5000
Technology Education Laboratories	75	1500
Family and Consumer Sciences	75	1500
Computer Laboratory	30	750

CHAPTER 10 – SUPPORT SPACES

"The playground is now regarded as the uncovered school room"
From, School Architecture or Contributions to the Improvement of School-Houses in the United States, Henry Barnard, Commissioner of Public Schools in Rhode Island, 1849

Support spaces in schools serve to accommodate the non-classroom needs of students and staff. Support spaces must be carefully planned, taking into consideration such factors as increased enrollments, future changes in the educational program and different methods of instruction. Classrooms can be added to a building without too much difficulty, but support spaces are often difficult to expand at reasonable expense after initial construction. Overcrowded support facilities are usually inefficient and may negate much of the effectiveness of instructional areas.

School planners should be aware of the possibility of multipurpose use of support spaces. An initial step in this direction is an analysis of the basic function of each support space required to fulfill the educational specifications. In general, spaces such as private offices, custodial quarters, kitchens, and rooms for mechanical plant equipment and operation do not lend themselves readily to multipurpose use, unless they can be used for classes relating to their specific functions, as, for instance, use of the kitchen for a service program. Such spaces as the cafeteria, the gymnasium, and the auditorium may be combined in several ways. For example, the cafeteria can serve as a lunchroom and auditorium; the gymnasium can serve as gymnasium and auditorium; the same area can serve all three of the above functions; and the auditorium can be combined with a theater. Dual use of these areas requires careful planning and usually places some restrictions on their adequacy for specific purpose.

Once the basic function of each support space has been determined, planners should consult the architect in order to integrate these spaces into the total project. Some of the anticipated questions are whether certain spaces, if enlarged, would do the work of two, but in less area; whether greater flexibility for changes could be achieved by a combination of two or more areas; whether savings could be realized in the costs of construction and operation; whether the disadvantages of converting from one use to another in the same space would offset the possible savings.

The following sections of this chapter are suggestions and recommendations that should be helpful in planning support spaces for administration, guidance, the faculty area, auditoriums, school lunch and health services.

ADMINISTRATIVE

School planners too often restrict the space for the central administrative office. This facility should be centrally located where it will be easily accessible to the public. While the office need not be elaborate, its general appearance should impress the visitor that it is the school headquarters. Ideally, the main office should be divided into at least two areas, one of which should be soundproof inner office for the principal. The principal's office should be large enough for conferences with teachers, students, or other groups. The outer office should provide adequate space for the clerical personnel and equipment. In a larger school a separate office should be provided for each assistant principal.

The central office should also include the following:

1. Adequate filing and storage facilities.
2. An intercommunication system within the school.
3. Durable, comfortable, attractive furniture.
4. Good lighting for all areas.
5. Controlled heat and ventilation for year-round operation. Air conditioning should be considered.

6. Provisions for safeguarding funds, records, etc.

7. Ample electrical outlets for office equipment.

Administrative space is also required for the food service director, head custodian, and any other staff members with administrative duties. The space needs to be properly designed and furnished for the administrative function. It should not be simply a desk placed in the corner of a storage room or similar type space.

GUIDANCE

To encourage greater student use, this space should be located near the library/media center. The facility should be designed along the following lines:

1. One counselor's office for every 500 pupils for elementary schools and 300 pupils for middle and high schools or portion thereof (of maximum enrollment).

2. Each counselor's office should be at least 100 square feet in size.

3. One waiting room containing a receptionist-secretary area, work tables, shelving for books and bulletins, and filing cabinets.

4. One conference room large enough to seat twelve people comfortably.

5. Storage space for testing materials, etc.

CONFERENCE/MEETING ROOMS

Rooms should be available for small staff meetings or for private meetings with students and parents. There should be at least one conference room with seating for at least ten people in every school. Larger schools should have several meeting rooms conveniently spread around the building.

FACULTY FACILITIES

Teachers require a properly furnished area to prepare lessons, review student work, and to meet with individual students and parents. This may be provided within a classroom, if each teacher has an assigned classroom exclusively for his or her use. In schools where teachers share classrooms, this space needs to be provided elsewhere. This maybe accomplished within space that is shared by several teachers, but each needs secure private storage space for personal items and class materials. A minimum of 64 square feet should be provided for this purpose.

Teachers also need a place to consume, and possibly prepare meals. This can also be a place for teachers to relax and socialize during breaks. A teachers lounge can double as a meeting facility.

SCHOOL HEALTH FACILITIES

Proper and complete facilities are a necessity for effective health services. A qualified school nurse should be consulted when planning the health suite. This space should be located near the guidance office and the administrative office, as close to the main entrance of the school as possible, and easily accessible to students, parents, and school staff. Space requirements vary according to the enrollment, available staffing, and the scope of the total school health program. In general, a minimum of 625 square feet of space is recommended for a school of 750-1000 students; schools with lower enrollment can modify the arrangements of the health suite according to school and community needs.

The health area should provide the following facilities:

1. Reception and waiting area (may be combined with guidance and/or administration.)

2. Office and record storage for the school nurse (clerical staff, telephone, intercom system are recommended in addition to regular office materials.

3. Resource library with materials for health instruction ("health alcove" in school library including audio-visual materials.)

4. Comfortable washrooms for temporary care of students and/or staff.

5. Conference room for consultation and health counseling.

6. Examination room and equipment for hearing and visual screening, and dental health inspection.

7. Space for scientific, health education displays.

8. Storage for first aid supplies, etc.

9. Rest area equipped with cots.

AUDITORIUMS

The auditorium and/or theater may serve several functions. It may be used for community programs and public meetings, school assemblies and large group instructional activities. If it is divisible into smaller units, it can function as a lecture-demonstration area and/or a large-small group instructional facility. The auditorium can provide excellent facilities for the school's performing groups in music, drama, public speaking, etc.

The auditorium can be used for instructional purposes, which makes construction of this facility more feasible. Except when the auditorium is being used for an assembly or similar type meeting, it can function continually as an instructional area.

It is strongly suggested that professional help be obtained in planning the auditorium, particularly if it is to be used extensively by performing groups. The lighting (stage and auditorium), the acoustical treatment, the seating, as well as other features must be planned and designed very carefully to provide an effective facility.

SCHOOL LUNCH FACILITIES

A school lunch program requires two major kinds of space: one for preparation (including receiving, storage, preparation and cleanup areas) and one for dining. Guidelines for the design and construction of kitchens and cafeterias are provided by the National Food Service Management Institute, which is located at the University of Mississippi. Guidance from the institute is available at www.nfsmi.org/Information/competencies_nfsmi_materials.html#facility_design.

Preparation and storage facilities should be located at ground level, adjacent to the dining area, with a separate entrance. In large schools, the dining area should be located in a relatively central location to minimize the travel distance from educational areas. Planners need to consider how foodstuffs will get into the building and how refuse will get out. There should be direct access from the kitchen to the loading dock or other delivery area and to the refuse dumpsters.

Planners must consider several factors in sizing and designing food service facilities. Each child must be provided with a seat and a sufficient amount of time to consume his or her meal. The administration must decide how many lunch periods are to be scheduled and the block of time to be allowed. These factors will enter into the determination of the size of the kitchen and dining area, the throughput required by the serving

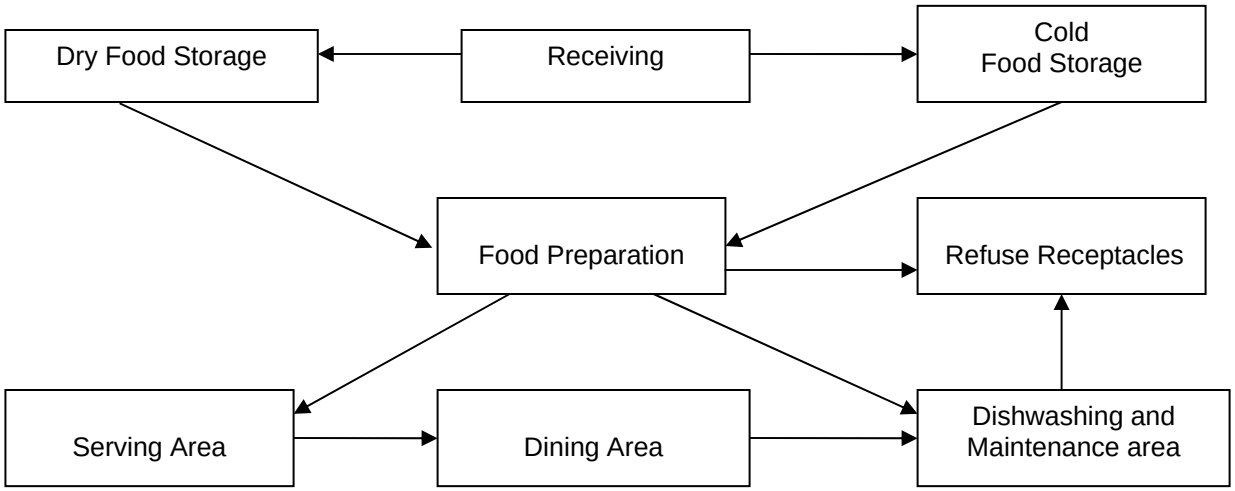
line(s) and the number of serving lines and cashiers necessary. Sizing the food service facilities will be an iterative process which may require adjustments to the schedule or other parameters.

A recommended list of kitchen equipment is located at the end of this chapter.

Recommended finishes and materials for kitchens:

WALLS:	Smooth, impervious to moisture, easy to wash and keep in repair, vermin proof, metal corner guards, and light colors.
CEILING:	Smooth, impervious to moisture, easy to clean, rodent proof, and fire resistant.
FLOORS:	Non-resilient quarry tile or slip resistant resinous epoxy with recessed floor drains. Curbs or gutters should surround areas under steamers, kettles and can washing equipment.
DOORS AND WINDOWS:	Outside doors: Self-closing devices and locks. Inside Doors: Lock and sound absorbing effect. Metal door frames. Walk-in refrigerators and freezers must have locking devices that can be opened from inside. Screens: Plan screens for all doors and windows Windows: They should be high enough not to obstruct equipment placement and located for cross ventilation. Louvers, rather than windows are recommended for storage areas.
LIGHTING:	Food preparation areas must be well lit. Light fixtures should include shatter resistant bulbs
VENTILATION:	Provide for the free circulation of air at the worker's level in all work areas. Dry storage areas should have outside ventilation, with no sunlight. Separate ventilation system from the rest of the school Separate temperature control for the kitchen area is desirable. Special wiring and outlets for heavy equipment and spare circuits for additional equipment.
EQUIPMENT:	The services of a food service consultant are recommended to help ensure that the correct sizes and numbers of appliances are provided. The equipment must be properly installed according to the manufacturer's instructions and any Department of Labor requirements. Strict attention must be given to the working space and safety space around each appliance. A recommended list is at the end of this chapter.

KITCHEN LAYOUT: Plan the facility arrangement for efficiency of operation with emphasis on principles of motion and labor economy. General work areas should be arranged to allow overall flow of work in a straight line. The flow of material being processed should be continuous of direct in progress. The following diagram illustrates the interrelationships of areas within the school lunch facility.



STORAGE FACILITIES

Sufficient storage capacity must be planned for the new building. Each student and each staff member needs a locker or other secure place to store outer garments, books, and other personal items. Storage in classrooms is extremely critical to ensure that the necessary supplies and equipment are easily available when needed. Careful planning is necessary for centralized storage areas for instructional materials. Building committees might consider the high-density type, or space-saver units to achieve maximum use for limited areas. Planners must consider the long-range demands on storage facilities because too often buildings prove to have inadequate storage space after a few years' use.

As outlined in Chapter 9, different subjects require different types of storage facilities. Because of its importance, however, it should be reiterated that science laboratories have a storage room or cabinet of fire-resistant or fireproof construction that can be locked. This will provide safe storage of dangerous chemicals, acids, etc. Other types of classroom activities may also require such specialized storage capability.

The custodial staff must have convenient and adequate storage space. Consideration should be given for satellite storage/work areas on each floor, and if the building is large a maintenance room should be included in the plans. A special room or facility should be planned for the storage of flammable materials, such as waxes, paint, etc. This room should also have suitable extinguishers and detectors.

When planning the location of all storage areas, the committee should keep in mind the service and delivery entrance. Supplies and materials delivered to the building should not have to be carried too far inside and should be moved so they do not interfere with student traffic. Outside the building the service and delivery entrance should be independent of normal student and faculty traffic.
An important consideration in planning today's schools is the method to be used for disposal of waste. Disposal of refuse has become a difficult issue in many communities. Schools should be models for their communities in efforts to reduce waste. This can be accomplished through careful planning. First, quantity control should be practiced to ensure that just the right amount of materials are ordered. Staff members must be discouraged from ordering more than they need and from hoarding supplies. Second, using supplies that have multiple uses or that can be used more than once can reduce costs, storage requirements and waste. Third, recycling should be practiced to the maximum extent possible. In some cases, recycled materials can be a source of revenue. An adequate number of appropriate recycling containers must be available in areas where recyclable materials will be used. Planners must ensure that space is provided for the containers. Remember the three "R's" of waste reduction: Reduce – Reuse- Recycle.

Schools with an athletic program and physical education curriculum will also have to plan for exterior storage of equipment and machines. Many schools find it convenient to have a separate building on the athletic field for storage of instructional equipment as well as mowers and other machines. Convenient location of such storage facilities can often reduce the time and effort of instructors and groundskeepers in organizing and carrying out their assignments.

WASHROOMS AND LOCKER ROOMS

Most people recall from their days in school that washrooms can be places of mischief or worse. That thought must be kept in mind in designing school washrooms and locker rooms. Although it may add to the cost, smaller washrooms, spread around the building are preferable to large centralized facilities. It is recommended that no more than five flushing fixtures be installed in any one washroom. Many schools do not include mirrors in student washrooms, because students tend to linger in front of mirrors. Washrooms without doors are recommended.

Toilet partitions should be installed at least 12 inches above the floor to allow visual supervision and should be 5-1/2 feet in height. Triangular shaped cross members are recommended on the tops of toilet stalls to discourage students from hanging on them by their hands. There are a number of choices in partition materials:

a. Hollow-Core Metal partitions are low cost and come in a wide range of colors. On the other hand they are vulnerable to impact, scratching, graffiti, and rust. Heavy use and vandalism can damage the hardware resulting in misalignment and other problems. They offer Class A fire rating.
b. Laminated Plastic partitions are resistant to impact and scratching. Graffiti is easily removed, but may leave ghosting. The cost is similar to metal partitions, but colors are more limited. A class B fire rating is standard.
c. Solid Plastic partitions are very popular in schools. The limited variety of colors is solid completely through the material. They offer great moisture resistance, but graffiti is difficult to remove. The cost is about 20% more than metal and they have no fire rating.
d. Solid Phenolic partitions are the most durable type available and offer great moisture resistance. They are resistant to impact and scratching. Graffiti is easily removed without ghosting. The main drawback is that the wide range of colors are not solid throughout. The cost is about 25% more than metal. Class A and B fire ratings are available.
e. Solid Color Reinforced Composite (SCRC) partitions provide an ultrahard surface that resists moisture, impact, and scratching. The limited number of colors is solid throughout the material. Cost is equivalent to solid phenolic. They have a class B fire rating.

Stainless steel fixtures offer the best characteristics for durability and ease of cleaning, but they are also more expensive than baked enamel, or powder coated finishes, or plastic materials.

Touchless features in washrooms aid in providing a sanitary environment. Lights should be controlled by vandal resistant occupancy sensors. Similarly, automatic flush valves and sink faucets are preferable. The choice of hand dryers or paper towels dispensers is not so easy. Dryers are sanitary and reduce custodial requirements, but they increase the use of electricity.

Floor, ceiling, and wall finishes should be moisture resistant. Ceramic tile and epoxy paints are good choices. Lay in ceiling tiles should not be used as they can be removed by students for storage of contraband or other misdeeds.

In new school buildings, every washroom must be ADA compliant. In existing buildings there must be at least one ADA compliant washroom in the building. Preferably, there is at least one on each floor.

The mechanical code requires an air exchange rate of 75 cfm per toilet or urinal in washrooms and 0.50 cfm/sf in locker rooms.

Washrooms should be located on main travel routes within the building and in places where supervision is easily provided.

Locker rooms should include a sufficiently sized changing area for the largest anticipated physical education class. Each student should be provided with a secure storage area for personal belongings. Locker rooms should be located adjacent to an outside exit and close to the outdoor physical fitness and athletic facilities. This will help prevent mud from being tracked throughout the building.

The inclusion of showers is something that requires thought and discussion. In today's environment, many children are reluctant to use showers at school. Many schools are being built today with few, if any, showers in the locker rooms. School boards and building committees should ask themselves if this is in the best interest of the students. The practice of good hygiene would seem to require that a student take a shower after strenuous activity such as physical education class or an athletic event. Locker room showers can be designed and built in a way that protects privacy and encourages good hygiene. Proper maintenance of these areas will also help encourage their use.

The administrative offices for physical education teachers and athletic coaches must be placed in a way that allows supervision of the changing areas and showers.

PLAYGROUNDS

Elementary schools require sufficient play areas to support daily play time and possibly physical education and other activities. Guidance on the construction of playgrounds can be found in the U.S. Consumer Product Safety Commission Publication Number 325, *Handbook for Public Playground Safety.* Playgrounds are required to be ADA compliant as explained in 36 CFR Part 1191.

OUTDOOR ATHLETIC FACILITIES

Middle and high schools require athletic facilities to meet the curricular and co-curricular activities outlined in the Educational Specifications. The New Hampshire Interscholastic Athletic Association (NHIAA) can provide the latest guidance for the construction of athletic facilities. Schools should check with the NHIAA prior to construction of facilities to be used for official competitions to ensure that they meet the minimum requirements. Larger schools will require practice facilities as well. Seating for spectators, parking, lighting, irrigation, equipment storage, restrooms, and fencing are other considerations. Site restrictions may necessitate the need to use one facility for several different sports. Surfacing of fields, tracks, and tennis courts and subsequent maintenance requirements must be considered. The life safety code requires annual inspections of bleachers by the facility staff and biennial inspection by a licensed engineer or manufacturer's representative. These inspections should be documented.

The initial construction of athletic fields is eligible for School Building Aid. Resurfacing, sealing, and other maintenance activities are not eligible for School Building Aid.

PARKING FACILITIES

All schools require adequate parking for the personal vehicles of staff members and visitors. High schools also need space for those students who are authorized to drive a vehicle to school. Administrative Rules Ed 321.12(j) requires that sufficient parking be provided for at least 100 percent of the staff and 75 percent of the students eligible to drive a vehicle. The eligible number of students is assumed to be all of the students in grades 11 and 12. Parking lots must also meet the requirements of the ADA for the number, location, size, and marking of accessible spaces. Parking lots and walkways must be properly lighted to provide for the safety of those using them. Visitor parking should be located close to the main entrance which should be obvious from the parking space or appropriate signage must be installed to guide the visitor to the correct entrance.

Great care must be taken in the layout of parking lots and access routes. If possible, school bus access, parent drop-off routes, and delivery routes should be kept separate from each other and separate from access to the parking lots. Many schools prefer to separate staff and student parking as well. Traffic control structures such as islands and barricades can assist in keeping things separate. Signage is critical. Angle parking is helpful for maintaining traffic flow and can help reduce minor accidents, but it takes approximately seven percent more space than perpendicular parking for the same number of vehicles. Spaces should definitely be clearly marked.

Parking lots are normally surfaced with asphalt, although gravel may be appropriate in some situations. All lots must be designed to drain properly. Snow and ice removal are important considerations.

RECOMMENDED EQUIPMENT FOR SCHOOL KITCHENS

Dry and Cold Storage Areas
Metal shelving
Dunnage racks
Can storage rack(optional)
Utility carts

Vegetable/Cold Food Preparation Area
Work tables
Two compartment sink with drainboards
Disposal
Mixer (shared with production)
Food processor
Slicer (shared with production)
Reach-in refrigerator
Utility cart
Utility racks
Storage rack for pans
Hand sink

Production Area
Work tables
Baking table with mobile ingredient bins
Two compartment sink with drainboards
Convection oven
Tilting braising pan
Steam jacketed kettle
Steamer
Range
Mixer (shared with vegetable/cold foods)
Slicer (shared with vegetable/cold foods)
Utility carts
Reach-in freezer
Reach-in refrigerator
Deep fat fryer with filter system (optional)
Proofing cabinet
Storage racks for pans
Utility racks
Scales

Pot and Pan Washing Area
Three compartment sink with drainboards
Disposal
Sink heater (optional)
Storage racks for pans

Warewashing Area
Dish washer
Disposal
Booster heater
Hand sink
Soiled dish table
Clean dish table
Pre-rinse with spray
Racking shelf
Tray dispensers
Dish dispensers
Utility cart

Serving Area
Pass-through heated cabinets
Pass-through refrigerators
Heated serving counters
Refrigerated serving counters
Milk cooler(s)
Ice cream freezer
Cashier counters
Point of sale computer/cash register
Ice machine
Chilled water dispenser
Tray dispensers
Dish dispensers
Utility cart
Hand sink

CHAPTER 11 – FURNITURE AND EQUIPMENT

"And how can you expect a teacher to instruct your children properly unless that teacher has proper help from blackboards, maps, globes, blocks, numeral frames &c.?"
From the Annual Report of the Superintendent of Public Instruction to the NH Legislature, June 1876

Selection of furniture and equipment for classrooms, laboratories, media centers, gymnasiums, offices, and other spaces should be part of the initial planning phase. Flexibility and adaptability are major factors to be considered. Movable equipment is recommended wherever practical in order to make instructional aids available to as many students as possible. A comfortable environment is essential to the learning process. Furniture and equipment should be adjustable in size and height to the age group or to individuals for whom they are intended.

Units should be selected not only to serve immediate needs, but with a view to fulfilling future requirements. Many items today provide movability and multipurpose usability. School planners should ascertain that all furniture and equipment serves the educational specifications that have been adopted.

For convenience, the equipment schedule should be in two major groupings: equipment (fixed items) and furniture (movable item). Items within the two groups can then be divided into specific categories (shop, library, etc.) Both unit prices and a total bid price for a particular grouping should be requested when purchasing equipment.

It is suggested that fixed equipment within the building be kept at a minimum. This will make future changes in the building easier and will make the facility more flexible if educational requirements are modified later.

Reuse of existing furnishings may be an option. The concerns of reusing furnishings are obvious. The excitement of a brand new school is quickly dampened by old worn out furniture brought from the old school. It may be possible to refinish older items that still have remaining useful life and give them a new appearance to match the new or newly renovated building.

EQUIPMENT CONSULTANT

If the building project is extensive and will require considerable outlay for equipment, consideration might be given to engaging a consultant with expertise in the area. Such a professional can offer a service that will assure the purchase of the proper equipment for the project. He can also aid in the writing of specifications for bidding and can follow progress of the project to assure arrival and installation of equipment at the proper times.

Many of the larger architectural firms have equipment consultants who provide this service, and committees can decide the circumstances under which to employ such an individual.

The architect must work closely with the equipment consultant for good coordination in the purchase and installation of equipment. For this reason, the consultant should be acceptable to the architect even though he or she might be under a separate contract with the district.

COLOR

Many studies have been done concerning the way that colors influence human behavior. The effects can be surprising and may vary between specific age groups. In general, colors have the following affects:

Blue - Is cooling and tranquilizing
Green - Is cooling and acts as a sedative
Yellow - Is cheerful, luminous, and stimulating
Red - Is exciting and stimulates the brain, but may have an aggressive quality

The architect may employ an interior designer to develop the color patterns to be used throughout the school. Furnishings and equipment should be part of the interior design plan, even if purchased separately.

SELECTION

All furniture is not created equal. Use of the following chart is recommended to assist in evaluation and selection of furniture that best meets the needs of the school:

Feature	High Priority	Medium Priority	Low Priority
Aesthetics			
Ergonomics			
Comfort			
Function			
Flexibility			
Adaptability			
Adjustability			
Quality			
Durability			
Storability			
Maintainability			
Safety			
Cost			

Districts may choose to solicit bids for furniture directly, rather than through the general contractor or construction manager. This method helps assure that the educational specifications will be followed. It also provides for professional coordination of the mechanical, electrical, and construction design, as well as aesthetic considerations of color, finish, and design that will complement the structure. It is easier if all furnishings come from one vendor, but the district may prefer certain items from one supplier and other items from a different source.

If bids for furnishings are solicited separately, the following procedure is recommended:

Advertise: Inform as many suppliers and manufacturers as possible.

Bidding Documents: Prepare concise drawings and specifications. Allow a minimum of two weeks for quotations.

Bid Openings: Establish time and place to open and read bids.

Bid Evaluations: See that proposals comply with specifications. Check bid security and delivery dates. Check any alternative proposals.

Furnishings Review: If there are enough reasons to warrant, ask all qualified bidders to present samples, catalogs, and to meet to answer questions.

Contract Award: The contract should be awarded to the lowest bidder who meets or exceeds the specifications. A company that bids as specified should be given prime consideration. Other bidders who propose alternative furnishings should be given careful item-by-item consideration.

INSTALLATION

The installation of furniture and equipment requires thorough attention and supervision by all concerned. It is recommended that a check list be used and that the architect be consulted in the final evaluation of installation.

If installation is to be performed under a separate contract from the prime contractor, the work must be carefully coordinated. The district's clerk of the works should oversee work of the separate contractor. Great care must be taken to prevent damage or liability claims from one contractor that result from the work of another contractor. It is best that separate contracts not be performed until the district has taken ownership of the areas where the separate contractor will be working.

CHAPTER 12 – HEALTH AND SAFETY

"This necessary confinement within the school-room walls, coming as it does during the growing period of the body, and while it is most susceptible to harmful influences, entails certain evils which have been too generally regarded as necessary accompaniments of school life. It is generally well known, however, to those who have studied these questions carefully, that most of the diseases incident to school life are in quite a high degree preventable, and that one of the first and most important requirements in guarding against these diseases is to have the building of school-houses conform to a few rules which are generally regarded as essential elements of in school-house construction."

From the First Annual Report of the Board of Health of the State of Maine, 1886

DESIGNING FOR A HEALTHY SCHOOL ENVIRONMENT

The following advice is provided by the U.S. Environmental Protection Agency.

Project Planning and Documentation

Programming

Establish Indoor Air Quality (IAQ) design goals. For example, demonstrate that:

- Ventilation of outdoor air is consistent with the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62-1999 under all operating conditions.
- Comfort levels are acceptable to most occupants, and consistent with ASHRAE Standard 55, under all operating conditions.
- Significant expected sources of pollutant emissions are isolated from occupants using physical barriers, exhausts, and pressure controls.
- Outdoor air entering the building is protected from contamination from local outdoor sources and from building exhausts and sanitation vents.
- Full documentation of building and HVAC design with design intent for operation and maintenance.
- Provisions for easy access to HVAC equipment requiring periodic maintenance.
- Occupant exposure to construction contaminants is minimized using protocols for material selection, preventive installation procedures, and special ventilation and pressure control isolation techniques.
- Building is thoroughly commissioned to insure that all IAQ design goals and related IAQ specifications are met.

Budgeting

Adequate budget to meet the IAQ design goals and specifications should be planned considering:

- Specialized services during each phase as may be needed: design, construction, initial occupancy.
- Time required for thorough commissioning and testing.
- Proper selection of the design team to include IAQ expertise.

Documentation Planning

As documentation accumulates, it should be organized and assembled in durable, moisture-resistant binders. Supplemented by operating and maintenance recommendations, project documentation creates a complete owner's manual for the building, and is good insurance against liability claims. Include:

- Documentation of project planning phase.
- Documentation of site and building design.
- Documentation of HVAC design.
- Documentation of construction and commissioning.
- Documentation of protection during initial occupancy.

Codes and Standards

Identify IAQ codes and standards to be met. For example:

- *ASHRAE Standard 62-1999, Ventilation for Acceptable Indoor Air Quality;*
- *ASHRAE Standard 55-1992, Thermal Environmental Conditions for Human Occupancy*
- *ASHRAE Guideline 1-1996, The HVAC Commissioning Process, can assist in establishing commissioning requirements.*
- *SMACNA Guidelines, 1995; IAQ Guidelines for Occupied Buildings Under Construction*

IAQ-Related Documentation during Project Planning

IAQ-related documentation during project planning would include:

- Building size and location.
- Types of occupants, noting special susceptibilities (e.g. young, elderly, people with asthma or other illnesses).
- Anticipated occupant densities (and potential for increased occupant densities), activities, and use patterns for each space.
- Major pollutant source activities.
- Uses requiring special environmental controls (e.g. computer rooms, libraries).

Site Planning and Design

Site Evaluation

Evaluate and document site conditions that can impact IAQ.

- General climate and site's microclimate, seasonal norms and extremes of temperature, relative humidity, wind speeds and directions.
- Local ambient air quality.
- Adjacent or nearby contaminant sources relative to building site and wind patterns.

- Potential future nearby sources (e.g. vacant nearby site zoned for industrial use).
- Outdoor noise sources.
- Soil and groundwater quality.
- Existing or potential underground contaminant sources (radon, underground fuel tanks, soil gas from landfill).
- Prior site history for potential soil or groundwater contamination (agricultural fertilizers and pesticides, landfill soil gases, toxic wastes from manufacturing plant).

Site Design

Plan the building location, orientation, and major site activities on the site to minimize contamination of the indoor environment. Relevant features should be documented, and noted on design drawings.

- Use setbacks as a means of separation from nearby pollutant sources. Since pollutants disperse quickly, a small increase in setback can mean a substantial decrease in pollutant concentration.
- Use landscaping as a buffer to offsite or onsite contaminants. Be careful not to place plants or soil close to air intakes where pollen, fertilizers or pesticides can contaminate the air, or where overgrowth can block air entry. Consider full potential after plants have matured.
- Plan the shape and orientation of the building to allow prevailing winds to move contaminants away from the building. Avoid designs that would trap pollutants in stagnant air pockets.
- Provide for good water drainage and grading around the building foundation.
- Locate and design outdoor air intakes away from and upwind of pollutant sources.

Locate onsite pollutant sources away from and downwind of air intakes. Roadways, parking, loading areas, trash and chemical storage areas are typical sources.

Building and HVAC Design

Building Envelope

The building envelope will affect thermal comfort, HVAC capacity requirements, lighting quality (daylight) and view, potential infiltration of outdoor (or underground) contaminants, and moisture.

- Conduct thermal, moisture, and air migration analysis of envelope for maximum control.
- Use windows to provide daylight and views.
- Minimize radiant heat gains and losses through glass or uninsulated surfaces that will cause discomfort or unduly complicate HVAC design.
- Prefer thermally efficient building shells to increase thermal comfort and reduce HVAC loads and capacity requirements (reduce first costs).
- Avoid glare from windows or skylights.
- Use, and insure proper installation of, insulation to avoid cold spots with associated problems of condensation (mold) and thermal drafts.

Space Planning

Plan space uses to maximize the potential for isolating occupants from sources of contaminant through physical distance, physical barriers, exhaust systems, and pressure control.

- Identify all major sources of pollutants that may exist during occupancy.
- Plan spaces to isolate occupants from source contaminants.
- Provide for adequate exhaust; consider supplying loop of exhaust ductwork to facilitate later hookups.
- Develop pressure map to insure that contaminants from sources do not contaminate surrounding areas.
- Locate spaces with special environmental control needs where these needs can be efficiently accommodated.

HVAC Design

General Design Provisions

The HVAC system is critical to the building's ability to provide thermal comfort and ventilation of building contaminants. Outdoor air ventilation rate and indoor climate conditions should meet the design requirements (e.g., ASHRAE 62-1999 and ASHRAE 55-1992) under all operating conditions, including peak and minimum load.

Plan HVAC zones (with single thermostat) so that the thermal demands of all spaces within each zone are similar during all seasons. When different spaces having different thermal requirements are in the same zone, occupant discomfort is inevitable and solutions to complaints will be difficult (or impossible). Avoid placing thermostats in direct sunlight, near equipment or other heat sources, or on exterior walls.

Plan heating and cooling capacity to satisfy the peak (design) conditions that occur under extreme or worst-case conditions. Capacity requirements should be calculated considering both the sensible (heat) and latent (humidity) loads. Peak latent load may occur at subpeak sensible load. Capacity requirements should be calculated based on the outdoor airflow and thermal comfort requirements adopted in the design goals (e.g. ASHRAE 62-1999 and ASHRAE 55-1992).

Consider separate dehumidification prior to cooling, or energy recovery systems to improve performance and energy efficiency and reduce capacity requirements and therefore first costs. If humidification is needed, steam is preferred as a moisture source. The source of steam should be from potable water to avoid contamination from additives to boiler or steam water supplies.

Energy efficient building design, lighting, and HVAC design can reduce capacity requirements and lower first costs.

HVAC Commissioning (Pre-Design and Design Phase)

See ASHRAE Guideline 1-1996, *The HVAC Commissioning Process* for detailed recommendations.

- Commissioning is a process to insure comprehensive planning, thorough documentation, and systematic implementation of plans.
- Commissioning begins in the pre-design phase, lasts throughout the construction process and into initial occupancy of the building.
- Systems may need to be re-commissioned periodically over the life of the building, particularly when changes in occupancy or equipment occur.

- Commissioning itself is an expense, but since it eliminates many problems, which add to construction costs, it need not add cost to the total construction budget.
- Commissioning can significantly increase energy efficiency and improve the indoor air quality of the final building.

HVAC Commissioning Planning

- Establish HVAC design criteria.
- Document HVAC design criteria and systems description.
- Prepare commissioning plan.
- Establish verification procedures.
- Document requirements for commissioning process:

Reports and submittals

- Drawings and schematics
- Checklists
- Operating and maintenance data
- As-built documentation

Exhaust of Indoor Sources and Pressure Control of Sources

Where major indoor sources are expected, exhaust ventilation and proper pressure control should be planned. Systems with direct exhaust from sources that also generate heat (e.g. copy machines) may also reduce HVAC energy requirements.

- Provide adequate exhaust for all localized sources of contamination.
- Plan for proper airflow and pressure control around sources.
- Seal return air plenum from exhaust air.
- Plan adequate source of make-up air (may be transferred from surrounding spaces).
- Insure room is under negative pressure relative to surrounding spaces and return air plenum.

General Air Circulation and Pressure Differentials

The patterns of air circulation and flow, between outdoors and indoors, from basements and crawl spaces, between floors, and between spaces on each floor may be more important to IAQ than the HVAC system or system components. Air circulation patterns showing areas of positive and negative pressure should be drawn for the building as a whole, and for all occupied spaces and major source areas.

The flow of outdoor air into the building must be planned to slightly exceed the total airflow out of the building from all exhausts, combustion flues, and stack effect exfiltration to insure that the building is positively pressurized, to avoid infiltration of outdoor pollutants. (In cold climates the risk of condensation in the building envelope increases if the building is pressurized so that moisture control may be the dominant concern in planning pressure relationships.)

Consider air flow and pressure relationships under worst case scenarios (e.g. kitchen exhaust fans running full in cafeteria. Consider the effect on a neighboring print room, or a boiler room where backdrafting of the flue is a possibility.

Avoid underground ducts or a duct through crawl spaces where possible.

Prefer ducted returns. Non-ducted returns complicate system balancing resulting in the potential for areas of stagnant air, undesirable pressure relationships, and contamination of the return airflow.

Develop a program statement that defines the range of possible occupant densities, activities and layouts to allow the designer to plan flexibility or sufficient capacities for future changes. Specify alterations to the system that can be accommodated under the HVAC design used, and what changes to the system would be required.

Carefully analyze location of supply and return air grills for all occupied spaces, as well as the throw capacity of diffusers, and airflow pathways. Map the anticipated airflow patterns to insure proper air mixing (or plug flow airflow if that is planned). Avoid short-circuiting of supply air to return air. Also avoid dead spaces (e.g. provide for a 2-3 inch air space between the floor and workstation partitions to facilitate air circulation).

Filtration

Particle pollutants cause mucus membrane irritation and other effects, and can foul ventilation system components and reduce efficiencies. Fine particles comprise only a small portion of the total particle mass, but constitute the overwhelming majority of the number of particles. Filtering larger particles is most important for protecting equipment, while filtration of finer particles is most important for human health and comfort.

Filtration efficiency for a given filter will vary with particle size. Thus, a filter rated as 40% efficient by the ASHRAE dust spot method will have about that efficiency for large (above 2.5 microns) and very small (0.01 microns and less) but have close to zero efficiency at 0.1 to 0.5 microns. Another common method of rating filters is the Minimum Efficiency Rating Value (MERV).

- Specify specific filter rating in the moderate or higher efficiency range, and design system for anticipated pressure drop.

- Low efficiency filters (e.g. ASHRAE Dust Spot rating of 10%-20%) (MERV 12 or lower), if loaded to excess, will become deformed and even “blow out”, leading to clogged coils, dirty ducts, reduced indoor air quality and greater energy use.

- Moderate efficiency filters (e.g. ASHRAE Dust Spot rating of 40%-65%)(MERV 13-15) have more body, are easier to insure a tight fit, and are less subject to blow out. Moderate efficiency filters are recommended for most school applications.

- Higher efficiency filters are often recommended for certain facilities which require a very high level of filtration. These are typically High Efficiency Particulate Air (HEPA) or Ultra Low Penetration Air (ULPA) filters. These filters are generally only used in hospitals and laboratories. Carbon filters to absorb odors may also be used in highly specialized applications. The cost of using these filters in schools is difficult to justify.

- Ultraviolet light sterilization can be incorporated into the air handling system to reduce biological pathogens in the air and on the filters themselves. This technique is particularly effective in schools because of children’s susceptibility to respiratory infections.

- Filter installations should be designed for ease of inspection and replacement, and to minimize bypass airflow.

Materials Evaluation and Selection

Selecting Materials

Work with manufacturers to select products with the desired emission profile, and develop a strategy to minimize building contamination during installation. Require information about emissions from manufacturers. Manufacturers have both a marketing and liability motivation to test their products. Testing laboratories and emission testing protocols are rapidly developing. In selecting materials, investigate the materials potential to pollute the indoor environment in four key areas:

1. Release of particles, fibers, or chemicals inherent in the material selected.

2. Potential ability of chemical molecules or particles in the air to adsorb (physically attached) to the material and be released later (e.g. during warm weather or when disturbed).

3. Potential for microbial growth on material surfaces.

4. Maintenance or refurbishing requirements requiring chemical treatment that can become pollution sources.

- "Wet-applied" materials such as caulks, paint, adhesives, are of particular concern because of the high emission rates experienced while curing.

- Fast drying materials offer greater flexibility in developing strategies to minimize contamination of other building materials.

- Materials used in areas, which are likely to become moist, or wet (e.g. kitchens/showers, downstream from cooling coil, area around humidifier) can foster microbial growth if a carbon source is available. Easily cleaned, smooth surfaces are recommended.

- Use of fibrous material, including fiberglass insulation in ducts, requires careful consideration of the potential for soiling. Soiled fiberglass will take on moisture much more rapidly than clean fiberglass creating the potential for microbial growth. Particles provide carbon, and the fiberglass matrix provides self-sheltering surfaces for microbial growth.

- Fleecy materials covering large areas, such as carpeting, fabric upholstery, textile wall coverings, or ceiling tiles, all can adsorb chemical and particle contaminants during the finishing stage of building construction, and release it later after occupancy. When wet, these surfaces also foster microbial growth.

Strategies for Selection and Installation of Materials

- Identify target products of particular concern, considering potential emission rates, toxicity, and quantity used.

- Gather information from manufacturers, suppliers and other sources.

- Require specific testing, if necessary, of emissions over time.

Select and/or negotiate for materials with low emissions and quick decay rates where possible. Use this information to determine strategies for the sequence of installation and the ventilation strategies during installation. Negotiate pre-shipment storage techniques that accelerate emissions of partitions, carpets and similar materials prior to installation. Sometimes perforated containers can serve to facilitate off gassing during shipment.

Construction

Many IAQ problems occur as a result of poor construction practices, change orders, or field orders. Monitoring all work is critical to good IAQ.

Monitoring the Construction/Renovation Process

Monitor field orders, shop drawings, and change orders impacting IAQ specifications and designs. Check deviations from construction documents. Monitor IAQ specifications during progress by inspections, and check that products and materials specified are being used.

- Obstacles or construction debris in ventilation airflow paths.
- Proper installation of insulation, HVAC equipment, ductwork
- Monitor HVAC system testing and balancing as it occurs.
- Monitor contaminant isolation and control strategy during construction/finishing.

Emission Control During Construction/Renovation

Protect current and future occupants during construction.

- Accelerate emissions of wet products by using high ventilation.
- During high emission periods, protect workers and increase ventilation.
- Delay installation of adsorbent (fleecy) materials such as carpet, furniture, or ceiling tiles until emissions from other construction contaminants (e.g. wet product emissions) have dissipated. Otherwise, these materials will adsorb the contaminants and later release them during occupancy.
- Protect ducts from construction dust and debris. Keep ducts clean.
- Delay occupancy until emissions have subsided.
- Continue high ventilation rates for a significant period after occupancy.

Isolation of Construction/Renovation Contaminants When Occupants are Present

An isolation strategy is usually a necessary condition for effective IAQ control, but it is made more feasible to achieve when pollutant emissions are also controlled through material selection and installation strategies.

- Establish a complete physical enclosure to the construction zone.
- Seal all return ducts to insure that contaminants do not enter the HVAC system.
- Using existing and temporary exhaust fans (negative air machines) establish a containment zone under significant negative pressure (e.g., 5 to 10 Pa. or 0.02 to 0.04 w.g.). The supply air to the construction area may also need to be shut down.
- Monitor pressure relationships to insure that the containment zone is under significant negative pressure, and that the construction zone beyond the containment area is under negative pressure relative to all surrounding occupied spaces on the same and on adjacent floors.
- Insure that exhausted contaminants do not re-enter the building through open windows or the air intake of the HVAC system.
- Maintain the occupied spaces under slight positive pressure relative to the outside.

After Construction

Check the Building Envelope

Check the integrity of the entire building envelope by performing the following:

- Flood test flat roof systems for leaks (do not exceed design live loads).
- Inspect flashing for signs of leakage.
- Inspect doors and windows for operation and weather-stripping.
- Inspect windows and solar equipment (e.g. solar shades) for proper installation and solar angle.
- Verify that outdoor air is not entering the building through openings near loading dock or other sources of pollution.

Commissioning of HVAC System (Construction Phase)

Proper commissioning in the construction phase insures that the building is built correctly and that it works right before occupancy. See ASHRAE Guideline 1-1996, *The HVAC Commissioning Process* for detailed recommendations.

- Test and balance system.
- Test system performance under full and part load conditions.
- Test outdoor airflow at breathing zone in the occupied spaces under full and part load conditions.
- Review system operation and documentation.
- Test pressure relationships consistent with an air pressure map showing areas of planned positive and negative pressure.
- Assemble all relevant parties to discuss system; answer any questions about system sequences, set points, and operation; and review all documentation prior to submittal.
- Insure that part of the documentation includes operating and maintenance procedures, and an air pressure map.
- Submit documentation.
- Train operational and maintenance personnel on all the operating and maintenance practices required for the particular HVAC system and other systems in the building.

Initial Occupancy After or During Construction/Renovation

Protocol for Ventilation System Operation under Initial Occupancy Conditions

Special HVAC strategies should be employed for an extended period after initial occupancy.

- Extend hours of ventilation system operation.
- Increase outdoor air fraction and operate at reduced temperatures during occupancy.
- Increase outdoor air fraction during unoccupied periods.
- Measure key contaminants such as formaldehyde and total volatile organic compounds (TVOC) as a means to judge when the HVAC system can return to normal operation.

- Run HVAC continuously and increase outdoor air fraction during first hot weather period.

HVAC Verification under Occupancy Conditions

Verify system components are all operational and system meets performance requirements under all operating conditions (full and part load) when the building is occupied.

- Verify outdoor air louvers are open and working correctly.
- Verify that all interior spaces are receiving design quantities of outdoor air.
- Verify that fans in air handling units operate continuously during occupied periods.
- Verify that all supply registers/diffusers, and return grills are open and unobstructed. Adjust diffusers to insure proper mixing and to avoid drafts on individual occupants.
- Verify the operation of all VAV boxes according to design.
- Verify that local exhaust grilles and hoods are operating correctly.
- Check for backdraft from all combustion appliances under worst case scenarios.
- Check air pressure relationships according to original plans.

Indoor Air Quality Evaluation

Evaluate IAQ by conducting a building walkthrough to identify problems. Talk to occupants to identify problems.

ACOUSTICS

The NH Code of Administrative Rules Part Ed 321.21 requires that new schools be designed to meet the standards of ANSI S12.60-2002 American National Standard Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. Among other requirements, this standard establishes a maximum sound reverberation time of 0.6 seconds in small learning spaces and 0.7 seconds in larger classrooms. The standard limits classroom background noise to 35 dBA. Sound Transmission Class limits are also identified for walls and doors around various types of spaces. The standard impacts the design of the HVAC system, the construction of interior walls, and the choices for interior finishes.

Designing a classroom to meet the standards is neither difficult nor costly. It is important to include acoustic requirements early in the planning process and to ensure that the architect and mechanical engineer work closely together. Reverberation time is most easily addressed by adding sound-absorbing materials to the ceiling and walls of the room. Contrary to popular belief, carpet does little to improve the acoustic characteristics of a room. That is because carpet typically has a noise reduction coefficient of less than .25 compared to .70 in a typical acoustical ceiling panel. Most background noise in a classroom comes from the HVAC system. Centralized systems perform much better than unit ventilators or packaged units installed directly above the classroom. Mechanical equipment such as VAV boxes and fan-coil units are best located above hallways or noisy areas such as cafeterias. Select air handlers with low sound level ratings. Size ducts large enough to permit low air velocities while still meeting the necessary air exchange rate. Sound transmission concerns will be lessened by locating noisy activities such as cafeterias, music rooms and shops away from classrooms. In many cases spaces can be arranged in such a way that a fire wall is required at a particular location which also needs a higher sound transmission class. That will help minimize the “extra” materials necessary for acoustics.

FIRE SAFETY

NFPA 101, 2003 edition is the current New Hampshire Life Safety Code. New code updates are published every three years. Chapters 14 and 15 specifically address Educational Occupancies, but other chapters also pertain to schools. Chapters 12 and 13 are for Assembly Occupancies which include school gymnasiums, cafeterias, and auditoriums. Chapter 7 addresses means of egress, Chapters 8 and 9 address fire protection measures such as fire walls, fire doors, smoke control, alarm systems, and sprinkler systems. Chapter 10 addresses interior finishes, contents, and furnishings.

Some specific requirements for schools include:

a. Classrooms for pre-school, kindergarten, and first grade students must be on a floor with direct exit to ground level. Second grade classrooms may be no more than one floor above ground level.

b. Basements in new schools must be protected by an automatic sprinkler system. In older buildings, sprinkler systems are required in basements if the basement includes spaces for student occupancy.

c. Classrooms must have an outside window that meets the requirements for use as a rescue window. This means that there can be no interior classrooms that are not on an outside wall unless the building is fully protected by an automatic sprinkler system.

d. The fire alarm system must automatically notify the fire department when activated.

e. Stages must have a stand pipe for fire protection.

f. All school construction plans must be reviewed and approved by the State Fire Marshal.

DESIGNING FOR SAFETY AND SECURITY

Recent events have raised the awareness of school security and the vulnerability of school children to acts of violence and events of nature. Good school planning, architecture, and modern security technology enhance building security and help prevent the situations that have been making headlines. The Federal Emergency Management Agency (FEMA) has published a *Primer to Design Safe School Projects in Case of Terrorist Attacks* and the *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*. Many of the design practices in these references will provide safety for both natural and manmade situations. For example, there is little difference between a terrorist bomb and an earthquake in terms of the effect on a building.

Visibility is crucial when planning a school. School security is like security on the street or in any public place where groups of people have a positive effect on each other by providing accountability and supervision. In schools, faculty and administrators should strive to have students move around amicably. Straight lines of sight are useful for navigating, keeping the peace, and maintaining safe areas of passage. The advantage of straight corridors with clear lines of sight is that everyone, students, faculty, visitors, is visible at all times. The disadvantage is that straight corridors can make the school feel institutional and boring. Designers should strive for a layout that is pleasant, but safe.

Security is not only an indoor issue. Schools tend to have large grounds around them where students and intruders can hide. Proper site and landscape design should ensure visibility from all points of access. Large trees, with canopies above 12 feet, can serve as obstructions to vehicles attempting to approach the building across lawns or playing fields. Vehicles should be kept at least 50 feet and preferably 100 feet away from the building. Access roads and vehicle routes should be designed so that a vehicle cannot get a high speed, direct approach to the main entrance or other critical areas. If an analysis of threats so indicates, fencing of the entire school site may be appropriate.

Most schools are designed as public spaces for the community at large. This may actually enhance security. A school that is considered a public building and valued by adults throughout the community may be seen and treated in a special way by the entire community. Scheduled activities in the evenings and on weekends

signal that the school is a community facility. Keeping the school open after mid-afternoon helps create a safe environment for those students who choose to stay later. If the school is a constantly active place, children will not be isolated.

Other security considerations include crowd control and crowd size. This is particularly true in large high schools which may be used for athletic events, performing arts events, or public meetings that attract large numbers of participants and spectators.

Some basic design guidelines:

a. Shorter corridors on a square building plan make the building easier to secure via clear lines of sight. With a square floor plan, two staff members can see the entire building at any one time. With a circular plan, it could take five or six hallway personnel to secure the school.

b. Schools should be planned with sufficient locker space so students can put their coats or other outdoor wear away when they arrive. No student should ever wear outdoor garments inside the classrooms or other instructional areas. In addition, students should understand that lockers are school property, and as such, are on loan and are subject to inspection at any time.

c. Internal and external TV monitors should be installed in schools to cover areas without continuous line of sight monitoring.

d. In larger schools, where everyone may not know everyone else, identification badges with photograph should be worn by staff at all times. Visitors and contractors should also be required to wear a badge that clearly identifies them as someone who is not normally in the school. The requirement for identification badges for students is a policy decision that must be closely considered by the school board and administration. The badges make it easy to know at a glance who is supposed to be in the school. Anyone who is not properly identified is assumed to be not properly authorized and should be immediately confronted and escorted to the main office.

e. All entrances must be controlled. As much as possible, it must be impossible for an intruder to gain access to the building without being approved for entry. This is much easier said than done. Security is often an inconvenience, but the potential result of ineffective security is too serious to ignore. Any exit that is not manned should be alarmed and any alarm must generate an immediate response to determine if an intruder has entered the building.

f. As difficult as it is to control doors, it is never acceptable to block, chain or lock a door in a manner that prevents it from being easily opened by a child in the event of an evacuation.

g. Public areas of the building such as gymnasiums, auditoriums, and cafeterias should be located in a way that allows restricted access to the rest of the facility.

h. There should be a central receiving area for all deliveries. This includes supplies, foodstuffs, mail etc. Travel into the building by delivery personnel should be restricted to the shortest distance necessary and should not allow access to student areas.

i. Access to roofs should be restricted. Take care that trees or structural features do not provide a means to gain access to the roof.

j. Fresh air intakes should be located at least ten feet above ground level to prevent the deliberate introduction of contaminants. This is another reason to avoid using unit ventilators as described in Chapter 7. Air filters with a rating of at least MERV 13 will also help prevent contamination of the air.

k. Minimize the number of driveways or parking lots that students must cross to enter the school building.

l. Provide an identifiable, secure outdoor assembly area to be used during evacuation drills and actual events. Ball fields with perimeter fences are excellent for this purpose.

m. Ensure that any courtyards can be observed from offices, classrooms, or main corridors.

n. Select a quality lock system, preferably a programmable system that allows for rapid changes if security has been compromised due to lost keys, or keys in the hands of an individual who may wish to do harm to people or property.

SAFETY DURING CONSTRUCTION

Conducting education in a school building that is undergoing a major construction project is a difficult undertaking. School administrators and the contractor must work close together to ensure that safety of the children is the absolute first concern. The National Clearinghouse for Educational Facilities publishes *A Principal's Guide to On-Site School Construction*. More information is available in Appendix 1. Some key points are:

a. Involve the school staff in the planning process from the outset.

b. Inform staff, students, and parents of the construction schedule and keep them informed as changes develop.

c. School administrators and maintenance staff must be involved in and aware of important issues such as construction site security, location of staging and storage areas, traffic patterns, work hours, worker identification, noise and dust control measures and similar matters which will impact on school operations.

d. The identification of restricted areas and the method of separation must be discussed continuously. Access issues for construction workers, school staff, and students must be constantly reviewed.

e. Keep students informed of progress. Use the project as a learning experience.

f. Most projects will have a weekly construction meeting which the principal should attend. The head maintenance staff member should meet daily with the clerk of the works and the construction superintendent.

g. Deal with noise and dust problems immediately. If the barrier systems fail to keep dust out of the school, notify the clerk of the works and ensure that better systems are put in place. Coordinate the scheduling of tests and school activities that are more susceptible to noise than others. Construction contracts should require that the builders follow the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) guidelines for dust control.

h. Be especially aware of the proper use, storage, and disposal of hazardous materials. The NH Department of Environmental Services has published a pamphlet, *Best Management Practices for Construction Site Chemical Control.*

i. Ensure that students and staff are kept well clear from the possibility of objects falling from the roof or scaffolding.

j. Immediately inform the clerk of the works of any signs of water leaks, insects, or rodents.

k. Coordinate to avoid construction traffic around the times of school opening and closing.

l. Ensure that a system is in place to immediately inform the school principal when something unexpected occurs such as breaking a water main, shutdown of the heating system or similar events which will have major impact on school operations.

m. Ensure that interruptions to the school's communications, security, and life safety systems are minimal and that alternative systems are in place before any primary system is shut down. This may involve issuing cell phones to staff, posting hall monitors etc.

SAFETY IN PORTABLE CLASSROOMS

Portable classrooms are intended to be a temporary solution to a space shortage problem, but they have a way of staying around for many years and becoming a permanent fixture. They offer some unique safety challenges.

The New Hampshire Code of Administrative Rules Saf-C 3300 governs the manufacture, sale, and installation of modular buildings in the state, and applies to portable classrooms.

Portable classrooms are required to meet the state fire code and building code. Each unit must have been inspected and must have a NH Department of Safety Modular Building Approval Label from a licensed third party inspection agency.

The state plumbing code requires that portable classrooms contain toilet facilities or that they be connected via an enclosed passage way to a building with toilet facilities. The code requires that no individual shall have to travel more than 500 feet to the nearest toilet facility.

Electrical power to a portable classroom needs to be connected by a licensed master who will ensure that the system is properly grounded and bonded. These connections should be inspected at least annually.

A licensed plumber must make connections to any sewer, water, and hydronic heating systems.

Units must meet the building code for snow loading. Snow should be removed from roofs as soon as possible.

The units must be skirted and trailer hitches must be protected to prevent injuries to people walking around the unit.

Vehicle parking should be restricted within 20 feet of the unit to prevent blocking the exits.

Exterior doors should be locked while classes are in session to prevent access by intruders.

Each unit should be clearly marked on the outside with a large distinguishing number or letter to assist safety officials in response to an emergency.

Keys to mobile units should be available in the main office.

Smoke detectors and fire alarms are required.

Exterior power boxes, fuel tanks, and other mechanical equipment must be enclosed in locked vandal proof boxes or fenced.

Objects such as bricks, blocks, or metal objects that can be used as weapons should not be used for door props.

Units should be anchored against high winds.

There must be two way communications between each portable unit and the main office.

Stairs and access ramps must be properly constructed, installed, and maintained to meet fire and building codes and ADA requirements.

CHAPTER 13 – CONSTRUCTION CONTRACTS AND DELIVERY METHODS

"In essence, construction is a combination of organizations, engineering science, studied guesses, and calculated risks. From their very nature, construction operations must be performed at the site of the project. Construction is a dynamic, restless, compelling business…. The construction of a project involves thousands of details and complex, interwoven relationships among owners, architects, engineers, general contractors, specialty contractors, manufacturers, material dealers, equipment distributors, governmental bodies and agencies, labor, and others."

From Standard Handbook for Civil Engineers, Frederick Merritt editor, Section 4 by J.B. Bonny, President and Chairman, Morrison-Knudson Company, 1976

There are several types of construction contracts and methods of construction delivery that are used to build schools in New Hampshire. Generally, standard contract documents developed by the American Institute of Architects (AIA) are used. There are other organizations such as the Associated General Contractors (AGC) who also publish contract documents, but the AIA documents are the most common. In addition to the contract document itself, there will normally be a set of construction drawings and technical specifications that describe the work to be done and the materials to be used. The drawings should follow standard architectural and engineering practices for symbols and labeling and should include keys to symbols where appropriate. The specifications will normally follow the Master Format of 16 Divisions developed by the Construction Specifications Institute. A new Master Format with 49 Divisions was developed in 2004. A slow transition to the new format is expected in the next few years.

The most commonly used types of contracts and methods of construction delivery are discussed in this chapter. There are others that are used less frequently. There are also many variations and combinations that can be used. The school district should have an attorney review all contracts and make modifications as necessary to protect the interests of the district.

School boards and building committees will often spend many hours debating the type of contract and method of delivery to be used. All of the various agreements discussed in this chapter can all result in a successful project if used correctly and in the right situations. Likewise, problems and dissatisfaction can occur with any contract. These agreements are first and foremost human endeavors. The skills and qualifications of the designers and builders and the relationships between the designers, builders, and owners, are far more important than what may be written on a contract document. Teamwork and trust are more important than a piece of paper. In considering past projects or work done in other districts, the board must take care that good or bad results are not incorrectly attributed to the type of contract or method of delivery that was used.

CONSTRUCTION CONTRACTS

In any construction contract, the cost of the project consists of the costs for labor and materials and the builder's profit and overhead. Before a project begins, the costs are only estimates. That includes price quotes from a contractor. There is risk involved for both the owner and the builder concerning the builder's ability to perform the work for a given actual cost. The differences between types of contracts primarily lie in who takes the risk, who has to pay for cost over runs, and who keeps the savings if the project costs less than the estimate. In a major construction project, some or all of the different types of contracts may be used. There may be one type of contract between the owner and the primary contractor and different types of contracts between the primary contractor and the sub-contractors.

Lump Sum. A lump sum, sometimes called stipulated sum, contract is the most basic form of agreement between a supplier of services and a customer. The supplier agrees to provide specified services for a specific price. The receiver agrees to pay the price upon completion of the work or according to a negotiated payment schedule. In developing a lump sum bid, the builder will estimate the costs of labor and materials and add to it a standard amount for overhead and the desired amount of profit. If the actual costs of labor and materials are higher than the builder's estimate, the profit will be reduced. If the actual costs are lower,

the builder gets more profit. Either way, the cost to the owner is the same. In practice however, costs that exceed the estimates may lead to disputes over the scope of work or attempts to substitute less expensive materials for those specified.

Unit Price. In a unit price contract, the work to be performed is broken into various parts, usually by construction trade, and a fixed price is established for each unit of work. For example, painting is typically done on a square foot basis. Unit price contracts are seldom used for an entire major construction project, but they are frequently used for agreements with sub-contractors. They are also often used for maintenance and repair work. In a unit price contract, the contractor is paid the agreed upon price, regardless of the actual cost to do the work.

Guaranteed Maximum Price. In a guaranteed maximum price (GMP) contract, the contractor estimates the cost just like in a lump sum bid, but profit is limited to a specified amount. In the event that actual costs are lower than the estimates, the owner keeps the savings. In the event costs are higher, the contractor pays the difference and profit is reduced. Sometime, savings are shared between the owner and the contractor as an incentive to keep costs down. As in a lump sum contract, higher than anticipated costs can lead to disputes. The GMP will only apply to the work specified in the cost estimate. Changes, possibly including unforeseen circumstances, or additional work which the contractor agrees to perform can result in a final payment that is higher than the GMP. School districts should take care that their voters understand that increases are possible, even with a GMP.

Cost Plus. In a cost plus contract the contractor's profit is set at a fixed amount. If actual costs are lower than the estimate, the owner keeps the savings. If actual costs are higher than the estimate, the owner must pay the additional amount. Cost plus contracts are rarely used for school projects because school administrators and school boards rarely have the authority to exceed the amount appropriated for the project. The great advantage of a cost plus contract is that, generally speaking, the project will result in the building that was envisioned, even if costs run high. The builder is less likely to cut corners or argue for less expensive materials because his profit is not in jeopardy. By the same token, the builder has little incentive to keep the owner's costs down.

CONSTRUCTION DELIVERY METHODS

Construction delivery refers to the relationships between the owner, the builder, and the designer. There are three primary methods used to construct schools in NH. Each has advantages and disadvantages and should be used only in situations where its advantages can be beneficial. Diagrams for the various delivery methods can be found at the end of this chapter.

Design-bid-build. The traditional method of building a school is to have the work designed by a team of architects and engineers and then advertise the plan to solicit bids from construction firms. The winning firm becomes the General Contractor, responsible for overall completion of the project using the firm's own employees, sub-contractors, or a combination of both. The design and construction phases of the project are clear and distinct. A complete set of design documents is finished before the builder becomes involved. There are several advantages to this process. First of all it has been around for a long time and is well understood. The design documents must be thorough and complete which lessens the chance of misunderstandings. This method should allow plenty of time to consider alternatives and to complete a thorough integrated design that involves all the occupants and design team members. The disadvantages are that this method takes the greatest amount of time to complete and that the designers and builders can sometimes become antagonists when the builder is unable to understand or even unable to build what has been designed. Design-Bid-Build is most frequently done using a lump sum bid contract, but guaranteed maximum price is sometimes used. One pitfall to look for is that sometimes builders will intentionally bid low in order to win the project and then hope to make up the loss in profits through change orders.

Design-build. Design-build is very old method that fell out of use until recent years. In this process the owner selects one contractor to both design and build the project. There are firms that specialize in design-build and have their own architects and engineers, but in New Hampshire this process typically means that the owner selects a builder who then hires the design team as required. Design-build is primarily intended to

save time. Because the designers and builders work together from the beginning, the design effort can be substantially reduced. It is not necessary to prepare drawings in great detail if the builder already understands what needs to be done. Time is saved by using a fast track schedule where the builder begins working on each phase of the construction as soon as the design for that phase is complete. Ideally the designers complete the next phase just as the builder is ready to start that phase. Design-build works very well when using standard designs that have been built repeatedly. It is absolutely critical that the owner and builder have the same clear picture of the final project before construction begins. There are those who advocate design-build as a cutting edge method and as a method which will result in significant cost savings. Neither is correct. Design-build had been around since the construction of the pyramids. There may be some slight savings in design costs, but those have no impact on the costs of labor and materials for the actual construction, which is where the greatest part of the total cost is to be found. Since the owner and the builder commit to a cost before design is started, there is an amount of uncertainty which will have an associated cost that will probably be included in the builder's bid. The Department of Education feels strongly that design-build is not a good method for most school projects for the following reasons:

1. Fast track schedules eliminate the possibility of integrated design. They also often mean that very little time is spent with the occupants to ascertain their needs in a new facility.
2. When the designers work for the builder, rather than the owner, the checks and balances that exist in other methods are lost. Many New Hampshire communities lack a robust code enforcement department. The architect and clerk of the works are usually relied upon to keep track of construction to ensure that the builder follows the plan and codes. The architect cannot objectively fill this important role if he works for the builder.
3. People in a hurry make mistakes. Fast track schedules can lead to serious problems which are difficult and expensive to resolve.
4. Saving time is the main advantage of design-build, but that should not be as critical an issue for a school project as cost and construction quality.
5. Changes are difficult to implement once construction starts in a design-build project because everything moves too fast and the budget is often inflexible. When a costly unforeseen situation arises, the only alternative is often a reduction in the scope of work. This will lead to a final product that is something less than what was envisioned at the beginning of construction.
6. Unforeseen circumstances are the bane of any construction project, but they are particularly difficult to handle in design-build. For this reason design-build is ill suited for renovation projects.
7. Design-builders like the freedom that this method gives them. They do not have to clear every decision with the design team. If the owner also has limited involvement, the builder can get about his business and get the job done without interruptions. This can be an advantage when everything works well, but when problems arise, as they almost always do in construction, unilateral decision making by the builder can lead to everyone's dissatisfaction with the outcome.

Construction Management. Construction Management is a relatively new method of delivery in which the owner hires a construction professional early in the design phase. The construction manager works with the design team to help ensure that the design is something that can in fact be built for a reasonable cost and that the builders will be able to understand the design drawings and specifications. This can result in a reduction of the total design effort similar to what occurs in design-build. There are two basic types of construction management: construction manager as advisor and construction manager at risk. In the construction manager as advisor variation the construction manager acts as technical consultant to the owner and has no legal responsibility for the performance of the actual construction work. The actual work may be done by a general contractor or though multiple prime contracts with the necessary sub-contractors. The construction manager as advisor method is seldom used on school projects in New Hampshire. In the construction manager at risk variation, which is frequently used for school projects, the construction manager becomes the prime contractor during the construction phase. The construction manager awards sub-contracts much like a general contractor in a design-bid-build project. Construction management projects are most frequently done through a guaranteed maximum price contract, but other types may be used. Fast track schedules are also possible, with all their inherent risks that are described under design-build above. The great advantage of construction management is its emphasis on teamwork, and the fact that a builder is involved in the design and decision making process almost from the start. Another advantage is that the owner can often be more involved in the selection of sub-contractors if so desired. The disadvantages of

construction management are that the builder must be paid for his participation in design, that there may be some blurring of the lines of responsibility, and that the owner should expect to have more meetings requiring attendance. Another problem with construction management is that there are relatively few true construction managers currently working in New Hampshire. Many construction firms advertise that they will do any of the three types of construction delivery discussed in this manual, but most of them are general contractors at heart. The basic difference between a construction manager and a general contractor is in their approach to managing sub-contractors and in keeping the owner's costs down. A true construction manager, whose fee is not affected by the result, will attempt to negotiate the best value for the owner in selecting sub-contractors. A general contractor will tend to negotiate in a way that maximizes his profit. Many contractors who call themselves construction managers will expect to self perform significant portions of the project. That means that they will use their own firm's employees, rather than sub-contractors, to do much of the actual construction work. This arrangement may not result in the best value to the owner. A good rule of thumb is that if the firm owns anything larger than a pickup truck they are not construction managers and a traditional design-bid-build contract is a better choice for that firm.

In summary, there are several choices that the school district must make concerning the type of contract and method of delivery to be used. In making these choices the school board should consider and attempt to maximize the advantages of the various contracts to best meet the goals of the district. The board should also consider the ability of the district staff to manage the contract. No one contract, method, or combination is better than another for all situations.

SAFEGUARDS

Integrated Design

One way to prevent many problems that occur during and after construction is to insist on an integrated design. As discussed in Chapter 3, designs are developed by a team of architects and engineers who may work more or less independently of one another. It is important that the designers coordinate their efforts and that there is a process to ensure that all parts of the design fit together and work together properly for the optimum performance. For example, the selection of the type of roof or windows has significant impact on the requirements for the HVAC system, thus it is critical that the architect, structural engineer, and mechanical engineer work together. This coordination is often not possible in fast track schedules which, at best, leads to less than optimal performance by the final product and can result in serious shortcomings that require costly corrective measures in future years.

Value Engineering

Value engineering (VE) is a term that is extensively used on school projects in New Hampshire, but it is most often used incorrectly. According to VE experts Kirk and Dell'Isola, "Value Engineering is a team approach that analyzes a function by systematically developing the answers to such questions as: what is it?; what does it do?; what must it do?; what does it cost?; what other material or method could be used to do the same job without sacrificing required performance or degradation to safety, reliability, or maintainability?" VE is concerned with elimination or modification of anything that adds costs without contributing to the program functional requirements. Reductions in a project's scope or quality to get the cost within the budget are not considered VE—those decisions are simply "cost cutting". Many people refer to the process of reducing costs to fit into a budget as value engineering. Sometimes the term is applied to a situation in which a subcontractor recommends a less expensive item for what was specified by the designers. That may be an attempt to dignify what is actually taking place. Because of the misuse of the term, value engineering has unfortunately developed a negative context. True value engineering is a process in which the entire design is reviewed by an independent team of experts who look for opportunities to improve the design for better value. Better value is not synonymous with lower cost. It may in fact be more expensive initially, but result in lower life cycle costs or extend the life of a building component. Recommendations by subcontractors may also be part of the value engineering process if they do actually add value. Conducting a value engineering process can be difficult. Egos often get in the way of good value engineering. The designers must be willing

to accept recommendations for improvement. At the same time, the value engineering team must make recommendations that truly add value, and not simply second guess the original designers. The process of value engineering takes time and costs money, but the cost may be worth the improvements that result.

Involve the Building Occupants in Design

The staff of the school who will use, operate, and maintain the building must be involved in the design process and must be trained to operate the equipment before the project is complete. Their input, early in the process, can help avoid construction of facilities that do not fulfill the intent. It will also help reduce the request for owner originated change orders as the building takes shape and people begin to see what is really being built. Even the students may have valuable input that should be considered to make their school better.

Selection of Contractors

New Hampshire law currently imposes few requirements on school districts concerning the solicitation and hiring of contractors. Unless a local district or municipality has placed restrictions upon itself, the district is essentially free to hire whichever contractor it chooses using its own criteria for selection. While this degree of openness allows great flexibility, it can lead to problems if not managed carefully. If a district advertises its project widely it may receive bids from contractors about whom little is known or who have not done previous work similar to the project at hand. If one of these contractors submits the lowest bid, there is no requirement to accept it, but it is often hard to justify reasons for choosing another contractor. One commonly used method to help control quality is to limit bids to a select group of pre-qualified contractors. The architect can assist the district in identification of contractors who have demonstrated the necessary skills and capacity to do the work. Requests for Proposal (RFP) are then sent to and accepted from only those contractors. Of course, the risk of doing this is that a well qualified contractor may be omitted from the list. One way to avoid that is to advertise a Request for Interest (RFI) first. Based on the responses to the RFI you can narrow the list of contractors who will receive the RFP. School boards and building committees must be willing to take the time to thoroughly investigate the responses to the RFI and RFP. It is not something that can be done properly in a two hour meeting. You may wish to conduct a two or three stage selection process, especially if you receive a large number of responses. In the first stage you may narrow the list, based simply on the responses, to a group who are then invited for a face to face interview. You may further narrow that group to two or three whose work you wish to see in a site visit before making the final selection. In going through such a process you must take care to ensure that all contractors who respond are treated fairly and equally and that you conduct the process exactly as you said it will be conducted in the RFP. Districts should establish the criteria on which responses will be judged, publish those criteria in the RFP, and then base the selection on those criteria and nothing else. Criteria might include the demonstrated capacity of the company to do the work, past experience on similar projects, safety record, record of completion on time and within budget, number of contractor generated change orders, and similar factors. Cost is certainly a major consideration that cannot be taken lightly. Be suspicious if there is a wide range in the cost quotes, particularly if most costs are close, but one is much lower. Insist that the contractors respond to the RFP and provide the information requested. If they are unwilling to do that, they should be disqualified from further consideration. Remember that large firms will be building several projects simultaneously and they have several different project teams. Insist that the project team that will be managing your project comes to the interviews and that you visit projects done by that team. If you base your selection on the work of the “A Team” but the “G Team” is managing your project, you may not be satisfied with the result. Definitely speak with past customers, preferably some from projects that the contractor did not include in the response to the RFP. The best reference might be from a project that had difficulties which the contractor successfully resolved, rather than one where everything went well.

Commissioning

Building commissioning is a systematic process of ensuring that building systems are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs. The objective of commissioning is to provide documented confirmation that a facility fulfills the functional and performance requirements of the building owner, occupants, and operators. To reach this goal, it is necessary for the commissioning process to establish and document the owner's criteria for system function, performance, and maintainability; and also to verify and document compliance with these criteria throughout design, construction, start-up, and the initial period of operation at least through the warranty period. In addition, complete operation and maintenance (O&M) manuals, as well as training on system operation, should be provided to the building operators as part of the commissioning process. Commissioning should be accomplished by a qualified commissioning agent under contract to the owner independent from the design and construction contracts. Commissioning may be done by the engineering firm responsible for the project design, or by an independent commissioning agent. The commissioning agent should become involved early in the design process, and should continue through at least one year after occupancy of the facility. In general, the heating, ventilating, and air conditioning (HVAC) systems and controls, lighting controls, and life safety systems should be commissioned. Other systems such as plumbing, data and communications, security, emergency power, and elevators may also be included in the commissioning plan. The cost of commissioning is generally less than $1 per square foot of building space. The savings far outweigh the cost. A 2004 study by the Lawrence Berkeley National Laboratory, involving 224 buildings in 21 states concluded that the payback time for commissioning was less than five years. The annual savings per commissioned new building was nearly $25,000.

Benefits of commissioning include:

- Early detection of potential problems
- Precise tune-up of systems and controls
- Better building documentation
- Trained building operators
- Shortened occupancy transition period
- Lower utility bills and operating costs
- Healthy and comfortable environment

Clerk of the Works or Owner's Representative

The Clerk of the Works is a key member of the building team. The clerk serves as the owner's on-site representative on a day to day basis. The clerk may be an employee of the owner, or under contract with the owner. Responsibilities may vary from one project to another and from one owner to another. A key point is that the clerk's loyalty is only to the owner. The clerk's authority must be specifically delegated in writing by the owner. In order to preserve objectivity, the clerk's fee cannot be affected in any way by decisions made in the course of construction. The clerk must be covered by the owner's insurance or must have his/her own general comprehensive liability insurance and accident insurance. The clerk must have a good understanding of all aspects of construction, although technical skill in any particular construction trade is not necessary. The clerk must maintain a holistic view of the project, while appreciating the details of various parts of the work. The clerk must not attempt to fill the role of the design team, construction manager/general contractor, construction superintendent, safety officer, or any other member of the building team. Recommended qualifications and responsibilities for a clerk of the works may be found at www.ed.state.nh.us/buildingaid.

Contingency Budget

Every construction project budget should include some amount to be used to handle unforeseen circumstances. Authority to commit funds from the contingency budget should be held tightly. For new construction, the recommended contingency budget is five percent of the estimated construction cost. For renovation work, ten percent is recommended. Some project teams like to establish a separate contingency budget for the site work since many of the most expensive surprises will be found beneath the surface of the ground once the work begins.

Change Orders

A change order is written authorization for making a change in the original drawings, specifications, or contract documents. Change orders may increase or decrease the total project cost. Uncontrolled change orders can quickly drive up the cost of a project beyond the budget limits. Change orders usually originate in one of the following ways:

1. The owner desires a change in the original conditions of work and requests the contractor, through the architect, to present a quotation on the change. The owner will be responsible for any costs.

2. The contractor or architect may request a change due to additional, less, or different work resulting from conditions not known at the time of bidding. The owner is usually responsible for any costs. This situation may lead to disputes about the reason that the conditions were not known in advance, and who is responsible for the lack of knowledge.

3. The contractor identifies what is believed to be a better or less expensive method to complete a portion of the work and recommends a change. This is sometimes referred to as value engineering, but true value engineering involves a much more thorough analysis by qualified design professionals. The owner is usually responsible for any cost. Savings are sometimes shared with the contractor who recommended the change.

4. An official with proper jurisdiction determines that some aspect of the design or construction is not in compliance with codes or other requirements and directs that a change be made. The owner will be responsible for costs unless the change results from errors or omissions by the designers or if the change results from mistakes made by the builders. Disputes over responsibility and payment of increased costs are inevitable.

In all cases the architect obtains the necessary quotation for the additional work or allowance for work not done. The architect, in consultation with the engineers, evaluates the impact of the proposed change on the complete design and schedule and recommends approval or disapproval to the owner. The required forms are completed by the architect and signed by both the owner and the contractor. No change should be made from the original specifications of the job without a change order signed by the owner, architect, and the contractor. Work involved in any change should not begin without a signed change order.

Verbal authorization for change in the work specifications should neither be given nor accepted by the owner or his representative, the architect, the contractor or his representative. The process and authority to initiate and approve change orders must be established in the contract documents, clearly understood by all parties, and rigorously enforced. A poorly administered change order process can be one of the most significant causes of cost overruns and frustrations.

One way to reduce the number of change orders is to conduct a constructability review near the end of the design phase of the project. Some experts say that this can reduce the number of change orders by 30 percent or more.

Performance Bond (RSA 447:16)

Performance bonds are required by RSA 447:16 for construction and/or renovation of public buildings on all contracts of $25,000 or greater. The construction contract should require that the general contractor, construction manager, or design builder purchase and provide the school district with a performance bond in an amount at least equal to the total value of the contract. This will protect the district in the event the contractor fails to complete the work due to bankruptcy or other reasons. If that situation occurs, the bonding company will be responsible for hiring another contractor to finish the project according to the original contract. No sizable project should be attempted without a performance bond.

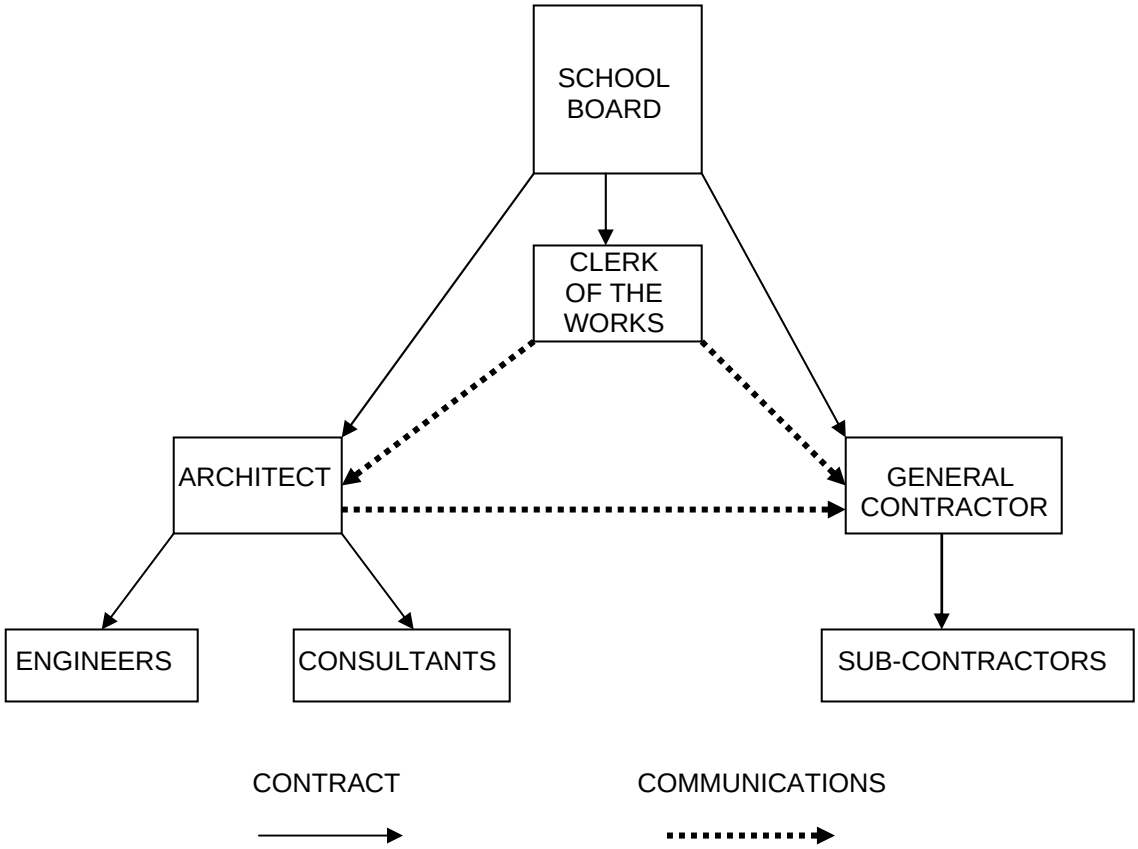
Insurance

Districts should require that projects be covered by builder's risk insurance, general liability and workers compensation insurance, and professional liability insurance. Insurance policies are often the responsibility of the contractor and are part of the cost of construction. Districts might consider purchasing their own policies in order to ensure that they have the coverage they desire and to help reduce costs. If the contractor purchases insurance the district should require a copy of the policy and ensure that the district is named as insured in the policies. Districts should realize that their own property and liability insurance policies need to be in effect at the time the certificate of substantial completion is issued.

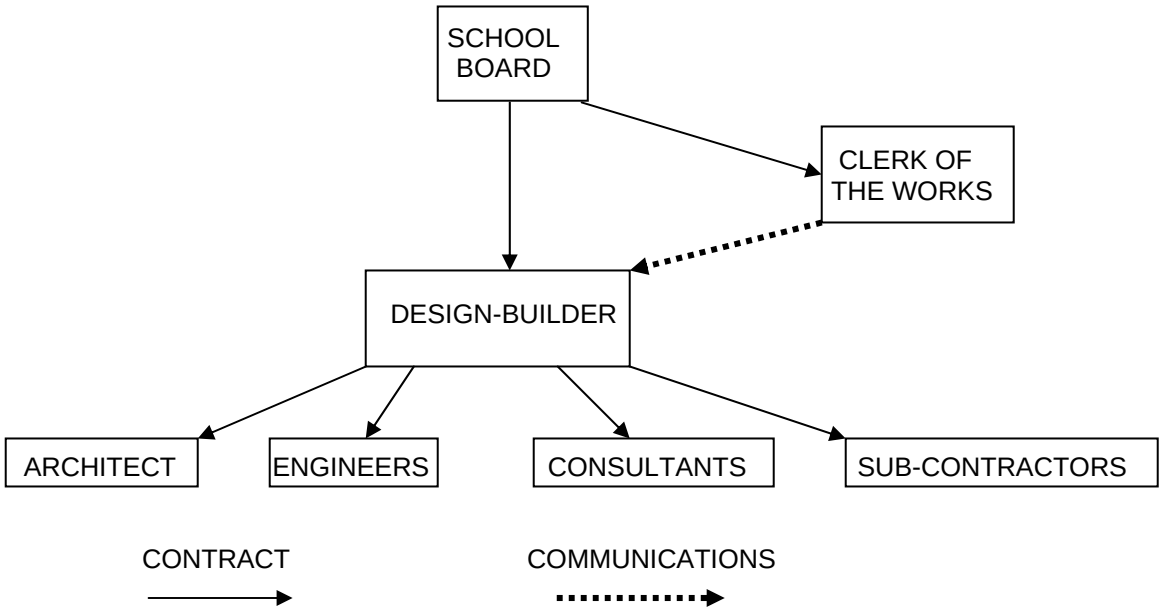
Retainage

School construction contracts will generally have a payment schedule established according to which the school district makes payments to the contractor at various points in the construction process. The points at which payments are to be made are usually identified as being upon the completion of particular parts of the construction work. In establishing the payment schedule, districts should take care that the contractor does not lose the incentive to complete the work because too much money is paid early in the process. There should always be a significant portion of the total payment which is withheld until all work has been completed to the satisfaction of the school district. The amount should be enough to ensure that the district has sufficient funds available to complete the work if the contractor terminates the contract prior to completion. Retaining more than enough to finish the project may be a violation of contract law and may result in a legal challenge by the contractor.

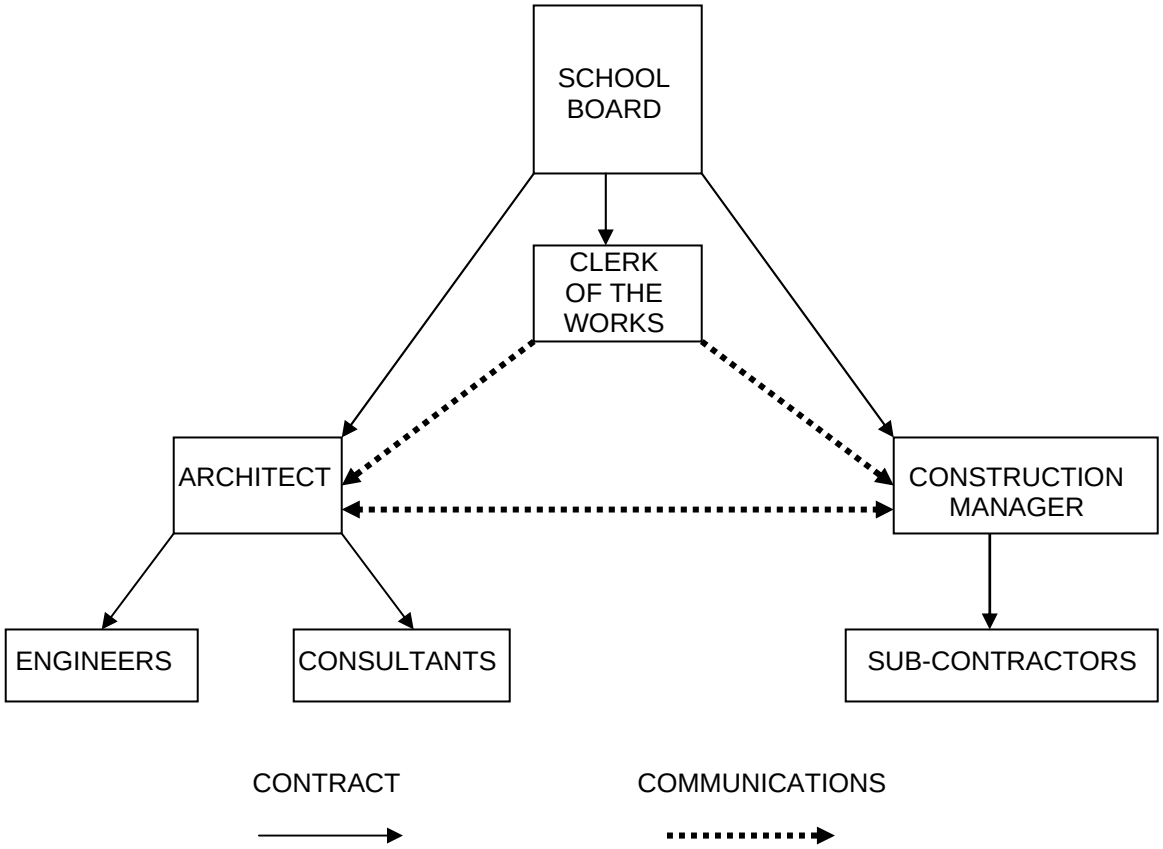
DESIGN – BID – BUILD



DESIGN – BUILD



CONSTRUCTION MANAGER AT RISK



CHAPTER 14 – FINANCING THE SCHOOL BUILDING PROGRAM

"Neat, comfortable, and convenient school buildings are indispensable for successful schools. Costly buildings and expensively furnished school-rooms are incompatible with the means and sterling good sense of the patrons and supporters of the public schools in a majority of the school districts of our state."
From the Annual Report of the Superintendent of Public Instruction to the NH Legislature, June 1876

There are several methods of financing school construction projects. School boards should choose the plan which is most appropriate for the size and type of building project being proposed and for the financial resources of the district. Each method has certain advantages and disadvantages which are discussed briefly below.

MUNICIPAL BONDS OR NOTES (RSA 33:3)

The most frequently used method of financing a school building project is through the issuance of municipal bonds or notes. This approach provides for the borrowing of the money needed for a project at one time while offering the advantage of repaying the loan(s) with the financing cost over a longer set period of time. Thus, needed facilities can be constructed expediently to serve immediate needs. With proper planning, this type of financing may be obtained at a time when interest rates are favorable.

Bonds or notes may be issued by a municipality, in New Hampshire that includes school districts, for the construction of new facilities or for the renovation, alteration, and enlargement of an existing building. They may also be used for the acquisition of land, for planning relative to public facilities, for the purchase of a facility for public use, for the purchase of equipment of a lasting nature, and for the payment of judgments. Bonds or notes may not be issued for the payment of expenses for current maintenance or operation. Municipalities shall not issue bonds payable on demand.

The cost-sharing aspect of financing by bond issue should also be recognized. For example, with a 20-year bond issue, the costs of the new building are borne proportionately by both present and future taxpayers; i.e., those parents whose children are going to use the building several years after its completion are helping to defray the costs of construction. Other advantages of this method are the stabilization of the local tax rate by consistent payments over a period of years, while normally allowing for the gradual reduction of the District's indebtedness. This permits borrowing for other projects if necessary as well as protecting the district's credit rating while simplifying the yearly budget process through planned annual payments. This method has certain disadvantages with the chief objection being the increased total cost of the project due to the necessity for paying interest. Taxpayers may also object to paying for facilities for many years after they have been in use and possibly for funding repairs or additions to the original structure before its debt is completely retired.

THE "PAY-AS-YOU-GO" PLAN

Another method utilized to finance capital projects is the "pay as you go" method whereby a facility is financed by the use of current revenues which are voted annually as the project progresses. A large school system with constant, predictable building needs may choose this type of funding. One evident advantage of this method is a reduction of the total project cost, since no interest would have to be paid for a bond issue. On the other hand, most districts, especially small ones, may find that this method imposes too great a burden on the local tax structure, since the adoption of the "pay-as-you-go" method locks a district into an automatic increase in the local property tax rate (separate and in addition to other school needs) for as many years as it takes to complete the project. Although most districts do not finance major projects in this manner, some capital outlay programs, such as site acquisition, a small building addition or renovations, or the purchase of equipment, may be carried out through annual budget appropriations. This method may be used to meet the 25% of replacement cost threshold for substantial renovations in order to receive School Building Aid.

CAPITAL RESERVE FUNDS (RSA 35:1 – 18)

A third method centers on the use of capital reserve funds. Under RSA 35:1 school districts are authorized to establish reserve funds for "the construction, reconstruction, or acquisition of a specific capital improvement or specific items of equipment." By this method certain funds are set aside on a regular basis for future capital improvements and are accumulated until the fund is sufficient to finance them. Expendable Trusts Funds are authorized as well (RSA 198:20-c) and can be used for the acquisition of specific equipment or costs.

As under the "pay-as-you-go" plan, this plan does not require the payment of interest but it also has the advantage of investing the funds set aside, thereby earning interest which helps offset rising construction costs. Taxpayers, though, may be unwilling to vote for large sums of money to be placed in a capital reserve fund year after year to finance indefinite building plans. Also, the purpose of the fund may be changed by the voters before enough money is accumulated to initiate the originally projected program. Here again the importance of long-range planning becomes evident; taxpayers will be much more likely to support a capital reserve fund approach if the needs and goals of the district over a period of years have been determined beforehand and are presented in an orderly format.

Since most projects are financed by the issuance of bonds or notes the remaining information in this chapter will address that financing approach.

OTHER FUNDING SOURCES

Federal

There is funding for non-food assistance under the federal school lunch program that can be used for the purchase of kitchen equipment. Information can be provided by the Bureau of Nutrition Programs and Services.

Up to 20% of Title IV funding for safe schools may be used to purchase security cameras or other equipment. Contact the Bureau of Integrated Programs for information.

Grants are available each year from the Land and Water Conservation Fund which may be used for construction of athletic facilities or playgrounds that are also used by the community. Grants are awarded by the NH Department of Resources and Economic Development.

Qualified Zone Academy Bonds may be available for projects at schools with at least 35% of the student population eligible for free or reduced lunch. These are no interest bonds that may be used for repairs and renovations, but not for new construction. Contact the Bureau of School Approval and Facility Management for information.

State

School Building Aid provides 30% to 60% of the cost for construction of new schools or substantial renovations of existing facilities. An additional 3% can be provided for construction which meets the regional high performance schools criteria. See Chapter 16 for more information.

Kindergarten Construction Aid can provide up to 75% of the cost of construction of classrooms for new kindergarten programs.

The state will contribute up to 75% of the cost to renovate and expand regional career and technical centers. Each center is eligible according to a schedule managed by the Bureau of Career and Technical Education.

Utility Company Programs (RSA 374-F)

Through an agreement with the NH Public Utilities Commission the regulated electric power companies throughout the state collect a small fee from their customers known as the Systems Benefit Charge. The proceeds of those fees are used to fund a number of programs aimed at improving energy efficiency. School districts should contact their utility account representative early in the design process to ascertain which programs may apply to a particular project. The utility companies will review designs and offer technical advice for improvements. In many cases the utility company will reimburse all or most of the incremental cost for using more efficient equipment or techniques.

Private Grants

The Nike Corporation has a grant program through 2009 which will contribute toward the cost of construction or renovation of running tracks.

Playground equipment vendors occasionally have matching grant programs for playground construction.

From time to time other grants are available that may be used for school construction projects.

PRELIMINARIES TO THE ISSUANCE OF NOTES AND BONDS

School boards and building committees should carefully study RSA Chapters 32, 33, 35 when considering a capital project of any nature. These chapters outline the legal requirements for financing a project as well as provide information regarding voting, hearings, payments, investments, payments from surplus, appropriations, expenditures, purpose and change of purpose. In addition legal counsel should be retained early in the process for advice at all stages of a capital project.

Since the legislature may amend the RSAs at any time, the details regarding specific procedures will not be included in this manual. This manual though provides a guide to the major elements that need to be considered. Also, it is important that school boards and/or local administrators maintain communications with the Department of Education in order to become aware of any changes in the legal requirements for passing bond issues.

In addition, bond counsel, who generally represents a financial institution, should be retained to help guide you through the bond selling process insuring that you meet all the necessary legal requirements. Guidelines written by legal and/or bond counsels are often available for your assistance.

STATE GUARANTEE ON BOND ISSUES (RSA 195-C)

RSA 195-C established a School Building Authority whose duty is to consider and investigate applications for a state guarantee for a portion of a bond issue voted for school construction. School boards, superintendents and business administrators should familiarize themselves with the provisions of this RSA. A state guarantee may be granted for up to 75% of the amount of a bond. The state guarantee may result in a reduction of the interest rate on the bond. Generally there is no benefit to a state guarantee unless the state has a higher credit rating than the school district.

DEBT LIMIT OF SCHOOL DISTRICTS AND CITIES

The following information on the debt limits for various types of school districts and on the computation of these limits is critical to determining the amount of a bond issue a district can issue.

a. Per RSA 33:4-a & -b Cities shall not incur net indebtedness for school purposes to an amount at one time outstanding exceeding seven (7) percent of its assessed valuation as last equalized by the Department of Revenue Administration (DRA).

b. Per RSA 33:4-a & -b School Districts shall not incur net indebtedness to an amount at any one time outstanding exceeding seven (7) percent of its assessed valuation as last equalized by DRA.
c. Per RSA 195:6 Cooperative School Districts organized to provide both elementary and secondary schools shall not incur debt that exceeds ten (10) percent of its assessed valuation as last equalized by DRA. Grade combinations other than K-12 have limitations as follows:
    1. Elementary grades only: five percent of valuation as last equalized.
    2. Grades nine to twelve only: five percent of valuation as last equalized.
    3. Grades seven to twelve only: six percent of valuation as last equalized.

d. Per RSA 195-A:7 AREA (Authorized Regional Enrollment Area) receiving districts may borrow money as provided in RSA 33 as amended. "However, in calculating whether it is within its debt limit, there shall be charged thereto an amount no greater than its proportionate share of any such required capital outlay, which shall be the proportion which its then established enrollment in the AREA school to be constructed or enlarged, bears to the then established total enrollment therein, as determined by order of the State Board."

There is no provision in the statutes to permit a district to exceed its debt limit. A district may obtain this permission only through a special act of the Legislature.

SCHOOL DISTRICT MEETINGS

Most school districts in the state are required to hold annual or special district meetings where the registered voters of the district make decisions on financial and other matters. For districts which are departments of city governments, these decisions are made by the city councils or boards of aldermen. The school districts of the cities of Claremont, Keene, and Lebanon use the district meeting process explained below. The school board of the City of Concord makes these decisions for the Concord School District.

A district is authorized to issue bonds and notes only through the vote at an annual or special school district meeting. It is important to observe all legal requirements when holding a school district meeting at which a bond issue is being considered. Failure to strictly follow all legal requirements may invalidate a bond vote and can delay a construction project for an entire year, assuming the voters approve the project again at the next meeting. The timelines for posting notices must be met. Districts should plan ahead to make the deadlines in plenty of time. A last minute flurry of activity is likely to result in something being missed or disputes about whether or not the day of the posting or the day of the meeting count toward the number of days required. The advice of legal counsel is vital to assure proper observance of all technicalities. RSA 197:1-8; RSA 32; RSA 33 should be studied and understood prior to the vote on the issuance on bonds and notes and carefully complied with after the meeting if the vote was successful.

It is extremely important that a careful record of the annual or special school district meeting be kept by the clerk of the school district when a bond or note issue is voted. The permanent record must include copies of the original warrant, the certification of publishing notices in the newspaper for special meetings, and the actual vote count. With regard to this last item, the total number of votes cast must be recorded, as well as the number voting for and against, since according to law a bond issue passes only by the necessary super majority of those voters present and casting ballots. The SAU Administration may assist the School Board Clerk in meeting these responsibilities.

RSA Chapter 40 authorizes two methods for conducting a district meeting, the traditional town meeting method, and the optional form of meeting using the official ballot referenda.

Town Meeting Format (RSA 40:4 to 40:10)

Under the town meeting format, the registered voters of the school district meet at least once a year between March 1 and March 25 at a designated time and place to consider articles developed by the school board. The annual operating budget is always one of the items to be considered at the annual district meeting. Other specific items requiring voter approval may also be presented to the voters including approval for the sale of

bonds for construction projects as authorized by RSA 33:3. Special district meetings can be called, for authorized reasons, at any time during the year for consideration of specific items that could not be considered at the annual meeting.

The legal requirements for annual and special school district meetings are summarized as follows:

1. Annual School Meeting
    a. Authorized by RSA 197:1.
    b. Warrant must be posted fourteen days prior to meeting, not including day of posting and day of meeting (RSA 197:7).
    c. The school board must hold a public hearing on bonds in excess of $100,000 at least 15 days, but no more than 60 days, prior to the district meeting(RSA 33:8-a). Notice of the hearing must be published in a newspaper of general circulation at least 7 days before it is held.
    d. Budget shall be posted at same time as warrant (RSA 197:5-a). If the District is under municipal budget law, then the budget is prepared by budget committee, and given to school board for posting with warrant (RSA 32:5).
    e. RSA 33:8-a includes requirements for the sequencing of bond articles and the length of time that must be allowed for voting.
    f. A two-thirds vote of those present and voting is required to authorize the issue of serial notes or bonds (RSA 33:8).

2. Special School Meeting
    a. Authorized by RSA 197:2, 3.
    b. Conditions for posting warrant and budgets and public hearings are the same as for an annual meeting.
    c. A two-thirds vote of those present and voting is required for authorization of bonds or serial notes.
    d. No appropriation or authorization of bonds or serial notes shall be made except by ballot. The number of ballots cast at such meeting must be equal in number to at least one-half of all the voters in the district entitled to vote at a regular meeting (RSA 197:3). (Exception – see 3 below).
    e. A copy of the warrant shall, within one week after posting, be published at least once in a newspaper of general circulation in the district (RSA 197:8).
    f. If a checklist was used at the last regular meeting, this list shall be used to ascertain the number of legal voters in the district and such list, corrected according to law, shall be used at the special meeting upon the request of ten legal voters of the district (RSA 197:3).
3. Special School Meeting with same authority as an Annual Meeting.
    a. Authorized by RSA 197:3 in case an emergency arises requiring the immediate expenditure of money
    b. School board must appeal to Superior Court for a special meeting.
    c. Meeting does not require that one-half of the voters be present.

Optional Form of Meeting – Official Ballot Referenda (RSA 40:12 to 40:14)

Districts which have adopted the official ballot method are sometimes referred to as SB2 districts after the 1995 Senate Bill which established this procedure. The primary difference between the traditional town meeting and the official ballot format is that the district first holds a deliberative session in which the ballot is established and then a voting session is held on another day in which all registered voters are allowed to report to a designated polling place and vote on the articles on the items included on the ballot. The deliberative session is conducted much like a town meeting however, the result of the deliberative session is the development of articles to go on a ballot rather than the actual decisions. Another unique aspect of the official ballot is the default budget. An annual operating budget will be proposed by the school board that may be amended by the voters in attendance at the deliberative session. That budget will then be placed on the ballot for voting. In the event the budget is not approved by a simple majority of the voters, a default

budget will become the operating budget for the next year. The default budget consists of the current year's operating budget, minus one time expenses, plus any increases due to previously approved contracts, debt service, or other mandatory increases. An important difference concerning construction bonds is that approval is required by three fifths of those voting rather than the two thirds required in the town meeting format.

The legal requirements for districts using the official ballot method are as follows:

a. Authorized by RSA 40:13
b. Deliberative session must be held between the first and second Saturdays following the last Monday in January, February, or March
c. Voting must be held on the second Tuesday in March, April, or May based upon the month of the deliberative session.
d. For districts voting in March, notice of budget hearings or bond hearings must be posted by the second Tuesday in January. Budget hearings and bond hearings must be held by the third Tuesday in January. Warrants must be posted and copies available by the last Monday in January.
e. For districts voting in April or May add one or two months to the dates above as appropriate See RSA 40:13 II b and c.
f. A three fifths vote is necessary to authorize the sale of bonds for school construction.

MUNICIPAL BUDGET COMMITTEES AND BOND ISSUES

School boards and officials of districts that are under the Municipal Budget law and expect to vote on a bond issue should be very familiar with Chapter 32 of the statutes. As mentioned elsewhere, it is advisable to secure legal counsel when voting on a school construction project utilizing a bond issue for financing.

Particular attention is directed to sections 14 – 24 of Chapter 32. The budget committee must hold a separate hearing on the bond issue in addition to the public hearing required in RSA 33:8a. This hearing must be included as part of the posted budget committee's budget. This is true for a special meeting (RSA 32:6) as well as an annual meeting since the same procedures must be followed by the budget committee for both types of meetings.

ISSUANCE AND SALE OF NOTES AND BONDS

After the school district meeting has authorized the issuance of bonds or serial notes, the school board should meet as soon as possible to decide on the following points:

1. Whether the notes or bonds should be issued immediately or at a later date. Districts are allowed one year to determine the most advantageous time to enter the bond market; however, the bonds or notes must be sold at the end of this period regardless of the then prevailing interest rate.
2. The length of the issue and the borrowing terms.
3. The method for selling the bonds; four common methods of selling bonds are:
    a. Direct sale at a specified interest rate and price to a local bonding house.
    b. Direct sale at a specified interest rate and price to a local banks
    c. Issuance of a call for public bids on the issue.
    d. Selling the bond through the NH Municipal Bond Bank.

Each procedure has advantages and disadvantages. Local banks can provide direct assistance with the necessary legal procedures and may offer the advantage of greater familiarity with local conditions. In recent years, however, public bid or selling through the Bond Bank seem to have become the two preferred methods for handling bond issues. In these cases the school board and administration and its legal counsel work with a municipal department of a local bank, or with the Bond Bank itself. In either case, the District retains its own bond counsel, whose advice will be very helpful in meeting legal requirements early in the process. Bidders and/or the Bond Bank, also retain their own bond counsel.

TIMING OF ISSUES

The bond market is highly competitive. The interest rate level is governed not only by factors of supply and demand prevailing at the time of sale, but also by monetary conditions in the private sector of the economy. Each district's banker or the NH Bond Bank can provide you with up to date information in interest rates. Additional help in assessing the state of the bond market may be obtained from such publications as *The Bond Buyer* of the *Wall Street Journal*, and from bond dealers and investment bankers.

IMPORTANCE OF LEGAL AND BOND COUNSEL

Again, legal assistance is an absolute necessity in planning and administrating the bond program. School boards should expect their legal counsel to help in meeting all state and local requirements, while bond counsel must approve the legality of an issue to assure its favorable reception by major bond buyers.

Sample checklists for the submission of bond applications to bond counsel are located at Appendix 6.

CHAPTER 15 – PRESENTING THE BUILDING PROGRAM TO THE PUBLIC

The best-developed plans of a much-needed school building are useless unless the public or its elected representatives provide the necessary funds for its construction, furnishings, and equipment."
From Educational Facilities: Planning, Remodeling, and Management, Basil Castaldi, 1977

The approval of a school building program is largely dependent on public knowledge and support. It can be extremely frustrating for members of building committees, school boards, administrators, and school staff to put their heart and soul into a project for many months only to have it rejected at the district meeting. One major factor in the failure of school building programs is often the neglect of public relations. Good public relations between school and community cannot be created overnight; this aspect must be considered in the earliest stages of planning (See Chapter 1, "Planning Educational Facilities"), and a channel of communication must be provided which will permit a two-way flow of communication between planners and community. A school board or building committee may assume this task, using all services available, such as an educational consultant, the architect, groups and clubs, public hearings, and news media, to present the program and at the same time make themselves available throughout the planning and building process to all expressions of public concern.

It may be more desirable to allocate this function to a special subcommittee, which would act as liaison between the building committee and the community. The size of the subcommittee is important. It is desirable to have diversity of community viewpoints represented, but a group that is too large will not be effective. Nine to fifteen members is sufficient in most cases. A member of the building committee should be designated as chairman of this subcommittee, and the school board should, after careful consideration, select the remaining members from representative segments of the community.

Two basic considerations must be taken into account in developing any kind of group effort. First, all group effort takes place in some kind of social system composed of people with some interest in common; the school board, building committee, and school administrators are the nucleus of this system; every member of the community has an interest or a stake in the educational system. Second, for every group action there exists within the social system past experience, either good or bad, with a history of success, failure, crisis, or conflict. The factors leading to success or failure should be carefully analyzed; good experiences should be capitalized upon, and poor experiences should be studied for techniques and actions to be avoided.

TECHNIQUES FOR PUBLIC RELATIONS

Past experience has shown that certain techniques are successful in helping the general public recognize the need for a program. The following general principles and specific suggestions may be helpful in building a good relations program:

1. Basic Education. This is long-range program, but is effective in getting facts across to the public.

2. Program Development Committees. Certain key people in the community study situations, problems, resources, etc. Publicizing their findings contributes to public awareness

3. Exploiting a Crisis. When a crisis arises, it may be used to point up certain needs. Examples are unexpected overcrowding in certain grades due to sudden in-migration, explosion of a boiler, breakdown of a heating or electrical system due to antiquated installations, etc.

4. Demonstration or Trial. A need for comparison may be created by demonstrating how improvements may be made.

5. Building on Past Experiences. For instance, the recent successful introduction, of new curriculum offerings (languages, sciences, etc.) or other programs (expansion of physical education or career education courses) maybe used to show that a new program is necessary and beneficial.

6. Channeling Complaints. If the public is against some aspect of the school system, it may be possible to channel this negative attitude into support for positive action.

7. Survey or Questionnaire. The process of planning, conducting, and analyzing a survey on school needs gives participants a clearer insight into the problems involved and may bring useful suggestions to the planning committee's attention. Some districts have used questionnaires at the polling places to get immediate feedback on why people voted the way they did.

There are many specific means of communicating with the public, and school planners should select the methods that prove most effective in their community. For all the opportunities provided by modern technology, the person-to-person approach remains by far the best public relations procedure. Civic organizations, the P.T.A., clubs, and other associations offer opportunity for this two-way exchange of information. Telephone campaigns and surveys (mentioned above) are also helpful in ascertaining community attitudes and opinions. Individual voters will react to different sources of information. It is important to use every available medium to get the message out. Do not expect that one flyer, advertisement, or one meeting will achieve the desired results.

a. Public informational meetings can be held by the school board and staff. Such meetings would be especially timely after the educational specifications have been formulated in order to bring the public up to date and give citizens an opportunity to react and to make suggestions.

b. Websites and internet bulletin boards are great methods of providing the most up to date information.

c. Newspaper articles are an excellent means of presenting a program. Editors and reporters should be asked for suggestions. Since effective utilization of newspapers means continuous use, series of articles should be planned, presenting the facts as simply as possible in a well-organized format. If acceptable to the paper, pictures should be used wherever feasible.

d. Local radio or community access television stations can be used for advertising, or perhaps someone can participate in a talk show.

e. A newsletter, notice, leaflet, flyer or inserts with school mailings can be used throughout the program to disseminate information and to announce hearings or meetings.

f. Tours of the existing facility for the public can point out the reasons for the project. Schedule tours at a variety of times to accommodate different schedules. Encourage all voters to come and see the situation.

One of the final and perhaps most important sources of information for the public is the brochure or report of the project that will be presented for approval. The contents of the brochure should be well planned, sufficient information must be included to provide full coverage of all aspects of the program, but care must be taken to keep the presentation brief and concise. The following features might be incorporated in this publication.

1. An attractive cover, possibly with a colored drawing of the new school or addition. A black and white photograph may be used if color is too expensive.

2. A section explaining the need for new construction. This might include enrollment projections, an analysis of present buildings, program needs, community needs and use. Tables, graphs, and charts are effective.

3. An explanation of how the proposed construction will meet these needs.

4. A floor plan or drawing of construction, with each room labeled and easily identifiable.

5. A section on the financial aspects of the program. This would include an estimated budget for the project, the borrowing capacity of the district, tax evaluations of the district, means of obtaining funds, the cost of borrowing money, the estimated annual effect of the tax rate, and any other pertinent details.

6. A section on the advantages of the project for the children and the community in general. Statements from citizens might be included here.

7. A complete list of committee members by areas of activity. This will inform the public that the project has been developed with thorough, careful planning.

The brochure can be printed as a separate pamphlet or published in a local newspaper with wide circulation. Discretion is advisable in choosing the format since many communities might tend to interpret an extravagant, elaborate publication as an indication that the building will involve unnecessary expense. If a public relations committee has been working closely with the planners at every stage, the information gathered from the public and familiarity with the community will be helpful in making this decision.

THE MESSAGE

In any public relations effort, the important thing to be done is to clearly communicate the message that you wish to be received. In the case of a school construction project the desired outcome is to have each voter attend the district meeting and vote in favor of the project, or simply vote in favor for those districts that use the official ballot method.

In order to gain a positive vote, the voter must be convinced that:

a. The project is necessary for the community at this time.
b. The proposed project is the best of all feasible alternatives that have been evaluated by the school board.
c. The proposed project is a wise use of the community's resources.

This sounds very simple, but often this simple message gets lost in all of the background noise. As explained in Chapter 1, the building committee and school board must objectively identify and evaluate all the feasible alternatives. The analysis of each alternative must be sufficient to be able to compare costs and effects on the educational program among all the alternatives. Nothing will halt momentum in a building campaign faster than to have someone stand up at a public meeting and ask if a particular solution has been considered; to have that solution sound like it makes sense; and to have not considered it.

Once an alternative has been selected, the entire building committee and school board must get behind it. If certain members continue to campaign for their favorite alternative, which was not selected, a confusing message will be sent to the voters and the likely result will be that nothing gets done. It might be wise to ask every potential member of the building committee if he or she will be willing to support the group's recommendation even if it is not the one that he or she would prefer. It is a little harder to do that with school board members, but perhaps the board could all formally agree at the beginning of the process to support the final choice of the group.

Listen and treat all opinions respectfully.

As much as possible, try to anticipate the questions and issues that will be brought up in opposition to the project. Try to have an answer for everything. Thorough planning will help accomplish this. Be able to say, "Yes we thought about that, but after looking at all the facts we decided …." Objective, quantitative responses to the arguments against the project will help convince reasonable people that the building committee and school board have come up with the best solution to meet the needs of the district.

Whatever happens, always be truthful. The need for the project should stand by itself. It should not be necessary to stretch or embellish the story. Do not use scare tactics such as impending loss of accreditation unless written information has been received that supports such a statement.

Employees of the school district should not be actively involved in the marketing campaign. Teachers should not send materials home with children in support (or opposition) to a project. The SAU office should only be involved in the provision of factual information not recommendations on how to vote.
Do not assume that the project is eligible for state aid, unless confirmation has been received from the state. Early contact with the Bureau of School Approval and Facility Management is important. Once confirmation has been received, stress the amount of funding from the state or other non-tax derived sources.

School boards should be careful about quoting cost estimates to the media, especially early in the process. Any estimate will be based on assumptions and incomplete information that may not be valid when it comes time to perform the actual construction. For this same reason, school boards should avoid pressing the architect for an estimate until the program has been developed and a site chosen. People tend to lock in on a cost number once that is published. Subsequent increases can be difficult to explain despite their accuracy and validity. When an estimate is finally published all assumptions must be included and fully explained. Thorough planning as explained in Chapter 1 can help greatly to assure that estimates are accurate and well understood. Any time that an estimate is published the board should stress the basis by which it was calculated and any remaining assumptions and should insist that full information be included in any publication. Inaccurate reports should be refuted immediately.

CHAPTER 16 – PROCEDURES FOR APPLYING FOR SCHOOL BUILDING AID

"School building aid was established in New Hampshire in 1955, with payments in 1956. Since then it has enjoyed more widespread legislative and public support for a longer period of time than any other state aid program."

From the NH School Facilities Study Committee Report, 1988

The purpose of this chapter is to outline the procedure that school districts must follow to have building projects approved for School Building Aid. The procedure follows the provisions of the law for building aid, RSA Chapter 198:15-a/w and Part Ed 321 of the NH Code of Administrative Rules. Persons concerned with building projects should be thoroughly familiar with the contents of the statute and rules. Forms and other information are available on the department website at www.ed.state.nh.us/buildingaid.

While many of the required documents may be provided by architects, state agencies, banks, and other entities, it is ultimately the responsibility of the school district to ensure that complete and accurate information is provided to the Bureau of School Approval and Facility Management.

The rates of eligibility for School Building Aid and the maximum allowable costs for the upcoming year will be published by the Bureau of School Approval and Facility Management in October of each year.

The estimated amount of School Building Aid to be provided to each district in the following fiscal year shall be provided to each district for verification by April of each year.

The actual amount of School Building Aid to be paid in the current fiscal year shall be published by September 30 of each year.

Districts may apply for the High Performance School Incentive to receive up to 3 percent in additional School Building Aid. Contact the Bureau of School Approval and Facility Management for instructions and criteria.

STEPS IN PROCEDURE FOR SCHOOL BUILDING AID APPROVAL

1. The local district should notify the State Department of Education, Bureau of School Approval and Facility Management, at the inception of the building program. A face to face meeting is recommended. State Department of Education consultants will be available to aid local districts in the planning and designing of the facilities.

2. Preliminary application Form A24P will be submitted to the Bureau of School Approval and Facility Management. The Form A24P should be accompanied by the educational specifications and preliminary drawings which include a site plan and floor plans with room dimensions and labels for the use of each space. The preliminary application should be submitted as soon as a construction alternative has been selected and a good cost estimate has been developed. Districts are encouraged to submit preliminary applications prior to their district meetings. The itemization of costs to be used to complete the Form A24P is provided in Appendix 5.

3. The Bureau of School Approval and Facility Management will issue From A24 PA upon approval of the preliminary application. In accordance with RSA 198:15-c, construction should not begin prior to approval from the Department of Education. Districts that begin construction before receiving approval risk the loss of School Building Aid.

4. A copy of the bond payment schedule should be submitted to the Bureau of School Approval and Facility Management as soon as it is available. School building Aid payments cannot begin without a copy of the bond payment schedule if financing is done with a bond.

5. Final drawings and building specifications should be submitted to the Department of Education and to the State Fire Marshal for final review as soon as they are available. Again, districts which begin

construction prior to approval of the design risk costly corrective actions and loss of School Building Aid.

6. The Bureau of School Approval and Facility Management will forward a letter to the school district noting any necessary changes to the design or any recommendations for improvement.

7. A letter of approval from the State Fire Marshal will be issued and distributed upon his approval of drawings and specifications.

8. Letters of approval are required from the Department of Environmental Services for wells and septic systems, and from the Department of Health and Human Services for food service operations. Appropriate design drawings and other information should be sent to those departments as soon as the information is available.

9. A written copy of the school or school district maintenance plan must be submitted to the Bureau of School Approval and Facility Management.

10. Form A24M, Maintenance Impact Analysis, must be submitted to the Bureau of School Approval and Facility Management.

11. A copy of the district's application for funding under the applicable utility company energy efficiency programs must be submitted to the Bureau of School Approval and Facility Management.

12. School Building Aid payments shall be made annually beginning after the district has made its first principal payment. The annual amount shall be calculated from the estimated costs on the Form A24P until final costs are known. Form A24P must be received by December 31st in order to receive School Building Aid payment in the following fiscal year in accordance with RSA 198:15-c.

13. Form A24F, final application, must be submitted by the school district after all construction work is complete and final actual costs are known. Future School Building Aid payments will be adjusted based on final costs. School Building Aid may be withheld if the Form A24C is not received within a reasonable period of time following completion of the project.

14. The Bureau of School Approval and Facility Management will provide Form A24C to indicate that all documentation has been received and that the project is completely approved for School building Aid.

GENERAL

The Bureau of School Approval and Facility Management is available to provide advice and technical assistance to school districts on all aspects of facility management including planning, construction, facility evaluation, selection of design professionals, financing, and maintenance.

The Bureau manages any federal programs or grants concerning construction, renovation, or repair of school facilities.

The Bureau maintains an extensive library of information on construction and facility management as well as information on vendors and products.

OTHER CONSTRUCTION AID PROGRAMS

The Department of Education also administers aid programs for the construction of new kindergarten classrooms and for the construction or renovation of regional career and technical centers. Districts undertaking projects in those types of facilities should contact the Department of Education for information about these programs.

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GLOSSARY

ABC Associated Builders and Contractors, Inc.

ADA Americans with Disabilities Act

ADAAG Americans with Disabilities Act Accessibility Guidelines

AIA American Institute of Architects

AGC Associated General Contractors of America

ANSI American National Standards Institute

ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers

ASTM American Society for Testing and Materials

BOCA Building Operators and Code Administrators International

BTU British Thermal Unit (used to measure heat energy)

CEFPI Council of Educational Facilities Planners International

CHPS Collaborative for High Performance Schools

CFR Code of Federal Regulations

CM Construction Manager or Construction Management

CMU Concrete Masonry Unit (the standard concrete block)

GC General Contractor

GMP Guaranteed Maximum Price

IAQ Indoor Air Quality

IBC International Building Code

ICC International Code Council

IEQ Indoor Environmental Quality

IESNA Illuminating Engineering Society of North America

KWH Kilo-Watt Hour (used to measure electricity consumption)

LEED Leadership in Energy and Environmental Design

MERV Minimum Efficiency Rating Value (For rating air filters)

MSDS Material Safety Data Sheet

NCEF National Clearinghouse for Educational Facilities

NEC National Electric Code

NFPA National Fire Protection Association

O & M Operations and Maintenance

RFI Request for Interest

RFP Request for Proposal

RSA Revised Statutes Annotated (Laws of the State of New Hampshire)

SHPO State Historical Preservation Officer

SMACNA Sheet Metal and Air Conditioning Contractors National Association

UFAS Uniform Federal Accessibility Standards

USGBC United States Green Building Council

As-built drawings are the edited design drawings that reflect what has actually been built. The term is often incorrectly used to refer to record drawings, which are the final corrected and accurate drawings of the facility after construction has been completed.

Buildable land means land upon which a school building, parking lot, or school playing field can be built. Wetlands, including required setbacks from wetlands; areas with slopes in excess of 60 percent; areas with extensive amounts of bedrock within 6 feet of the surface; and sites known to be contaminated with hazardous materials are not buildable land.

Construction cost means the total cost of labor and materials for the construction of the foundation, erection of the structure, finish work, and the installation of equipment integral to the operation of building systems.

Core space means those spaces in a school facility that:

(1) Serve a general function to operate the building;

(2) Provide the overall academic program; or

(3) Are used by the majority of students and staff as support space, but may occasionally be used as educational space.

Typical examples of core space include main administrative offices, libraries, gymnasiums, cafeterias, and kitchens.

Design capacity means the maximum total number of students intended to be educated in a school building following completion of a construction project. This number is usually based upon a projected future enrollment that the district intends to house in the new or renovated facility.

Educational capacity of a school building means the sum of the maximum number of students that can be simultaneously instructed in every educational space of the building using the minimum space allocations specified in Ed 321.10. In an existing building educational, capacity is measured dimensionally. In a proposed facility, educational capacity is determined by dividing the design capacity by the utilization rate.

Educational space means those parts of a school building to which pupils are assigned for instructional purposes.

General purpose classroom means an educational space intended for the instruction of a group of students that is suitable for teaching a variety of subjects and that requires no special permanently installed equipment or unusually large spaces.

Modular construction means a type of building construction that involves the prefabrication of large pieces of the final structure at a location off the site and then the installation and connection of those pieces on the actual school site. The term modular is often misused in reference to portable or relocatable classrooms. Modular construction may refer to temporary or permanent construction.

Multi-purpose space means areas within a school building that are used at different times for educational purposes and for support purposes.

New construction means construction work that results in the creation of a new building or additional space in an existing building. Work involving upgrades to existing space or conversion of the use of existing space is renovation, not new construction.

Record Drawings are the final drawings which reflect the building as actually constructed. All dimensions, locations of equipment, and other information should be accurately depicted. The term, as-built drawings, is often misused to refer to record drawings.

Relocatable classroom (also portable classroom) means a supplementary educational facility intended for temporary use, generally fabricated off site, in one or more sections, and moved to and erected at the desired location. These facilities are often inaccurately called modular units.

Renovation means work involving upgrades to existing space in a building or conversion of the use of existing space in a building.

Substantial renovation means:

(1) Construction done for the purpose of renewing a building that is valued at an amount greater than 25 percent of the cost to replace the building;

(2) To repair and bring the building back to new or good condition; or

(3) To prepare space for a new or different use.

Support space means those parts of a school building that are generally not used for instruction or rarely used for instruction.

Total cost means the cost of all related land, labor and materials authorized by RSA 198:15-b, IV for construction costs.

Utilization rate means the extent to which school buildings are used by comparing actual student enrollment to the educational capacity of the school. Recommended utilization rates are 85% for high schools, 90% for middle schools, and 95% for elementary schools.

Value Engineering is a systematic evaluation procedure directed at analyzing the function of materials, systems, processes, and building equipment for the purpose of achieving required functions at the lowest total cost of ownership. The term is often incorrectly used to describe cost cutting measures.

APPENDIX 1 – SPECIAL CONSIDERATIONS FOR RENOVATION PROJECTS

1. To be eligible for School Building Aid, the cost of a renovation project must be at least 25% of the cost to replace the building or $5 million, whichever is less. See Administrative Rules Ed 321.27.

2. Every school constructed prior to 1989 is required by federal law to have an asbestos management plan. Designers should review the asbestos management plan at the beginning of the design phase. If the project involves work in newly acquired facilities that were built prior to 1989, an asbestos inspection must be conducted and an asbestos management plan developed for the facility. Asbestos plans must be updated following construction.

3. A traffic control plan must be developed and implemented. As much as possible, contractor traffic should be kept separate from bus, parent, and student vehicle routes.

4. Procedures for identification and authorized access by contractors must be established. The school administration should be provided a schedule indicating which sub-contractors will be on site every day.

5. Modify the emergency evacuation plan as necessary. Conduct an evacuation drill under the modified plan as soon as possible.

6. A dust control plan must be developed, implemented, and monitored. Follow SMACNA *IAQ Guidelines for Occupied Buildings Under Construction*.

7. Seal all doors and windows adjacent to the renovation area with plastic sheets and duct tape. Close open corridors between the occupied area and the renovation area with plywood or other appropriate materials and create an air tight seal between the areas as well. See Chapter 12.

8. Isolate air intakes into the occupied part of the building. Close intakes adjacent to the renovation area. Redirect fresh air as necessary into the occupied area.

9. Modify cleaning cleaning schedules and procedures as necessary to maintain cleanliness of the occupied area.

10. A plan and system for notifying staff, students, and parents of construction activities must be developed and implemented.

11. Barricades to keep unauthorized people out of construction areas must be installed.

12. Weekly coordination meetings should be held between the school administration and the construction contractor. Daily meetings may be necessary at certain times. Especially noisy construction work must be scheduled around school activities.

13. Address safety violations promptly.

14. Use the construction project as a teaching tool.

15. Contingency Budgets should be higher than new construction. At least ten percent is recommended.

16. Design costs will be a higher percentage of the total cost than in new construction due to the need to assess the existing building before design can start.

APPENDIX 2 - RECOMMENDED TIMELINE FOR SCHOOL CONSTRUCTION PROJECTS

# Months Prior to bond vote	
24	Appropriate funds for initial demographics studies and facility audits.
23	Retain consultant services to conduct demographic studies to ascertain future location of student populations and projected enrollment estimates.
	Solicit contract for audits of existing facilities.
22	Conduct demographic studies and facility audits.
21	Analyze results of studies and audits.
20	Write educational specifications (See Chapter 4).
18	Form Building Committee (See Chapter 1).
17	Identify feasible alternatives that meet requirements of educational specifications.
16	Hire architect or educational consultant to develop initial and life cycle cost estimates for all feasible alternatives. Estimate tax impact of each alternative.
14	Hold public meetings for input on alternatives.
13	Evaluate alternatives. Rank order alternatives. Choose preferred alternative.
	Contact Bureau of School Approval and Facility Management for information and advice.
12	Appropriate funds for design of preferred alternative to at least concept design level and site evaluations. Amount should be at least 3% of estimate total cost for the preferred alternative.
11	Hire architect to proceed with design (See Chapter 3).
10	Architect conducts staff interviews.
	Determine method of construction delivery to be used (See Chapter 13).
9	Solicit and hire construction manager if construction management method is to be used (See Chapter 13).
	Identify possible construction sites if necessary (See Chapter 5).
8	Conduct surveys and evaluations of potential construction sites (See Chapter 5).
	Proceed to schematic designs. Recommend at least 3.
7	Choose preferred schematic design.
	Develop marketing plan (See Chapter 15).
	Select land to purchase and secure option to buy.

# Months Prior to bond vote	
6	Proceed to concept design.
	Implement marketing plan.
4	Finalize cost estimate.
	Submit preliminary application for School Building Aid (See Chapter 16).
	Contact potential financial institutions for bond rates etc.
	Finalize tax impact estimate.
	Continue marketing efforts.
3	Write warrant article.
	Continue marketing efforts.
2	Hold bond hearings as required (See Chapter 14).
	SB2 districts hold deliberative session (See Chapter 14).
	Continue marketing efforts.
0	Conduct district meeting and/or vote.
	Hire architect and proceed to final design.
	Issue RFP for General Contractor if necessary (See Chapter 13).
+1	Select and negotiate with General Contractor.
	Hire General Contractor.
	Apply for permits (See Chapter 2).
	Submit additional documentation for School Building Aid (See Chapter 16).
+3	Conduct ground breaking ceremony.
	Begin Construction.
	Initiate bond sale.
+4	Sell Bond.
+17 to +30	Begin classes in new facility.

APPENDIX 3 – SCHOOL DESIGN REVIEW CHECKLIST

This checklist is used by the Bureau of School Approval and Facility Management to review school design drawings and specifications.

Site Layout:

- Ingress/egress is safe and wisely planned. Traffic pattern is smooth.
- Two access routes for emergency vehicles. Emergency vehicle access to athletic fields.
- Separate bus ingress, egress, loading and parking areas.
- Separate parent drop off.
- Circulation: smooth student traffic flow between buildings.
- Playfield layout: efficient use of space and can be easily supervised.
- Placement of buildings: favorable orientation to wind, sun, rain, and natural lighting, majority of windows on north/south sides.
- Ventilation air intakes located away from bus parking areas and other sources of pollution.
- Design of school does not create supervision problems.
- Indicate location of planned future expansion.
- Appropriate site security; proper fencing, adequate lighting, alarms.
- Fence around detention ponds. Detention ponds are discouraged.
- Check for nooks and crannies where leaves may accumulate or where sunlight may not reach to help melt ice on walkways.
- Avoid planting grass on small traffic islands.

Classrooms:

- Proposed student capacity of the school is consistent with the needs of the district.
- Meet requirements of administrative rules, Ed 305.
- Capacity of classrooms and number of teaching stations are commensurate with educational specifications.

Science:

- Eyewashes and deluge shower are located in science lab.
- Science classrooms meet Admin. Rules ED 321.
- Maximum of 24 students in labs.
- Adequate circulation space between build-in stations.
- Fume hoods for science laboratories.
- Secured storage area for chemicals.
- Labs included ADA compliant work stations.

Administration & Guidance:

- Direct access for students to pupil personnel services area.
- Accessible countertops, (handicapped and primary) partial high, partial low.
- Appropriate rooms provided for private meetings with students and parents.
- Main office and nurse located near main entrance.

Kindergarten:

- Coat rack locations and cubbies are well located.
- Window locations and height of sills (3-4') are appropriate.
- Cabinet heights are appropriate.
- Play area is visible for supervision.
- Amount and type of storage is adequate.
- Appropriate sink placement and height of drinking fountains.
- Separate washroom provided.
- At least 1000 sq. ft. overall.
- Easily accessible to pick-up or bus loading.
- Direct exit to outside.

Locker/Gym/Cafeteria/Library:

- Locker rooms located with direct access to outside playing fields to avoid tracking mud through the building.
- Provisions for public use of toilets without access to locker or team rooms.
- If public use areas are to be separated from other areas by locked doors, adequate toilet facilities must be included within the public access area.
- Windows in coaches' offices placed so shower and locker area can be monitored.
- Number and location of exits appropriate.
- Appropriate ceiling height (gym min 20', multi 16' ok).
- Adequate shower/locker space.
- Smooth traffic flow in cafeteria lines.
- Sufficient seating provided for largest planned lunch period.
- Stage/platform area must be ADA compliant.
- Kitchen located on outside wall.
- Direct access from loading area to food storage.
- Direct access to trash dumpsters from kitchen.

Interior Layout & Systems:

- Effective layout of lighting grids, energy saving light fixtures, usage of natural lighting, window placement.
- Adequate ventilation, unit ventilators are discouraged.
- High efficiency equipment specified. Energy Star labeled.
- Durable, high quality carpet specified.
- Book cases – proper placement and height.
- Washrooms should be conveniently located and easily accessible. Smaller washrooms spread throughout the building are preferred over large central washrooms.
- Plumbing fixtures placed at age appropriate heights.
- Location of special education classes should not all be grouped together such as special education wing or cluster.
- Smooth traffic pattern between educational spaces and support areas.
- Grades K-1 on first floor, Grade 2 no higher than second floor.

Miscellaneous:

- Consistent floor layout for all sections of the drawings.
- ADA compliance throughout.
- Adequate entrances and exits located for efficient traffic flow and safety.
- Adequate amount of storage.
- Access ladders to multi-roof levels.
- Scuppers and overflow drains on flat roofs.
- Check for potential noise problems.
- Adequate teacher work area.
- Educational spaces in basements must have fire sprinklers.
- Check wall sections and roof details for proper overlapping of flashing etc. to keep water where it is intended to be.
- Check for moisture and air barriers where appropriate.
- If a membrane roof is included, fully adhered membranes are preferred over mechanically fastened membranes.

APPENDIX 4 – SCHOOL SECURITY CHECKLIST

The following checklist was developed by the State of Wyoming

- Building Exterior
  - Provide graffiti-repellant exterior wall finishes that allow for repeated cleanings
  - Create one clearly marked, visible visitors entrance
  - Provide exterior courtyards that can be supervised by one person

- Security Systems
  - Install remotely monitored, central alarm systems
  - Ensure that key areas are protected by the alarm system, including the main office, computer areas, cafeteria, gymnasium, shops, labs, and others
  - Install two-way communications between areas such as classrooms and the main office, portable classrooms and the main office, and large group areas and the main office

- Lighting
  - Ensure the school perimeter is well lit with appropriate fixtures that will not disrupt nearby residential areas
  - Provide sufficient lighting with marginal coverage in case a light goes out
  - Specify accessible light fixture lenses made of unbreakable material
  - Provide additional lighting at entries and possible points of intrusion
  - Locate switches, controls, and electrical panels in restricted access areas, protected from tampering

- Signage
  - Install signs declaring school grounds as drug-free and gun-free zones
  - Install signs indicating the penalty for trespassing
  - Provide welcome signs directing visitors to check in at the main office
  - Use exterior signage to direct visitors to the main office and other public spaces
  - Create signage that encourages wayfinding that is consistent throughout the building

- Outbuildings
  - Locate outbuildings, shads, and portable classrooms on the site to allow clear sight lines and visibility
  - Provide portable classrooms with securely fastened panels to enclose grade-level crawl spaces

APPENDIX 5 – ITEMIZATION OF CONSTRUCTION COSTS

The following lists indicate eligible and ineligible costs and where various project costs should be itemized for completion of Department of Education School Building Aid Forms.

Costs Included in Construction Cost

Forming for foundation
Pouring/construction of foundation
Building frame
Building envelope
- Doors
- Roof
- Walls
- Windows

Interior partitions
Heating System Equipment
- Boilers and burners
- Distribution piping
- Fuel Tanks
- Furnaces
- Heating units

Ventilation System Equipment
- Air Handlers
- Ductwork
- Rooftop Units
- VAV Units

Cooling Systems equipment
- Chillers
- Distribution piping or ductwork
- Rooftop units

Electrical Systems and Lighting
- Conduit
- Controls
- Junction boxes
- Lamps – one set installed
- Light fixtures
- Main panels
- Metering
- Occupancy Sensors
- Receptacles
- Sub-panels
- Switches
- Transformers
- Wiring

Plumbing systems
- Filtration systems
- Fixtures
- Holding Tanks

Partitions
Piping
- Pumps
- Radon removal systems
- Water Heaters

Waste disposal systems
- Backflow preventers
- Drain pipes
- Drains
- Force Mains
- Holding tanks
- Pumps
- Vents

Building Control Systems
Casework
Interior Finishes
- Ceilings
- Floors
- Walls

Telecommunications
- Backboards
- Cable Trays
- Conduit
- Connection terminals
- Interior Wiring
- Junction boxes
- Outlets

Bleachers
Auditorium Seating
Elevators

Not Included in Construction Cost, but Eligible for School Building Aid

Land Acquisition costs
Surveying
Geotechnical studies
Environmental studies
Historical/Archeological Studies
Architect and Engineer Fees
Permit Fees
Legal reviews
Demolition
Sitework
- Clearing & Grubbing
- Cut & Fill
- Blasting
- Final Grading
- Drainage structures
- Topsoil placement
- Seeding

Paving, new surfaces only
Septic systems from one foot outside building footprint
Water supply systems from one foot outside building footprint
- Wells
- Service piping and connection to municipal water supply

Furniture
Window treatments
Copiers
Telephones

Fax machines
Intercom equipment
Telephone equipment
Laboratory Equipment
Athletic Equipment that is attached to the building i.e. basketball backboards
Security Systems

Costs that are eligible for School Building Aid for new schools only on a one time basis

Outdoor athletic fields
- Fencing
- Seating
- Lighting
- Competition areas

Playgrounds and playground equipment
Library books
Computers, except those that are part of building control systems
Software for school administration
Servers and routers

Costs that are not eligible for School Building Aid

Anything funded by gifts, donations, bequests, charitable trusts, other state or federal grants
Finance charges and interest
Text books
Educational software
Athletic equipment that is not fastened to the building
Musical Instruments
Band and athletic uniforms
Cleaning Equipment
General expendable supplies
- Cleaning supplies
- Office supplies
- Repair parts

Resurfacing of paved areas
Resurfacing of tracks
Replacement gym floors
Resodding or reseeding of athletic fields and other grass areas
Vehicles including lawn mowers and similar equipment
Hand tools
Swimming pools
Field Houses
Indoor tracks, except suspended tracks
Indoor tennis courts
Auditoriums in elementary schools
Auditoriums in high schools and middle schools with seating capacity more than 50% of The school design capacity including staff
Ice skating rinks
Artificial turf on athletic fields

Categorization of Costs for Forms A24P and A24F

Item #3, Construction Costs. These costs are subject to the maximum allowable cost limit established annually pursuant to RSA 198:15-b, VII (a).

Include the costs of labor and materials for the following components under Construction Costs in Item #3:

a. Foundations
   - Footings
   - Slabs on grade
   - Slabs below grade
   - Retaining walls
   - Piles and piers

b. Structural framing

c. Building Envelope
   - Wall systems
     - Exterior Cladding
     - Interior wall board
     - CMU backing
     - Sheathing
     - Insulation
     - Moisture & Air barriers
     - EIFS
   - Roofs
     - Decking
     - Insulation
     - Surfacing Materials
     - Pavers or other walking surfaces
     - Drains, gutters, down spouts, and scuppers
     - Penthouses
   - Windows
   - Clerestories
   - Light shelves
   - Awnings
   - Vestibules
   - Covered entrances
   - Doors

d. Interior partition walls
   - Framing
   - Wall board
   - Insulation
   - CMU
   - Doors
   - Windows
   - Finishes (Painting, ceramic tile, wall paper etc.)
   - Base boards and/or base moldings

e. Flooring
   - Decks
   - Underlayment
   - Finishes (resilient flooring, ceramic tile, quarry tile, carpet, epoxy etc.)

f. Ceilings

- Framing
- Acoustical tiles
- Surfacing materials
- Finishes

g. Plumbing
   - Fixtures
   - Service pipes
   - Waste/drain pipes
   - Vents
   - Valves
   - Pumps
   - Backflow preventers
   - Domestic water heaters
   - Storage and expansion tanks
   - Grease traps
   - Controls

h. Electrical
   - Wiring and conduit
   - Main and sub-panels
   - Junction boxes
   - Transformers located inside the building
   - Switches
   - Meters
   - Light fixtures
   - Receptacles
   - Grounding system
   - Controls
   - Photo-voltaic panels

i. HVAC
   - Boilers
   - Furnaces
   - Burners
   - Interior fuel storage tanks
   - Vents, stacks, chimneys
   - Piping
   - Pumps
   - Heating units (Separate or system)
     - Unit ventilators
     - Cabinet heaters
     - Fin tube
     - Radiant
     - Packaged
   - Solar heat panels
   - Chillers
   - Duct work
   - Distribution Units
   - Diffusers
   - Grilles, louvers etc.
   - VAV units
   - Fans
   - Controls

j. Communications Systems
   - Inside wiring and cable trays

Ports, outlets, and receptacles
Terminal blocks and boxes
Backboards
Telephone switching equipment
Intercom system equipment
Clock systems
Data system servers and routers
Main frames
Uninterrupted power supply systems

k. Life Safety Systems
   Fire alarm
   Fire suppression
      Holding tank
      Pumps
      Piping
      Sprinkler heads
   Fire barrier systems
   Emergency lighting
   Egress signage
   Security systems
      Video cameras and related equipment
      Physical security equipment (locks, window bars etc.)
      Intrusion detection systems
      Alarms
      Security lighting
      Built-in metal detectors
   Radon removal systems
   Air quality monitoring systems
   Structural monitoring/warning systems
   Emergency shower/eye wash

l. Other
   Casework
   Built-in cases
   Built-in/walk-in freezers and coolers
   Elevators and lifts
   Fixed auditorium seating
   Interior demolition and disposal
   Abatement, removal, and/or disposal of hazardous materials
   Interior signage
   Acoustical treatments

Items #1, #2, #4-#9 are not subject to the maximum allowable cost restrictions.

Item #1, Site Acquisition Cost

a. Cost of land, including land purchased in past years
b. Fees paid to real estate professionals
c. Site investigations
   Geotechnical studies
   Environmental assessments
   Historical studies
   Surveying

Item #2, Site Development

a. Clearing and grubbing
b. Demolition
c. Abatement, removal, and/or disposal of hazardous materials
d. Stripping and stockpiling topsoil
e. Blasting
f. Grading
g. Cut and fill
h. Excavation
i. Removal of unsuitable soil
j. Erosion control
k. Wetlands mitigation activities
l. Environmental protection
m. Water Supply
    - Well drilling and pump installation
    - Water service work not performed by municipality or water district
        (From property boundary to the building only)
    - Outside storage tanks
    - Irrigation systems
n. Sewer service
    - Construction of septic systems
        - Leach fields
        - Holding tanks
        - Piping
        - Pumps
    - Construction of mains to municipal service
o. Storm water drainage
    - Catch basins
    - Culverts
    - Detention ponds and/or swales
    - Sub-surface systems
    - Oil/water separators
p. Exterior lighting
q. Customer owned outside plant for telecommunications/data
r. Landscaping
    - Final grading
    - Replacement of topsoil
    - Seeding
    - Trees and shrubs
    - Retaining walls
    - Edging
s. Paving
    - Access roads and driveways
    - Parking lots
    - Sidewalks
    - Curbing
    - Pavement marking, striping etc.
t. Outdoor facilities and equipment
    - Athletic fields and seating, including goals, nets, fencing as required
    - Playgrounds and playground equipment
    - Bus stop shelters
    - Storage sheds
    - Emergency power generators
    - Pump houses
    - Outside transformers

Outside fuel storage tanks

u. Fencing, gates, and barricades
v. Exterior signage

Item #4, Construction Manager Fees

Only if the project is done through a construction management contract, indicate the cost of construction manager services. Otherwise leave blank.

Item #5, Architectural/Engineer Fees

These fees must be reported separately from construction costs or administrative costs for all types of contracts including design-build.

a. Fees for design paid to architects and/or engineers
b. Fees paid to architects and/or engineers for work done during the pre-design phase
c. Fees for construction contract administration and/or A/E services during construction provided by architects and/or engineers
d. Cost of planning studies and evaluations not included under site acquisition
e. Cost of commissioning if done through a separate contract

Item #6, Furniture and Equipment

a. All moveable furniture
b. Indoor bleachers
c. Window treatments
d. Stage curtains
e. Special auditorium lighting and controls
f. Auditorium and gym sound systems
g. Office machines
h. Computers not associated with building control systems (new schools only)
i. Telephone sets
j. Science lab equipment
k. Kitchen equipment except built-in/walk-in freezers and coolers
l. All moveable shelving and storage systems
m. Library books (new schools only)
n. Administrative software (new schools only)
o. Band/chorus risers
p. Barres for dance instruction
q. Basketball goals and safety pads that are fastened to the building
r. Student and staff storage lockers
s. Gym lockers
t. Portable metal detectors and similar security equipment
u. Kilns
v. Darkroom equipment
w. Family and Consumer Sciences Education appliances and equipment
x. Technology Education equipment
y. Refuse containers (Trash cans, dumpsters, recycling bins etc.)

Item #7, Utilities & Services

Only include costs paid to utility companies or to municipalities for municipally provided utility services (Water, sewer, power, gas, telephone, CATV, fire alarm) on school owned property.

a. Cost to relocate utility plant
b. Cost to bring utility services from the property boundary to the building
c. Connection charges

Costs to extend or upgrade utility services not on school owned property are not eligible for School Building Aid.

Item #8, Legal/Administrative Costs

a. Permit fees
b. Legal document review
c. Clerk of the Works
d. Materials testing
e. General Conditions Costs
    Temporary power
    Portable toilets
    Contractor overhead if provided separately
    Construction site security
    Safety requirements
    Insurance
f. Cost of temporary classrooms or other facilities directly caused by the construction project

Item #9, Contingency

Provide only on Form A24P.

Do not include:

a. Textbooks
b. Educational Software
c. Athletic equipment
d. Portable basketball goals, volley ball nets etc.
e. Musical instruments
f. Uniforms
g. Costumes, stage props, etc.
h. General classroom and office supplies
i. Any leased equipment
j. Financing and/or bonding fees or interest
k. Costs for work not done on school owned property
l. Vehicles, including lawnmowers, snowblowers etc.
m. Hand tools
n. Custodial supplies and equipment
o. Spare parts
p. Vending machines

APPENDIX 6 - BOND CHECKLISTS

The information on the following pages provides a detailed listing of steps to be followed and information that will be required for approval of a bond. This material was graciously provided by David Barnes, Esquire, from Devine, Millimet, and Branch P.A.

There are four checklists. One is for a single town district that uses the town meeting format. One is for a single town district that uses the official ballot. One is for a cooperative district that uses the town meeting format, and one is for a cooperative district that uses the official ballot.

MATERIALS TO BE FURNISHED TO BOND COUNSEL IN CONNECTION WITH BONDS ISSUED BY NEW HAMPSHIRE SCHOOL DISTRICTS (NOT INCLUDING COOPERATIVE SCHOOL DISTRICTS) WHICH HAVE NOT ADOPTED RSA 40:13 (THE "OFFICIAL BALLOT LAW" OR "SENATE BILL 2")

Following is a list of materials which bond counsel will need to receive and review in order to render an approving opinion about your School District's proposed bond issue. Please call with any questions or comments.

In computing the time periods referenced below, neither the first nor last day of a prescribed period may be counted. For example, for a Warrant to be posted 14 days prior to a March 20 Annual District Meeting, the Warrant may be posted no later than March 5. To emphasize this point, the list below consistently refers to a specified number of "clear" days.

Subject to the foregoing, we will need to receive and review the following:

1. Copy of Charter of municipality within which School District is located; or, alternatively, special legislative charter for School District (Bond Counsel will procure this item).

2. Certificate of District Clerk (in form attached as Exhibit A).

3. Copy of School District budget.

4. The following materials regarding appropriations contained in the district budget or in separate warrant articles:

   a. Evidence that notice of the public hearing on the proposed budget and special warrant articles appropriating money was published or posted at least seven (7) "clear" days prior to the date of the hearing;

   b. Minutes of the public hearing on the proposed budget and special warrant articles appropriating money showing that the hearing was held at least twenty-five (25) "clear" days prior to the date of the district meeting;

   c. A certificate that an original of the budget and any recommendations on special warrant articles appropriating money was placed on file with the district clerk and forwarded to the Commissioner of the Department of Revenue Administrations;

   d. In those districts which are subject to a Budget Committee established under RSA 32, a certificate that two (2) copies of the budget and any recommendations on special warrant articles were delivered to the School Board at least twenty (20) "clear" days prior to the date of the district meeting; and

   e. In those districts which have established a Budget Committee under RSA 32, a certificate of the District Clerk showing the total amount appropriated at the district meeting.

5. If, and only if, the bond issue in question is in excess of $100,000:

   a. Evidence that notice of School Board's Public Hearing on the bond issue was published in a newspaper of general circulation in the District at least seven (7) "clear" days prior to the date of the Public Hearing;

   b. Minutes of School Board's Public Hearing on the bond issue showing that the same was held at least fifteen (15) "clear" days, but not more than sixty (60) "clear" days prior to the date of the School District Meeting;

6. A copy of the Warrant for the School District Meeting including the Bond Warrant Articles in consecutive numerical order and before all other warrant articles except warrant articles dealing with the election of officers (see attached proposed form of bond warrant article attached as Exhibit B). (Any bond warrant article shall contain a notation of whether or not the appropriation is recommended by the School Board and the Budget Committee, if any);

7. Certificate that Warrant for School District Meeting was posted at the place of the meeting and at least one (1) other public place in the District at least fourteen (14) "clear" days prior to the date of the School District Meeting;

8. Certificate that Budget was posted with the Warrant;

9. Extract of minutes of School District Meeting showing:

   a. All votes, if any, to adjourn the meeting to the date on which the vote to authorize the bonds was taken;

   b. That the bond issue was authorized by at least a two-thirds (2/3) vote of those present and voting at the meeting;

   c. That the vote on the bond issue was taken by secret written ballot;

   d. That there was a separate ballot box for each bond issue voted on at the meeting;

   e. That the polls were open for at least one hour; and

   f. Whether there was any motion made to reconsider the vote on the bond issue.

10. If the bond issue was subject to a reconsideration vote:

   a. Extract of district meeting minutes showing that motion to reconsider was posted by majority vote and establishing date, time and place of reconsideration vote;

   b. Evidence that actual reconsideration vote took place at least seven (7) days after the original vote on the motion to reconsider;

   c. Evidence that notice of the time and place of the reconsideration vote was published in a newspaper of general circulation in the district at least two (2) days before the reconsideration vote; and

   d. Minutes of said vote addressing those matters set forth in paragraph 9, above.

11. A specimen of the ballot used in the vote of the bond issue.

12. Certificate Regarding Outstanding Net Indebtedness (in form attached as Exhibit C) from district and other municipalities (e.g., town, village district, etc.) that cover the same geographical territory as the district.

13. A Debt Limit Certificate from the State Board of Tax and Land Appeals (bond counsel will procure this item).

14. If, and only if, the bond has been authorized at a special meeting:

a. When the school board has voted to petition the superior court for permission to hold a special meeting (i) evidence that notice of such vote was posted at the office of the school board and two (2) other conspicuous places in the district within twenty-four (24) hours after taking the vote and a minimum of ten (10) days prior to filing the petition with the court; (ii) evidence that such notice was published in the next available edition of a local newspaper with a wide circulation in the district; and (iii) evidence that notice of the court date for an evidentiary hearing on the petition was posted, as aforesaid, within twenty-four (24) hours after receiving notice of the court date from the court.

b. Evidence that Commissioner of Revenue Administration was notified of the District's plans to hold an emergency special meeting (i) showing that such notice was given at least ten (10) days prior to petitioning the Superior Court; (ii) showing that such notice was furnished by certified mail; (iii) explaining the nature of the emergency; (iv) including a copy of the proposed warrant articles(s); and (v) including a copy of the petition to the Superior Court.

c. The petition to the superior court for permission to hold an emergency special meeting (including Certification that Commissioner of Department of Revenue Administration was notified);

d. Order of superior court authorizing District to hold an emergency special meeting; and

e. Affidavit of publication with tear sheet attached showing that a copy of the Warrant for the special meeting was published within one (1) week after the posting thereof in a newspaper having general circulation in the District.

15. If, and only if, the bond is to be guaranteed, in whole or in part, by the State of New Hampshire:

a. The action taken by the State School Building Authority approving the guaranty; and

b. The resolution of the Governor and Council of the State of New Hampshire authorizing the State guaranty of the bond.

16. The District's federal tax employer identification number.

17. Copies of any filings made with the Internal Revenue Service (Form 8038-G) regarding other bonds or notes issued in the same calendar year as the bonds.

18. A description of any existing or proposed temporary financing for the Project to be financed with the proceeds of the bond (e.g., bond anticipation notes).

19. A copy of the application filed with the New Hampshire Municipal Bond Bank (in the event the bond is to be sold to the Bond Bank).

M0700075

EXHIBIT A

_____ SCHOOL DISTRICT, NEW HAMPSHIRE (the " District")
MUNICIPAL BOND (the "Bond")

DISTRICT CLERK'S CERTIFICATE

The undersigned Clerk of the District hereby certifies as follows with respect to the District's issuance of the Bond:

The District is not a Cooperative School District established pursuant to RSA 195;

The District has/has not adopted the provisions of the Municipal Budget Act, RSA 32;

The District has/has not adopted the provisions of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2");

There are/are not any village districts located within the District. (If there is a village district located within the District, the same is known as follows: (_____).
(name of village district)

The District does not have any charter provisions, ordinances, regulations or standing rules, bylaws or votes affecting, limiting or restricting the District's ability to (i) issue the Bond; (ii) appropriate or spend money; (iii) levy or collect real estate taxes or (iv) complete the project to be financed with the proceeds of the Bond.

The District does/does not have a seal.

Dated this ____ day of _____, 20__.

_____
District Clerk

(District Seal, if any)

EXHIBIT B

(PROPOSED FORM OF BOND WARRANT ARTICLE)

Article ___. To see if the District will vote to raise and appropriate the sum of _____ Dollars ($_____) for the purpose of _____ _____ _____; _____ Dollars ($_____) of such sum to be raised through the issuance of bonds or notes under and in compliance with the Municipal Finance Act, RSA 33:1 et seq., as amended; to authorize the School Board to apply for, obtain and accept federal, state or other aid, if any, which may be available for said project and to comply with all laws applicable to said project; to authorize the School Board to issue, negotiate, sell and deliver said bonds and notes and to determine the rate of interest thereon and the maturity and other terms thereof; and to authorize the School Board to take any other action or to pass any other vote relative thereto. (Recommended by School Board (and Budget Committee)).

EXHIBIT C

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ SCHOOL DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ School District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 200__.

1.	GROSS DEBT:	
	Outstanding debt	$_____
	Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Notes issued in anticipation of grant of federal or state aid (including notes issued under RSA 198:20-d in anticipation of catastrophic aid and notes issued in anticipation of state adequate education grants)	
	b. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____
	c. Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Total Deductions (a, b and c)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

TOWN OF _____, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the Town of _____, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m.	Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n.	Tax-increment financings pursuant to RSA 162-K	$_____
		Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")		$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ VILLAGE DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Village District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m.	Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n.	Tax-increment financings pursuant to RSA 162-K	$_____
		Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")		$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

MATERIALS TO BE FURNISHED TO BOND COUNSEL IN CONNECTION WITH BONDS ISSUED BY A NEW HAMPSHIRE COOPERATIVE SCHOOL DISTRICT WHICH HAS NOT ADOPTED RSA 40:13 (THE "OFFICIAL BALLOT LAW" OR "SENATE BILL 2")

Following is a list of materials which bond counsel will need to receive and review in order to render an approving opinion about your Cooperative School District's proposed bond issue. Please call with any questions or comments.

In computing the time periods referenced below, neither the first nor last day of a prescribed period may be counted. For example, for a Warrant to be posted 14 days prior to a March 20 Annual District Meeting, the Warrant may be posted no later than March 5. To emphasize this point, the list below consistently refers to a specified number of "clear" days.

Subject to the foregoing, we will need to receive and review the following:

1. A certified copy of the organizational documents for the Cooperative School District.

2. Certificate of Clerk of District (in form attached).

3. The following materials relating to the adoption of the Budget by a Cooperative School District which has not established a Municipal Budget Committee pursuant to RSA 32:14(I)(b) and 195:12-9:

   a. Copy of notice of Cooperative School Board's Public Hearing regarding adoption of budget together with Certificate of Clerk of School Board showing that this notice was published or posted at least seven (7) "clear" days prior to the date of the Public Hearing;

   b. Minutes of Cooperative School Board's Public Hearing regarding budget showing the same was held at least thirty (30) "clear" days prior to the date of the meeting;

   c. Copy of Cooperative School District Budget, as adopted;

   d. A certificate that the budget was filed with the District Clerk and forwarded to the Department of Revenue Administrations.

4. If, and only if, the Cooperative School District has established a Budget Committee pursuant to RSA 195:12-a, as amended, the following items:

   a. Copy of notice of Budget Committee Public Hearing together with Certificate of Clerk of Budget Committee showing that notice was published or posted at least seven (7) "clear" days prior to the date of the Public Hearing;

   b. Copies of minutes of Budget Committee's Public Hearing showing that the same was held at least twenty-five (25) "clear" days prior to the date of the School District Meeting;

   c. Certificate of Clerk of Budget Committee to the effect that two (2) copies of the School District Budget, as adopted, was delivered to the School Board at least twenty (20) "clear" days prior to the date of the School District Meeting; and

   d. Certificate of the School District Clerk showing the total amount appropriated at the School District Meeting.

5. If, and only if, the bond issue in question is in excess of $100,000:

a. Publisher's Affidavit, with tear sheet attached, showing that notice of School Board's Public Hearing on the bond issue was published in a newspaper of general circulation in the District at least seven (7) "clear" days prior to the date of the Public Hearing;

b. Minutes of School Board's Public Hearing on the bond issue showing that the same was held at least fifteen (15) "clear" days, but not more than sixty (60) "clear" days prior to the date of the School District Meeting;

6. A copy of the Warrant for the School District Meeting including the Bond Warrant Articles in consecutive numerical order and before all other warrant articles except warrant articles dealing with the election of officers (see attached proposed form of bond warrant article);

7. Certificate that the Warrant for the School District Meeting was posted at the place of the meeting as well as in a public place in each School District that existed prior to the creation of the Cooperative School District.

8. Certificate that Budget was posted with the Warrant;

9. Extract of minutes of School District Meeting showing:

a. All votes, if any, to adjourn the meeting to the date on which the vote to authorize the bonds was taken;

b. That the bond issue was authorized by at least a two-thirds (2/3) vote of those present and voting at the meeting;

c. That the vote on the bond issue was taken by secret written ballot;

d. That there was a separate ballot box for each bond issue voted on at the meeting;

e. That the polls were open for at least one hour; and

f. Whether there was any motion made to reconsider the vote on the bond issue.

10. A specimen of the ballot used in the vote of the bond issue.

11. Certificate from the District Treasurer as to the School District's outstanding net indebtedness.

12. A Debt Limit Certificate from the State Board of Tax and Land Appeals (bond counsel will procure this item).

13. <u>If, and only if, the bond has been authorized at a special meeting</u>:

a. When the school board has voted to petition the superior court for permission to hold a special meeting (i) evidence that notice of such vote was posted at the office of the school board and two (2) other conspicuous places in the district within twenty-four (24) hours after taking the vote and a minimum of ten (10) days prior to filing the petition with the court; (ii) evidence that such notice was published in the next available edition of a local newspaper with a wide circulation in the district; and (iii) evidence that notice of the court date for an evidentiary hearing on the petition was posted, as aforesaid, within twenty-four (24) hours after receiving notice of the court date from the court.

b. Evidence that Commissioner of Revenue Administration was notified of the District's plans to hold an emergency special meeting (i) showing that such notice was given at

least ten (10) days prior to petitioning the Superior Court; (ii) showing that such notice was furnished by certified mail; (iii) explaining the nature of the emergency; (iv) including a copy of the proposed warrant article(s); and (v) including a copy of the petition to the Superior Court.

c. The petition to the superior court for permission to hold an emergency special meeting (including Certification that Commissioner of Department of Revenue Administration was notified);

d. Order of superior court authorizing District to hold an emergency special meeting; and

e. Affidavit of publication with tear sheet attached showing that a copy of the Warrant for the special meeting was published within one (1) week after the posting thereof in a newspaper having general circulation in the District.

14. If, and only if, the bond is to be guaranteed, in whole or in part, by the State of New Hampshire:

a. The action taken by the State School Building Authority approving the guaranty; and

b. The resolution of the Governor and Council of the State of New Hampshire authorizing the State guaranty of the bond.

15. The District's federal tax employer identification number.

16. A description of any existing or proposed temporary financing for the Project to be financed with the proceeds of the bond (e.g. bond anticipation notes).

M0700069

EXHIBIT A

_____ COOPERATIVE SCHOOL DISTRICT,
NEW HAMPSHIRE
(the " District")
MUNICIPAL BOND (the "Bond")

COOPERATIVE SCHOOL DISTRICT CLERK'S CERTIFICATE

The undersigned Clerk of the District hereby certifies as follows with respect to the District's issuance of the Bond:

The District is a Cooperative School District established pursuant to RSA 195;

2. The District provides education for children in the following grades:_____
_____;

3. The District has/has not adopted the provisions of the Municipal Budget Act, RSA 32;

4. The District has adopted the provisions of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2");

5. There are/are not any village districts located within the District. (If there is a village district located within the District, the same is known as follows: (_____).
(name of village district)

6. The District does not have any charter provisions, ordinances, regulations or standing rules, bylaws or votes affecting, limiting or restricting the District's ability to (i) issue the Bond; (ii) appropriate or spend money; (iii) levy or collect real estate taxes or (iv) complete the project to be financed with the proceeds of the Bond.

7. The District does/does not have a seal.

Dated this ____ day of _____, 20__.

_____
District Clerk

(District Seal, if any)

EXHIBIT B

(PROPOSED FORM OF BOND WARRANT ARTICLE)

Article ___. To see if the District will vote to raise and appropriate the sum of _____ Dollars ($_____) for the purpose of _____ _____ _____; _____ Dollars ($_____) of such sum to be raised through the issuance of bonds or notes under and in compliance with the Municipal Finance Act, RSA 33:1 et seq., as amended; to authorize the School Board to apply for, obtain and accept federal, state or other aid, if any, which may be available for said project and to comply with all laws applicable to said project; to authorize the School Board to issue, negotiate, sell and deliver said bonds and notes and to determine the rate of interest thereon and the maturity and other terms thereof; and to authorize the School Board to take any other action or to pass any other vote relative thereto. (Recommended by School Board (and Budget Committee)).

EXHIBIT C

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ COOPERATIVE SCHOOL DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Cooperative School District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 200__.

1.	GROSS DEBT:	
	Outstanding debt	$_____
	Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Notes issued in anticipation of grant of federal or state aid (including notes issued under RSA 198:20-d in anticipation of catastrophic aid and notes issued in anticipation of state adequate education grants)	
	b. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____
	c. Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Total Deductions (a, b and c)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

TOWN OF _____, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the Town of _____, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m.	Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n.	Tax-increment financings pursuant to RSA 162-K	$_____
		Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")		$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ VILLAGE DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Village District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m. Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n. Tax-increment financings pursuant to RSA 162-K	$_____
	Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

M0700069

MATERIALS TO BE FURNISHED TO BOND COUNSEL IN CONNECTION WITH BONDS ISSUED BY NEW HAMPSHIRE SCHOOL DISTRICTS (NOT INCLUDING COOPERATIVE SCHOOL DISTRICTS) WHICH HAVE ADOPTED RSA 40:13 (THE "OFFICIAL BALLOT LAW" OR "SENATE BILL 2")

Following is a list of materials which bond counsel will need to receive and review in order to render an approving opinion about your School District's proposed bond issue:

1. Copy of Charter of municipality within which School District is located; or, alternatively, special legislative charter for School District (Bond Counsel will procure this item).

2. Certificate of District Clerk (in form attached as Exhibit A).

3. Evidence regarding the adoption of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2") by the district by at least a three-fifths (3/5's) vote at a meeting prior to the adoption of the bond issue.

4. Copy of School District budget.

5. The following materials regarding appropriations contained in the district budget or in separate warrant articles:

   a. Evidence that notice of the public hearing on the proposed budget and special warrant articles appropriating money was published or posted at least seven (7) "clear" days prior to the date of the hearing but in no event later than the second Tuesday in January;

   b. Minutes of the public hearing on the proposed budget and special warrant articles appropriating money showing that the hearing was held no later than the third Tuesday in January;

   c. A certificate that an original of the budget and any recommendations on special warrant articles appropriating money was placed on file with the district clerk and forwarded to the Commissioner of the Department of Revenue Administrations;

   d. <u>In those districts which are subject to a Budget Committee established under RSA 32</u>, a certificate that two (2) copies of the budget and any recommendations on special warrant articles were delivered to the School Board; and

   e. <u>In those districts which have established a Budget Committee under RSA 32</u>, a certificate of the District Clerk showing the total amount appropriated at the district meeting.

6. <u>If, and only if, the bond issue in question is in excess of $100,000</u>:

   a. Evidence that notice of School Board's Public Hearing on the bond issue was published in a newspaper of general circulation in the District at least seven (7) "clear" days prior to the date of the Public Hearing but in no event later than the second Tuesday in January; and

   b. Minutes of School Board's Public Hearing on the bond issue showing that the same was held (i) not more than sixty (60) "clear" days prior to the first session of the District Meeting; and (ii) no later than the third Tuesday in January.

7. A copy of the Warrant for the first session of the School District Meeting including the Bond Warrant Articles in consecutive numerical order and before all other warrant articles except warrant articles

dealing with the election of officers (see attached proposed form of bond warrant article attached as Exhibit B). The warrant should contain the following:

a. An indication of whether or not the appropriation contained in the bond warrant article is recommended by the School Board and the Budget Committee, if any; and

b. An indication of the place, day and hours for each of the two (2) separate sessions of the district meeting, as follows: (i) the first session to be held between the first and second Saturdays following the last Monday in January (inclusive of those Saturdays); and (ii) the second session to be held on the second Tuesday of March.

8. Certificate that Warrant for School District Meeting was posted at the place of the meeting and at least one (1) other public place in the District at least fourteen (14) "clear" days prior to the date of the School District Meeting but in no event later than the last Monday in January;

9. Certificate that Budget was posted with the Warrant;

10. Minutes of the "first session" of the district meeting showing that the same took place between the first and second Saturdays following the last Monday in January (inclusive of those Saturdays) and indicating the amendments, if any, made to the bond warrant article.

11. A copy of the "official ballot" voted on by the district at the "second session" of the district meeting (which may be separate from the official ballot used to elect officers) including the bond article as the same appeared in the warrant, as amended at the "first session" of the district meeting, "with only such minor textual changes as may be required to cast the motion in the form of a question to the voters."

12. Certified results of the voting that took place at the "second session" of the district meeting, including the following:

a. Evidence that such voting occurred on the second Tuesday of March;

b. Evidence that the bond issue was voted upon by ballot; and

c. Evidence that the bond issue was approved by at least 2/3's vote of all ballots cast.

13. Certificate Regarding Outstanding Net Indebtedness (in form attached as Exhibit C) from the district and other municipalities (e.g., town, village district, etc.) that cover the same geographical territory as the district.

14. A Debt Limit Certificate from the State Board of Tax and Land Appeals (bond counsel will procure this item).

15. If, and only if, the bond has been authorized at a special meeting the following materials should be produced (in addition to those set forth elsewhere in this checklist):

a. When the school board has voted to petition the superior court for permission to hold a special meeting (i) evidence that notice of such vote was posted at the office of the school board and two (2) other conspicuous places in the district within twenty-four (24) hours after taking the vote and a minimum of ten (10) days prior to filing the petition with the court; (ii) evidence that such notice was published in the next available edition of a local newspaper with a wide circulation in the district; and (iii) evidence that notice of the court date for an evidentiary hearing on the petition was posted, as aforesaid, within twenty-four (24) hours after receiving notice of the court date from the court.

b. Evidence that Commissioner of Revenue Administration was notified of the district's plans to hold an emergency special meeting (i) showing that such notice was given at least ten (10) days prior to petitioning the Superior Court; (ii) showing that such notice was furnished by certified mail; (iii) explaining the nature of the emergency; (iv) including a copy of the proposed warrant article(s); and (v) including a copy of the petition to the superior court.

c. The petition to the superior court for permission to hold an emergency special meeting (including Certification that Commissioner of Department of Revenue Administration was notified);

d. Order of superior court authorizing district to hold an emergency special meeting;

e. Evidence that the first and second sessions of such special meeting (and related requirements relating to hearings, warrants, budgets, etc.) conformed to the requirements for annual meetings (as set forth above insofar as applicable) as well as the following requirements specifically applicable to special meetings:

(i) Evidence that a copy of the warrant for the special meeting was published within one (1) week after the posting thereof in a newspaper having general circulation in the district;

(ii) Evidence that this is the only special meeting held for the purposes of appropriating money during the current calendar or fiscal year, as appropriate (not including meetings held to adopt an operating budget); and

(iii) Evidence that the "second session" of the special meeting was held on a date not fewer than twenty-eight (28) days nor more than sixty (60) days following the "first session."

16. If, and only if, the bond is to be guaranteed, in whole or in part, by the State of New Hampshire:

a. The action taken by the State School Building Authority approving the guaranty; and

b. The resolution of the Governor and Council of the State of New Hampshire authorizing the State guaranty of the bond.

17. The district's federal tax employer identification number.

18. Copies of any filings made with the Internal Revenue Service (Form 8038-G) regarding other bonds or notes issued in the same calendar year as the Bonds.

19. A description of any existing or proposed temporary financing for the Project to be financed with the proceeds of the bond (e.g. bond anticipation notes).

20. A copy of the application filed with the New Hampshire Municipal Bond Bank (in the event that the bond is sold to the Bond Bank).

M0700073

EXHIBIT A

_____ SCHOOL DISTRICT, NEW HAMPSHIRE (the " District")
MUNICIPAL BOND (the "Bond")

DISTRICT CLERK'S CERTIFICATE

The undersigned Clerk of the District hereby certifies as follows with respect to the District's issuance of the Bond:

The District is not a Cooperative School District established pursuant to RSA 195;

The District has/has not adopted the provisions of the Municipal Budget Act, RSA 32;

The District has/has not adopted the provisions of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2");

There are/are not any village districts located within the District. (If there is a village district located within the District, the same is known as follows: (_____).
(name of village district)

The District does not have any charter provisions, ordinances, regulations or standing rules, bylaws or votes affecting, limiting or restricting the District's ability to (i) issue the Bond; (ii) appropriate or spend money; (iii) levy or collect real estate taxes or (iv) complete the project to be financed with the proceeds of the Bond.

The District does/does not have a seal.

Dated this ____ day of _____, 200__.

_____
District Clerk

(District Seal, if any)

EXHIBIT B

(PROPOSED FORM OF BOND WARRANT ARTICLE)

Article ___. To see if the District will vote to raise and appropriate the sum of _____ Dollars ($_____) for the purpose of _____ _____ _____; _____ Dollars ($_____) of such sum to be raised through the issuance of bonds or notes under and in compliance with the Municipal Finance Act, RSA 33:1 et seq., as amended; to authorize the School Board to apply for, obtain and accept federal, state or other aid, if any, which may be available for said project and to comply with all laws applicable to said project; to authorize the School Board to issue, negotiate, sell and deliver said bonds and notes and to determine the rate of interest thereon and the maturity and other terms thereof; and to authorize the School Board to take any other action or to pass any other vote relative thereto. (Recommended by School Board (and Budget Committee)).

EXHIBIT C

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ SCHOOL DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ School District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 200__.

1.	GROSS DEBT:	
	Outstanding debt	$_____
	Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Notes issued in anticipation of grant of federal or state aid (including notes issued under RSA 198:20-d in anticipation of catastrophic aid and notes issued in anticipation of state adequate education grants)	
	b. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____
	c. Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Total Deductions (a, b and c)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

TOWN OF _____, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the Town of _____, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m.	Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n.	Tax-increment financings pursuant to RSA 162-K	$_____
		Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")		$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ VILLAGE DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Village District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m.	Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n.	Tax-increment financings pursuant to RSA 162-K	$_____
		Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")		$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

MATERIALS TO BE FURNISHED TO BOND COUNSEL IN CONNECTION WITH BONDS ISSUED BY NEW HAMPSHIRE COOPERATIVE SCHOOL DISTRICTS WHICH HAVE ADOPTED RSA 40:13
(THE "OFFICIAL BALLOT LAW" OR "SENATE BILL 2")

Following is a list of materials which bond counsel will need to receive and review in order to render an approving opinion about your Cooperative School District's proposed bond issue. Please call with any questions or comments.

1. A certified copy of the organizational documents for the Cooperative School District.

2. Certificate of Cooperative School District Clerk (in form attached as Exhibit A).

3. Extract of Cooperative School District Meeting minutes evidencing the adoption of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2") by a ballot vote of at least three-fifths of voters present and voting at such meeting.

4. The following materials relating to the adoption of the annual budget by the Cooperative School District:

   a. Copy of notice of Public Hearing held by School Board or Budget Committee, if applicable, regarding adoption of budget together with evidence showing that this notice was published or posted on or before the second Tuesday of January;

   b. Minutes of Public Hearing regarding budget showing the same was held on or before the third Tuesday in January;

   c. Copy of Cooperative School District Budget, as adopted;

   d. Evidence that the budget was filed with the Cooperative School District Clerk and forwarded to the Department of Revenue Administration.

5. If, and only if, the bond issue to be voted on at the annual meeting is in excess of $100,000:

   a. Evidence that notice of Cooperative School Board's Public Hearing on the bond issue was published in a newspaper of general circulation in the Cooperative School District on or before the second Tuesday in January;

   b. Minutes of Cooperative School Board's Public Hearing on the bond issue showing that the same was held on or before the third Tuesday in January;

6. A copy of the Warrant for the first session of the annual Cooperative School District Meeting including the Bond Warrant Articles in consecutive numerical order and before all other warrant articles except warrant articles dealing with the election of officers (see attached proposed form of bond warrant article attached as Exhibit B). The warrant should contain the following:

   a. An indication of whether or not the appropriation contained in the bond warrant article is recommended by the Cooperative School Board and the Budget Committee, if any; and

   b. An indication of the place, day and hours for each of the two (2) sessions of the Cooperative School District meeting, as follows: (i) the first session to be held between the first and second Saturdays following the last Monday in January

(inclusive of those Saturdays); and (ii) the second session to be held on the second Tuesday in March.

7. Certificate that Warrant for Cooperative School District Meeting was posted at the place of the meeting as well as in a public place in each school district that existed prior to the creation of the Cooperative School District on or before the last Monday in January;

8. Certificate that Budget was posted with the Warrant;

9. Minutes of the "first session" of the Cooperative School District meeting showing that the same took place between the first and second Saturdays following the last Monday in January (inclusive of those Saturdays) and indicating the amendments, if any, made to the bond warrant article.

10. A copy of the "official ballot" voted on by the Cooperative School District at the "second session" of the Cooperative School District meeting (which may be separate from the official ballot used to elect officers) including the bond article as the same appeared in the warrant, as amended at the "first session" of the Cooperative School District meeting, "with only such minor textual changes as may be required to cast the motion in the form of a question to the voters."

12. Certified results of the voting that took place at the "second session" of the Cooperative School District meeting, including the following:

a. Evidence that such voting occurred on the second Tuesday of March;

b. Evidence that the bond issue was voted upon by ballot; and

c. Evidence that the bond issue was approved by at least 3/5's vote of all ballots cast.

d. Evidence of amount appropriated at meeting.

13. Certificate Regarding Outstanding Net Indebtedness (in form attached as Exhibit C) from the Cooperative School District and other municipalities (e.g., town, village district, etc.) that cover the same geographical territory as the Cooperative School District.

14. A Debt Limit Certificate from the State Board of Tax and Land Appeals (bond counsel will procure this item).

15. If, and only if, the bond has been authorized at a special meeting the following materials should be produced **(in addition to those set forth elsewhere in this checklist)**:

a. When the School Board has voted to petition the superior court for permission to hold a special meeting (i) evidence that notice of such vote was posted at the office of the School Board and two (2) other conspicuous places in each town within the district within twenty-four (24) hours after taking the vote and a minimum of ten (10) days prior to filing the petition with the court; (ii) evidence that such notice was published in the next available edition of one or more local newspapers with a wide circulation in all towns within the district; and (iii) evidence that notice of the court date for an evidentiary hearing on the petition was posted, as aforesaid, within twenty-four (24) hours after receiving notice of the court date from the court; and published in the next available edition of one or more newspapers with a wide circulation in all towns within the district;

b. Evidence that Commissioner of Revenue Administration was notified of the Cooperative School District's plans to hold an emergency special meeting (i)

showing that such notice was given at least ten (10) days prior to petitioning the Superior Court; (ii) showing that such notice was furnished by certified mail; (iii) explaining the nature of the emergency; (iv) including a copy of the proposed warrant article(s); and (v) including a copy of the petition to the superior court;

c. The petition to the superior court for permission to hold an emergency special meeting (including Certification that Commissioner of Department of Revenue Administration was notified);

d. Order of superior court authorizing Cooperative School District to hold an emergency special meeting;

e. The following materials relating to the School Board's Public Hearing on the bonds:

   (i) Notice of public hearing as published in a newspaper of general circulation in the District at least seven (7) days prior to the date of the hearing;

   (ii) Minutes of such hearing showing that the same took place at least fifteen (15) but not more than sixty (60) days prior to the first session of the special meeting;

f. The following materials relating to the adoption of the budget for the special meeting by a Cooperative School District which has <u>not</u> established a Budget Committee pursuant to RSA 32:14(I)(b) and 195:12-a:

   (i) Copy of notice of School Board's Public Hearing on the budget showing that the same was published or posted at least seven (7) days prior to the date of the public hearing;

   (ii) Minutes of the School Board's Public Hearing on the budget showing the same was held at least thirty (30) days prior to the date of the first session of the special meeting;

   (iii) Copy of budget, as adopted;

g. The following materials relating to the adoption of the budget for the special meeting by a Cooperative School District which <u>has</u> adopted a Budget Committee pursuant to RSA 32:14(I)(b) and 195-12-a:

   (i) Copy of notice of Budget Committee's public hearing showing that the same was published or posted at least seven (7) days prior to the date of the public hearing;

   (ii) Minutes of the Budget Committee's public hearing showing that the same took place at least twenty-five (25) days prior to the date of the first session of the annual meeting;

   (iii) Copy of budget, as adopted;

h. Copy of the warrant for the special district meeting prescribing the date, place and hour for both a first and second session; showing that the second session is to take place not fewer that twenty-eight (28) nor more than sixty (60) days following the first session; and an indication of whether or not the appropriation contained in the bond warrant article is recommended by the School Board and Budget Committee, if any;

i. Evidence that the warrant was posted at the place of the meeting as well as in a public place in each school district than existed prior to the creation of the Cooperative School District at least fourteen (14) days prior to the date of the first session of the special meeting (not including the date of posting or the date of the meeting);

j. Evidence that a copy of the warrant for the special Cooperative School District meeting was published within one (1) week after the posting thereof in a newspaper having general circulation in the Cooperative School District; and

k. Evidence that this is the only special meeting held for the purposes of appropriating money during the current calendar or fiscal year, as appropriate.

16. If, and only if, the bond is to be guaranteed, in whole or in part, by the State of New Hampshire:

a. The action taken by the State School Building Authority approving the guaranty; and

b. The resolution of the Governor and Council of the State of New Hampshire authorizing the State guaranty of the bond.

17. The Cooperative School District's federal tax employer identification number.

18. Copies of any filings made with the Internal Revenue Service (Form 8038-G or 8038-GC) regarding other bonds or notes issued by the Cooperative School District in the same calendar year as the Bonds.

19. A description of any existing or proposed temporary financing for the Project to be financed with the proceeds of the bond (e.g. bond anticipation notes).

20. A copy of the application filed with the New Hampshire Municipal Bond Bank (in the event that the bond is sold to the Bond Bank).

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EXHIBIT A

_____ COOPERATIVE SCHOOL DISTRICT, NEW HAMPSHIRE (the " District")
MUNICIPAL BOND (the "Bond")

COOPERATIVE SCHOOL DISTRICT CLERK'S CERTIFICATE

The undersigned Clerk of the District hereby certifies as follows with respect to the District's issuance of the Bond:

The District is a Cooperative School District established pursuant to RSA 195 that provides education for children of the following municipalities: _____
_____
_____
_____;

2. The District provides education for children in the following grades:_____
_____;

3. The District has/has not adopted the provisions of the Municipal Budget Act, RSA 32;

4. The District has adopted the provisions of RSA 40:13 (the "Official Ballot Law" or "Senate Bill 2");

5. There are/are not any village districts located within the District. (If there is a village district located within the District, the same is known as follows: (_____).
(name of village district)

6. The District does not have any charter provisions, ordinances, regulations or standing rules, bylaws or votes affecting, limiting or restricting the District's ability to (i) issue the Bond; (ii) appropriate or spend money; (iii) levy or collect real estate taxes or (iv) complete the project to be financed with the proceeds of the Bond.

7. The District does/does not have a seal.

Dated this ____ day of _____, 200__.

_____
District Clerk

(District Seal, if any)

EXHIBIT B

(PROPOSED FORM OF BOND WARRANT ARTICLE)

Article ___. To see if the District will vote to raise and appropriate the sum of _____ Dollars ($_____) for the purpose of _____ _____ _____; _____ Dollars ($_____) of such sum to be raised through the issuance of bonds or notes under and in compliance with the Municipal Finance Act, RSA 33:1 et seq., as amended; to authorize the School Board to apply for, obtain and accept federal, state or other aid, if any, which may be available for said project and to comply with all laws applicable to said project; to authorize the School Board to issue, negotiate, sell and deliver said bonds and notes and to determine the rate of interest thereon and the maturity and other terms thereof; and to authorize the School Board to take any other action or to pass any other vote relative thereto. (Recommended by School Board (and Budget Committee)).

EXHIBIT C

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ COOPERATIVE SCHOOL DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Cooperative School District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 200__.

1.	GROSS DEBT:	
	Outstanding debt	$_____
	Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Notes issued in anticipation of grant of federal or state aid (including notes issued under RSA 198:20-d in anticipation of catastrophic aid and notes issued in anticipation of state adequate education grants)	
	b. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____
	c. Authorized but unissued Bonds or Notes (specify purpose)	$_____
	Total Deductions (a, b and c)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

TOWN OF _____, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the Town of _____, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m. Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n. Tax-increment financings pursuant to RSA 162-K	$_____
	Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer

CERTIFICATE REGARDING OUTSTANDING NET INDEBTEDNESS

_____ VILLAGE DISTRICT, NEW HAMPSHIRE

A. Certifications as to Issuer's Indebtedness.

I, the undersigned, the Treasurer of the _____ Village District, New Hampshire ("Issuer"), hereby certify that the following statement as to the debt of the Issuer is true as of _____, 20__.

1.	GROSS DEBT:	
	Outstanding debt including Tax Anticipation Notes	$_____
	Authorized but unissued Bonds or Notes	$_____
	Gross Debt	$_____
2.	DEDUCTIONS FROM GROSS DEBT:	
		$_____
	a. Unmatured Tax Anticipation Notes	
	b. Notes issued in anticipation of grant of federal or state aid	$_____
	c. Debts authorized or incurred for supplying inhabitants with water or for the construction, enlargement, improvement or maintenance of water works	$_____
	d. Debts authorized or incurred to finance the cost of sewage systems or enlargements or improvements thereof	$_____
	e. Debts authorized or incurred to finance new sewerage systems or sewage disposal works when the costs thereof is to be financed by sewer rent or sewer assessments	$_____
	f. Debts authorized or incurred under RSA 31:10	$_____
	g. Debts incurred to finance energy production projects, the reconstruction or enlargement of municipally owned utilities (RSA 33:6-b)	$_____
	h. Debts incurred to finance small scale power facilities (RSA 33:6-b)	$_____
	i. Debts incurred to finance acquisition of military base (RSA 33:6-c)	$_____
	j. Debts incurred for waste site cleanups (RSA 33:6-d)	$_____
	k. Debts or obligations of Issuer to solid waste management district (RSA 33:6-e)	$_____
	l. Debts authorized or incurred outside the statutory debt limit under any special law (indicating the law under which such debt was issued)	$_____

	m. Sinking Funds and cash applicable solely to the payment of debts incurred within the debt limit	$_____
	n. Tax-increment financings pursuant to RSA 162-K	$_____
	Total Deductions (a through n)	$_____
3.	"Net Indebtedness" as defined in Section 1 of the Municipal Finance Act, RSA 33:1. ("1" minus "2")	$_____

B. Other Municipalities Covering Same Territory Which Have Power to Incur Indebtedness. Following is a list of those municipalities (other than counties) which cover the same territory as Issuer and which have the power to incur indebtedness (e.g, towns, school districts, other village districts, etc.):_____
_____. (A certificate identical to this certificate must be completed for each named municipality.)

Dated this _____ day of _____, 200__.

_____
Issuer's Treasurer