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ABSTRACT

In 1968, the Province of New Brunswick initiated a three-phase program to provide for elementary school facilities, employing a component systems approach to their construction. This booklet describes briefly the planning and construction of these schools, and provides graphic and photographic records of the construction in progress as well as of the completed schools. Tables reflect the cost data for the schools. (Photographs may reproduce poorly.) (Author/MLF)

Component School Construction Program

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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General Report

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Students at work in an open teaching area — the cork-covered wall section (chalkboard on the reverse) is mounted on tracks and can easily be rolled out of the way to make the area even more open.

New Schools are required at the Elementary level to

(a) Provide flexible use space in which to operate the non-graded system of instruction.
(b) Provide replacement accommodation for the many rural schools with less than 6 classrooms.
(c) Provide the elementary school plant required in residential areas of new growth centres.

With these objectives, it is hoped to provide new accommodation for 42,000 students in grades 1 to 6 during the nine year period from 1 April 1968 to 31 March 1977 at a cost of $50,000,000.

Many existing High Schools will be replaced by new Vocational Schools. These existing schools will provide accommodation for Junior High students, but new growth centres and some obsolete plants will require new Junior High Schools.

It is hoped that provision of new accommodation for 20,000 students in grades 7 to 9 can be achieved in the same nine year period at a cost of $30,000,000.

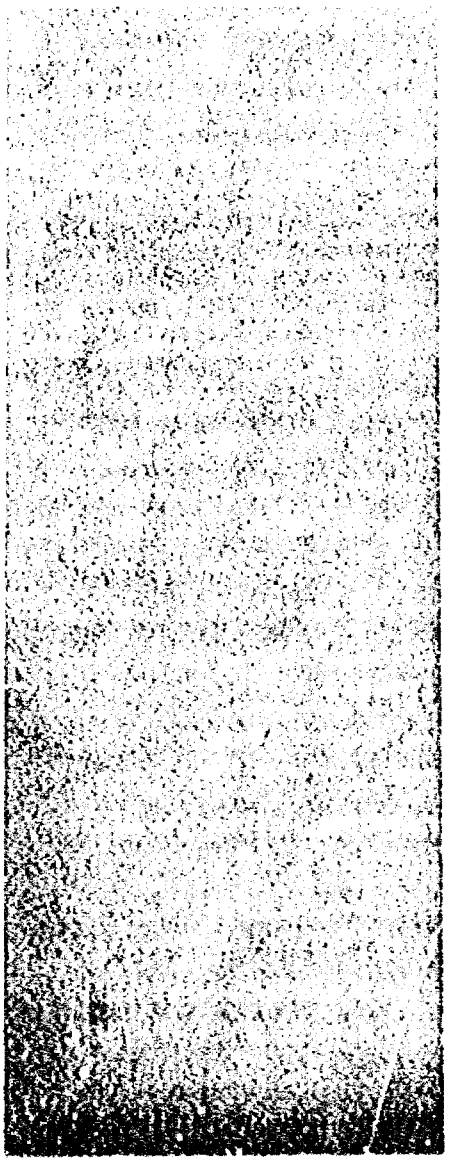
The great emphasis on a varied curriculum for grades 10 to 12 involving commercial, technical, vocational as well as general academic and college preparatory courses has made mandatory the early construction of large Senior school complexes throughout the Province.

The plan is to provide new accommodation for 48,000 students in grades 10 to 12 during the nine year period at a cost of $120,000,000. Some of this Vocational School expenditure is subject to assistance from the Federal Government. It is estimated that $24,660,000. will be recovered in the first four years.

Budgeting is based on a total expenditure per pupil of
$1100 for Elementary
$1500 for Junior High
$2500 for Vocational

These guide figures include total costs: Land, surveys, soil testing, architectural fees, construction supervision, building construction, site development and fixed equipment.

Interior detail -- showing how the double-T wall and ceiling precast sections join at the corners; also, such detail as window placement, terminal heating units, lighting arrangement, washroom and cabinet storage space for the individual classrooms may be seen quite plainly on this picture.



Programs for schools during 1968 established the adequacy of these control budget figures. Elementary schools and Junior High Schools with practically full programming of facilities and with little variety to the educational program, are being built within these control figures and are not likely to improve. Senior Vocational High Schools are costing as much as the budget figure but can be expected to improve substantially as greater flexibility of space use permits a higher percentage of facility area use at any one time. Multiple uses of the same space, with a more scientific programming matching curriculum, students and facilities may result in a 20% reduction in the number of square feet floor area.

Construction costs of the building proper without site development or outside services or specified equipment are controlled and must remain under $15.00 per sq. ft.

Three projects tendered in late 1968 were as high as $17.50 per sq. ft. and resulted in serious re-design to lower the cost to $15.00. One large Vocational complex came in at $13.80 in mid December 1968. The rest of the 1968 construction was bid reasonably close to estimates.

Control measures during the design stage, with an increasingly improved method of reporting will ensure that school buildings are built the way educators want them, in a manner that the people of New Brunswick can afford.

In the spring of 1968 the $200,000,000 nine year program was announced and immediately there was a reaction from the construction industry:

1. Prefabricating package dealers wanted to sell a whole pre engineered, pre conceived package. This approach did not meet N. B. requirements because the resultant schools would have no educational design input at the local level or indeed at the provincial consultant level, and in any case no prefab plan would answer the flexible or easily modified use concept. A second major objection to the prefab school approach was the fact that very little N.B. material or labor would be used.

2. Organizations, specialists, consultants and even other school jurisdictions offered their services based on their experience in their own areas. Everything documented along this line was examined carefully and again it was determined that local educators and architects and manufacturers and builders could best answer local problems.

3. New Brunswick Architects wanted to continue in the design of New Brunswick schools, working with local school boards, even though the schools would be subject to planning approval and total financing by the Province. This approach was adopted subject to Provincial control because it meant school plans would not become dull, standard and repitative but would benefit from ever changing educational demands at the local level.

4. New Brunswick manufacturers reacted by insisting that they become involved in this large program. All the manufacturers wanted to know was what to make, and how to make it so it could be used.

A look down the length of a 12 classroom wing — showing 6 classrooms each side and the intersecting corridor.

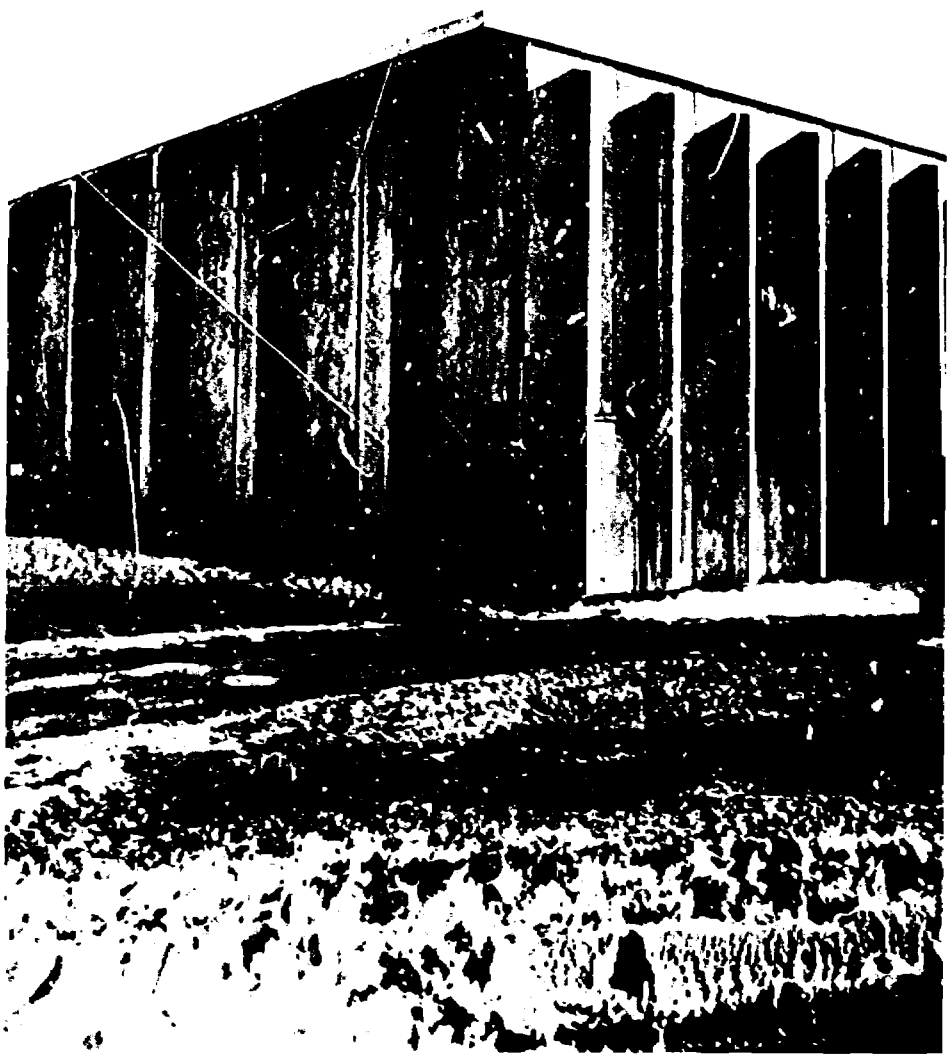
5. New Brunswick labor reacted by insisting that the construction methods used should not cause the importation of skills from other areas.

6. The New Brunswick Construction Association reacted by asking for methods of contracting that would allow New Brunswick contractors and subcontractors to cope with every project. Government policies in this respect do not exclude outside contractors from getting school contracts providing job management and purchasing is done within the Province. These same policies do make it as easy as possible for N.B. contractors and subcontractors to finance their parts of these projects.

With all of these reactions in mind, the N.B. Component School Construction approach was devised. Briefly it is described as follows

Included in the basic educational design criteria is the requirement that teaching stations (Minimum 700 sq. ft.) should be in groups of six, and that schools should have no fewer than 12 teaching stations. There would be some instances where 6 stations would make up a basic unit at least temporarily until a population growth demanded the next unit or units. Keeping this in mind, and

The gymnasium is constructed using double height (20') single-T pre-stressed concrete sections with single-T roof members. Contrasted to the classroom areas, the "T" member is on the outside - presenting a smooth wall appearance in the interior of the gym.

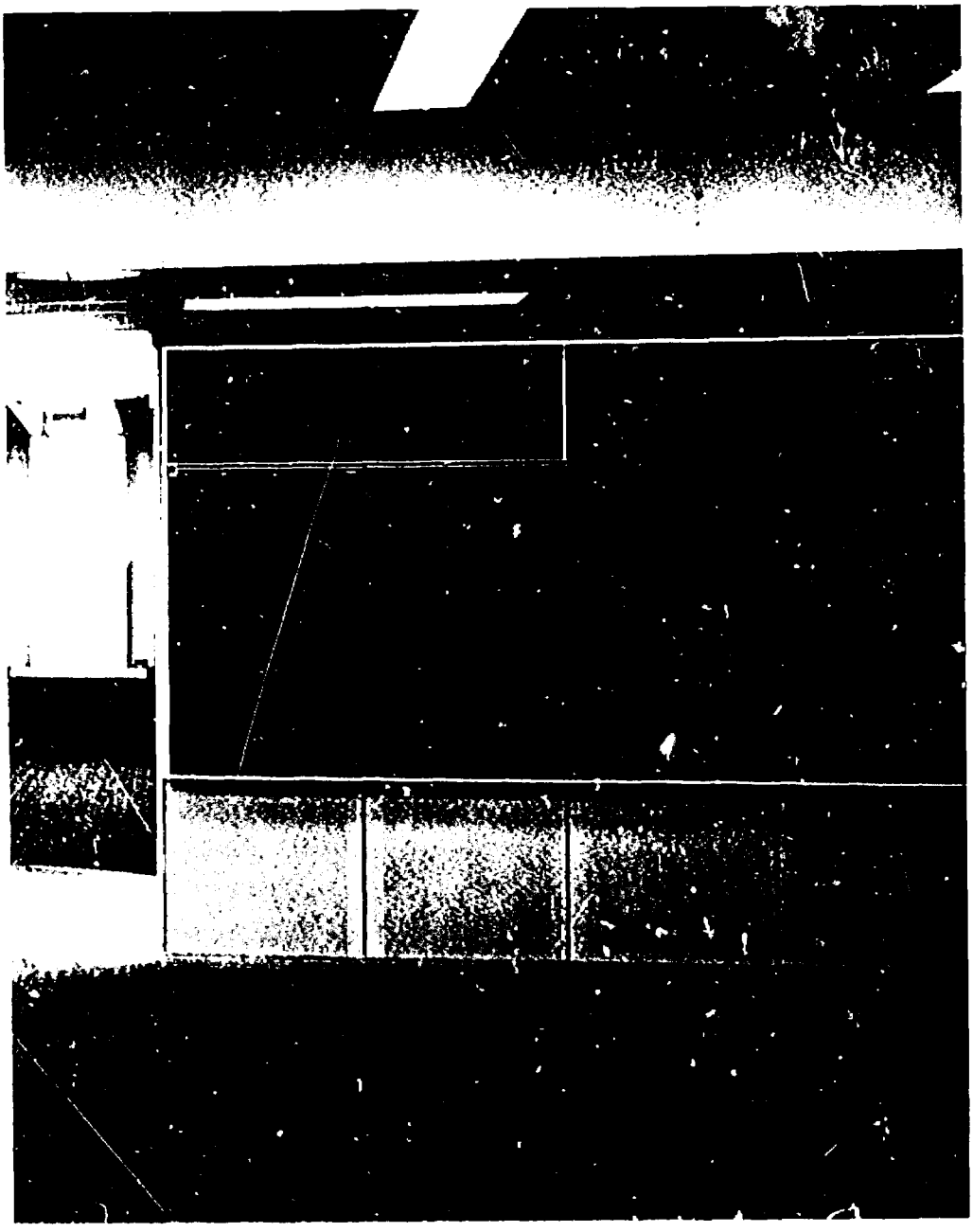


knowing that N.B. manufacturers can turn out almost all of the major parts needed to assemble a suitable school building, provided these parts are standardized in dimension and performance, we set out to plan a flexible use space to meet educational requirements and prove the dimensioning and performance of N.B. components.

A first order decision has now proven to be somewhat premature. This decision followed a thorough first hand examination of the school programs underway in Boston, Pittsburgh, Toronto and Montreal and led us into the adoption of a five foot planning grid. We assumed that lighting units, heating and ventilating equipment and other fixments which we would not expect to manufacture in New Brunswick, would be available at low cost from Toronto and Montreal manufacturers, and detailed to fit into a school planned on the five foot grid. We now find that none of these units or equipment will be available until 1970-71 from Central Canadian manufacturers and almost all of it is now being made for us in New Brunswick.

The most significant development in our summer program involves planning. Using the five foot grid, we have done exhaustive sketching and carried out extensive research. We have finally established an optimum teaching space or enclosure, which can be repeated up to 8 times, and accommodate any multiple of 180 students up to 1440. The teaching space is the equivalent of six classrooms in a 75 feet by 75 feet space, with an additional 25 feet by 75 feet space added for special seminars, resource centre and services. The arrangement gives 6 separate classrooms for a graded system of teaching, or any combination of spaces required as teaching developes into a non graded system. The ultimate is 180 students sharing one open team teaching space. We are sure the final space enclosure we have designed offers the maximum flexibility of use and the greatest potential in meeting all the varied current demands.

Having designed the optimum enclosure we have then been able to tell manufacturers exactly what their products should be in order to fit into the program. It should be made abundantly clear at this point, that this optimum enclosure is not in any sense a suggested standard plan. At this stage we are trying to standardize components which can then be used in endless variety of designs or space arrangements.



This view is from one classroom looking at and across the corridor to another classroom. As may be seen, the corridor has a hung ceiling with grills facing the classroom areas These are intake or exhaust grills and the enclosed space above the ceiling serves as a return air plenum for proper air circulation.

New Brunswick's Experience with Systems Building

In 1968 the Province of New Brunswick initiated a program to provide for elementary school facilities, employing a component systems approach to construction. The primary stimulant for adopting this approach to school construction was a realization that if urgently needed, educational facilities were to be provided, within budget constraints, that something had to be done to deal with the eroding effects on resources of increasing construction costs. The nature of the component systems approach offered promise that this method of construction would result in considerable economies and therefore be a positive approach to reducing costs.

Upon embarking on this program the Government set as its cost objectives for elementary schools, a total cost of $1,100 per student. At the same time, a ceiling of $15 per square foot on the cost of each building, including fixed equipment, but not including site development, was adopted.

A three phase program for developing the component systems approach was established. To date, two phases of the program have been completed and eight schools have been constructed. The first phase of the program concentrated on the development of components and the testing of new construction methods. During this phase of the program, three different structural systems and five wall panels were developed and used in the construction of five pilot schools. Each of the schools was constructed by direct contract with manufacturers to supply and install their components.

The second phase of the program involved the construction of three schools. The objectives during this phase of the program were to further improvements in components and also to introduce a time-work schedule in the specifications. In this stage of the program tenders were called for each school. The structural system and wall envelope were pre-tendered and then general contractors bid on the total job, including the pretendered elements.

The whole objective of the component systems approach is to provide educational facilities at minimum costs. But, the value of this approach rests on its capacity to provide facilities that are adaptable to current and future teaching techniques and teaching aids.

It would be naive to suggest that an optimum in school design has been achieved or that there is a universal acceptance of component schools by the teaching profession. However, the response from teachers using the component schools has been most favourable and indicates that the programme, as developed to this stage, is proceeding in the proper direction.

A Typical Construction Schedule

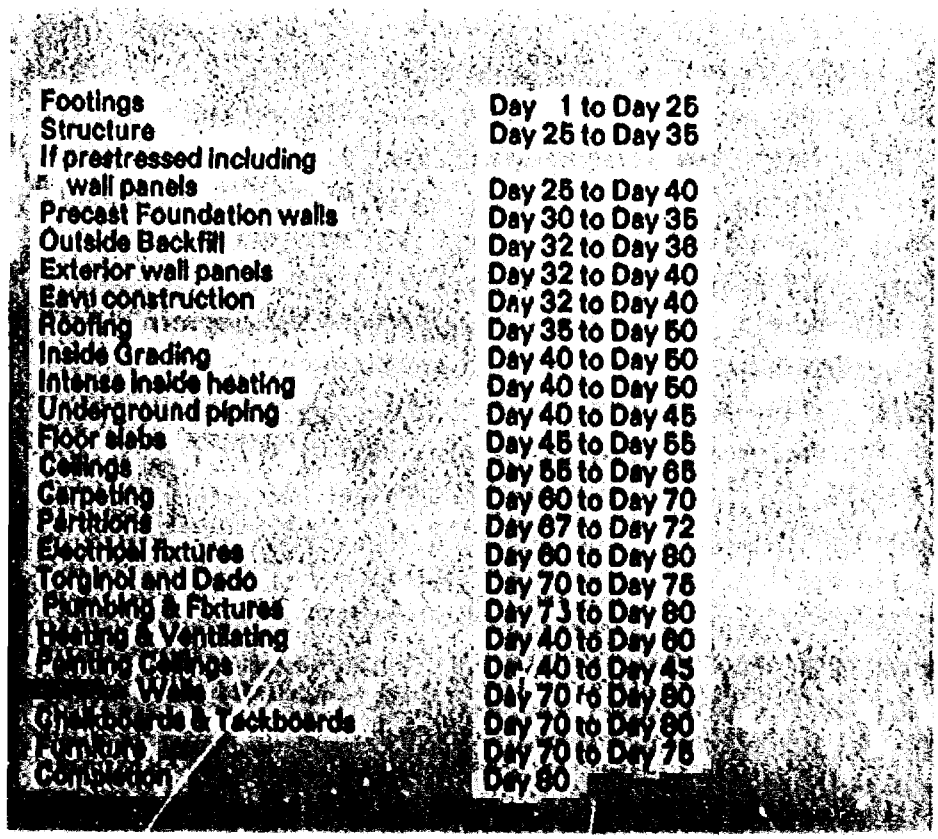


Table 1.
Component Schools (Phase One)

Type	No. of Classrooms	No. of Students	Total Floor Area (sq. ft.)	Cost	Unit Cost per sq. ft.	Cost per Pupil
Wood	6	180	6,815	204,424.00	23.19	1,135.69
Steel structure — asbestos panels	12	360	27,020	455,940.00	16.87	1,266.50
Steel structure — concrete panels	12	360	23,760	473,017.00	19.91	1,313.94
Steel structure — brick panels	18	540	39,800	728,029.00	18.22	1,342.65
Prestressed concrete	24	720	47,400	928,554.00	19.59	1,289.66

Table 2.
Component Schools (Phase Two)

Type	No. of Classrooms	No. of Students	Total Floor Area (sq. ft.)	Cost	Unit Cost per sq. ft.	Cost per Pupil
Steel structure — concrete panels	12	360	27,020	385,000.00	14.25	1,069.44
Steel structure — wood panels	18	540	39,800	668,957.00	16.81	1,238.81
Prestressed concrete	24	720	47,400	892,636.00	18.83	1,239.77

Tables 1 and 2 reflect the cost data for the eight schools constructed to date.

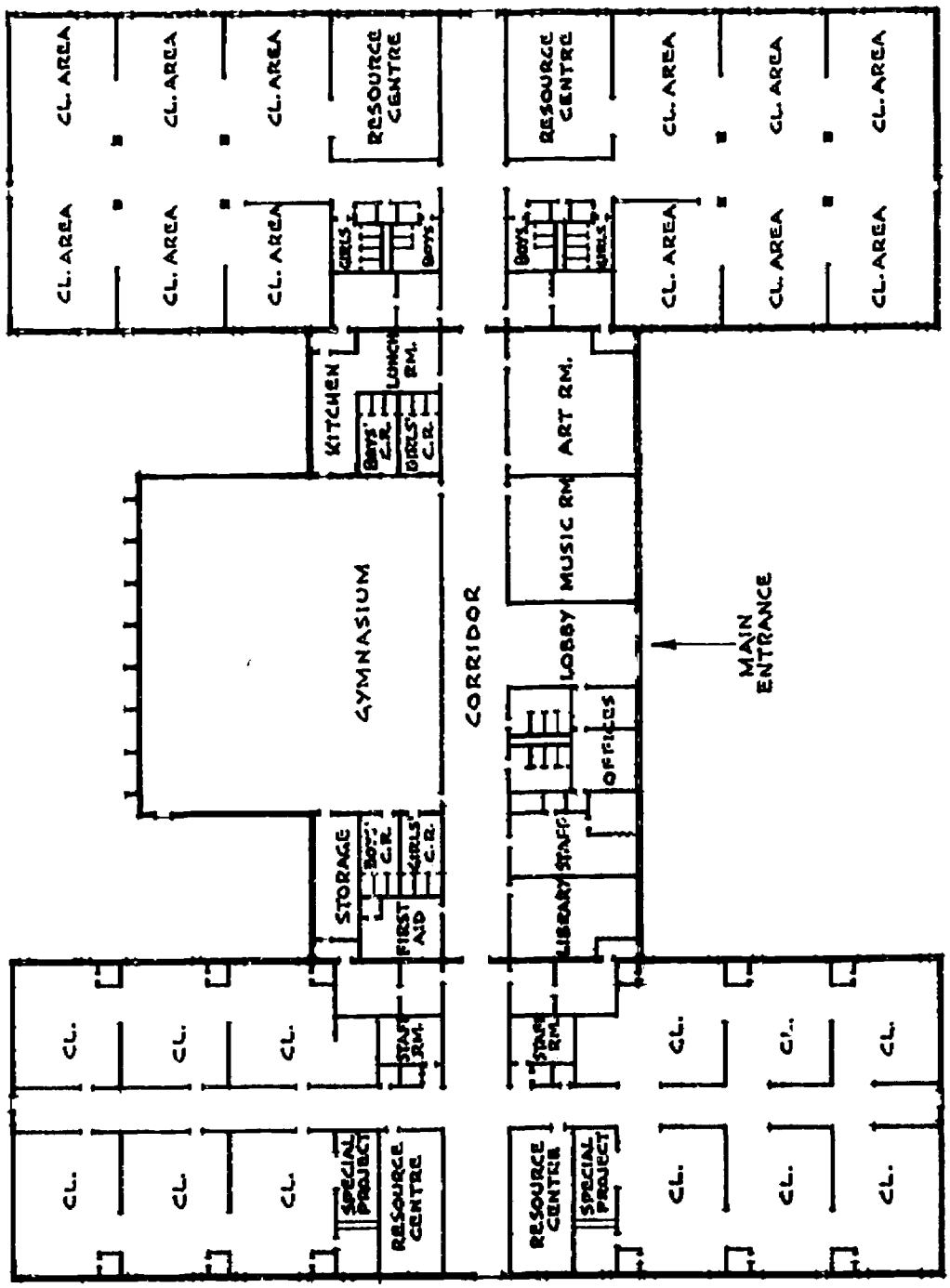
The phase one costs are considerably above the cost objectives of the Government. However, during this phase, primary emphasis was placed on developing the system and its components and included development costs.

With the exception of one school, the phase two costs also do not achieve cost objectives, but, on a comparison with equivalent sized schools constructed under phase one there is a favourable reduction in costs.

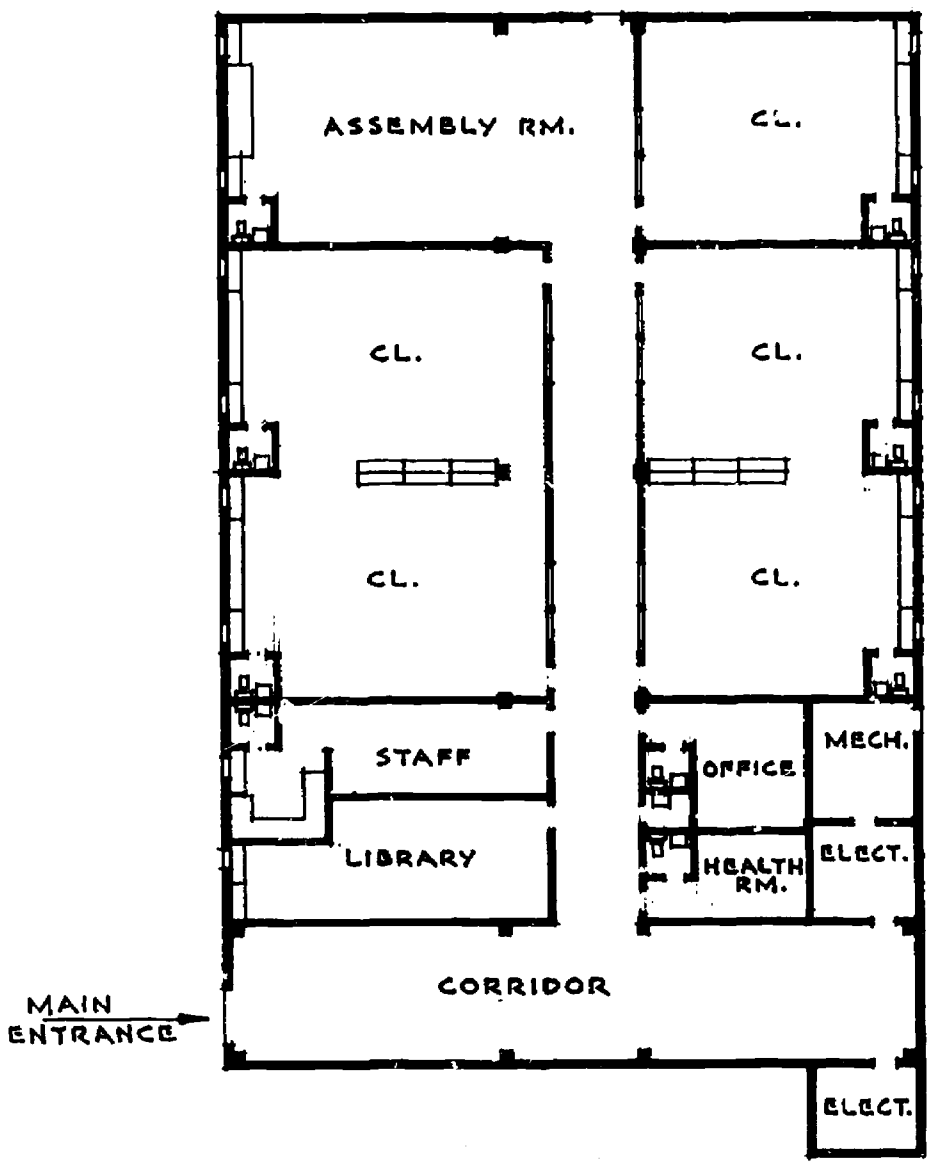
The reductions in costs for schools constructed in phase two are generally attributable to the introduction of a time-work schedule for specifications. During phase two there was no evidence of appreciable reductions in the cost of components.

Future prospects for the systems approach indicate further reductions in costs are achievable. Because of limited output of components economies of scale have not yet been realized. Experience gained from the eight schools constructed suggest further efficiencies in time and thus costs are possible.

Appreciable reductions in costs rests on the acceptance of the component system in the construction of other types of building. Phase three of the Governments program of school construction is designed to stimulate general use of the system's approach. During this phase of the program it is the intention to have private architects and engineers work with component manufacturers and contractors and sub-contractors to further develop and perfect the system.



FLOOR PLAN
COMPONENT SCHOOL
PRIESTMAN ST., FREDERICTON
SCALE 1" = 40'



FLOOR PLAN
COMPONENT SCHOOL
FOREST HILL, FREDERICTON
SCALE 1" = 20'

A completely open section of the school — a total of 3 normal classroom size teaching areas can be seen in this view. Furniture in the desired grouping has yet to be added, however, an appreciation for the airiness and spaciousness of this type of construction can be felt looking at this picture.

A view from the corridor to an open teaching area showing the type and grouping of the furniture used. Note also that this open area adjoins a partially enclosed teaching area, proving the flexibility of the system.