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ABSTRACT

THE PROBLEMS OF PLANNING AND DESIGNING EDUCATIONAL FACILITIES ARE OUTLINED WITH REGARD TO THE EVER-CHANGING EDUCATIONAL PROGRAMS, TEACHING METHODS AND TECHNOLOGICAL FACILITY NEEDS. PROBLEMS OF FLEXIBILITY ARE CONCERNED WITH HOW MUCH FLEXIBILITY IS REQUIRED AND HOW MUCH FLEXIBILITY CAN BE ECONOMICALLY JUSTIFIED. REQUIREMENTS FOR FLEXIBLE SCHOOL DESIGN ARE GIVEN WITH THREE EXAMPLE PLANS. SHOP AND LABORATORY FLEXIBILITY ARE DISCUSSED WITH EMPHASIS ON FLEXIBILITY AND ENVIRONMENTAL CONTROLS SYSTEMS, BUILDING SERVICES AND UTILITIES, AND BUILDING EQUIPMENT AND INTERIOR SPACES. (TG)

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PLANNING THE TECHNOLOGY AREA

Its Inflexibility by Weight of Mechanical Servicing

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A. INTRODUCTION

Colleges of Applied Arts and Technology comprise three fundamental functions; namely, academic, technology, and administration. Each area must be designed to perform a specific function and should do so in the most efficient manner. This is a basic responsibility of the planner and the designer.

All of us here are aware of the tremendous advancement achieved in education. The changes in teaching philosophies and in techniques in fact have been so great that the designer has difficulty in keeping pace with these developments. Although this may be a problem for the designer, he is faced with a much more challenging task, if not an impossible one. That is - how to design a plant which will enable the teaching profession to implement the latest teaching techniques and philosophies of tomorrow in a building built today. The teaching profession's answer to this challenge is "design for flexibility". This answer may be feasible in the academic areas and in the administrative areas, where changes are not so severe, usually involving partitioning, lighting and other minor changes to the building services. In the case of the technology areas, flexibility is a major problem. In this area the user service, the planner, and the designer must decide (a) how much flexibility is required, and (b) how much flexibility is economically justified.

B. TECHNOLOGY AREAS

In order to fully appreciate the difficulties in providing flexibility in the technology area, it is necessary to consider some of the activities which take place, and to analyze their requirements on the building and its mechanical services.

1. Laboratories

(a) These can be broken down into individual rooms, such as Chemistry Laboratory, Physics Laboratory, Electronics Laboratory, Testing and Control Laboratory, and others. The space required for these activities is quite comparable to the conventional classroom space. Finishes may not be as critical as that for classrooms. The mechanical services required include electrical power, gas, compressed air, water, acid resisting sinks, and acid resisting drains, fume hoods, distilled water, etc. These services usually are piped to the laboratory desk from the ceiling below if this is possible, or are piped down from the ceiling space. These services usually enter the laboratory from conveniently located and accessible pipe spaces. In addition to these specific services, the room itself must be planned for proper lighting and environmental control. In the latter case, provision must be made for the use of fume hoods, which exhaust in the order of 750 to 1,000 CFM per hood. This may vary, depending on the hood capacity. Unless the more costly induction type exhaust hood is used, this exhaust air must be provided through the main environmental control system. In this case provisions may be necessary to interlock the fume hood operation with the return air system to retain some degree of balance between supply and return and exhaust air.

Another item affecting the design of the environmental control system is the student occupancy, which in the case of a laboratory is based on 50 sq. ft. of floor area per student, whereas that of a classroom is in the order of 20 sq. ft. of floor area per student.

Electronics Labs obviously will not have the same requirements for all the plumbing services previously mentioned. On the other hand, their requirements from an electrical service standpoint are much greater. Also their impact on the environmental control system becomes a factor which must be provided for in the design of this system, in that the degree of heat dissipated from the equipment can be a major factor in determining the capacity of the environmental control system for this laboratory. In a similar manner, the Control and Instrumentation Laboratory may present another design problem for the engineer. Some test equipment may demand controlled temperature and relative humidity, the control tolerances of which are more critical than that provided for in conventional laboratory or classroom space.

(b) Drafting Laboratories

The space required for drafting laboratories is quite similar to that of a conventional classroom. In this area the intensity of illumination is much greater than is normally provided for in a classroom. This area should have an illumination in the order of 100 to 150 f. c., whereas conventional classroom illumination is approximately 60 to 80 f. c. Again the environmental control system must be designed to accommodate the higher heat load developed by this added lighting load.

2. Shops

The Shop Section of a Technology Area may include Civil Engineering, Mechanical Engineering, Welding and Heat Treatment, Machine Shops, Motor Mechanics, Metal Working, and Hydraulics. This space is of an industrial design incorporating a high ceiling (usually 16 to 18 foot clearance) and requires only industrial type finishes. Provisions in this area must be made for some, if not all, of the following:

(i) Vibration islocation foundations for heavy test equipment.

(ii) Heat treatment ovens with exhaust hoods.

(iii) Material testing equipment.

(iv) Welding machines with suitable power outlets and associated fume exhaust systems.

(v) Heavy metal working equipment with associated cooling systems as are required on metal cutting machines.

(vi) Material handling systems such as a monorail with chain blocks.

(vii) Power outlets, designed to accommodate heavy electrical motor loads. (This is usually provided for in the form of a higher voltage bus duct.)

(viii) Engine testing and exhaust systems.

(ix) Heat transfer systems.

Most of this equipment, of necessity, should be located on the ground floor slab.

Of necessity, the environmental control system of this space is unlike that of a classroom or a laboratory. A much higher rate of ventilation must be provided since the exhaust air requirement in this area is much greater than in any other area. Environmental control is less critical than in academic areas. For these reasons, shop environmental control systems are usually separate from any central environmental control system. Furthermore, this system must be designed to accommodate intermittent operation of the fume hoods.

C. REQUIREMENTS OF A FLEXIBLE DESIGN

Flexibility implies the multiple use of a given space and/or the economical conversion of a space from one function to another. Here one must not overlook the importance of the meaning of "economical conversion". Also implied is complete accessibility and expandibility of all mechanical services mentioned previously to meet the new demands of the teaching profession. The review of the individual rooms in the technology area clearly indicates that complete flexibility of space is not economically possible. What degree of flexibility then is economically possible? In order to intelligently answer this question it is necessary to examine various systems which will produce some degree of flexibility.

1. <u>The Central Double Walled Corridor Concept</u>

This concept involves a central corridor with laboratories on either side. In order to provide access and flexibility of mechanical services, a double corridor wall is provided on one or both sides of the corridor. Distribution of services is by means of ring mains at the lower level with vertical risers located in the double corridor wall extending the full height of the building. The double wall must provide free access to all mechanical services at each floor and for this reason the space may vary from a minimum of two feet to a maximum of four feet clearance. Depending on the length of the building, banks of risers are strategically spaced so as to reduce the horizontal runs within the double wall space to a minimum. From this space, mechanical services can be extended through access panels into any laboratory ceiling space, or behind laboratory desks depending on the type of distribution system utilized in the laboratory design. This type of flexibility is utilized primarily in multi-storey buildings where the demand on mechanical services is extremely high.

2. <u>The Perimeter Double Wall Corridor Concept</u>

This concept is somewhat similar to the Central Double Walled Corridor concept, but differs primarily in the location of the

Corridor. In cases where environmental control tolerances are much more demanding, this scheme in essence eliminates the effect of the exposure on the environmental control system. For this reason, corridors and the double wall shafts are located around the perimeter, forming an envelope around the laboratory areas. Pipe shafts again are provided in the manner described for the Double Corridor system. Needless to say, the shape of the building, or the shape of the area involved, also influences the choice of system selected.

3. A Central or Multiple Service Shaft Concept

This concept is intended to reduce the added cost factor of the Double Wall Corridor Concept, which is quite substantial. Through careful planning, laboratories may be located so that mechanical services can be provided through a common vertical service shaft rising the full height of the building. Again these service shafts should be designed in such a manner that the services contained therein are completely accessible at each floor. This concept usually involves a greater degree of horizontal distribution piping. The horizontal distribution piping can be reduced if the laboratories can be so arranged that each group is serviced by its own service shaft. This system does not provide the flexibility of the two systems previously mentioned, but does increase the ratio of net floor area to gross floor area, thereby reducing the cost of the building.

All the above concepts are primarily intended for laboratory services such as compressed air, gas piping, distilled water piping, drain services, power, instrumentation, etc. They will make possible the conversion of a chemistry laboratory to a physics laboratory. They are not intended, however, to enable the conversion of a chemistry laboratory to a civil engineering lab. They will permit the extension of existing services into laboratories without any serious cutting and patching of the building walls and floors. Also they will permit the addition of new central services.

D. ENVIRONMENTAL CONTROL SYSTEMS

Up to now we have considered ways and means of providing some degree of flexibility to building services, as applied to the technology areas. However, not to be overlooked, and of equal importance, is the environmental control system or systems which form an integral part of the building. The major factors which affect the design of this system can be summarized as follows:

(a) Design of building fabric.

(b) Exposure.

(c) Lighting intensity.

(d) Occupancy.

(e) Laboratory equipment.

Of these, only the first two factors are constant. The latter three factors probably will change with a change in activity. In order to accommodate this change, the central plant and the air distribution system must have a built-in flexibility. This flexibility can be provided only in one form and that is excess capacity. This excess capacity must be designed into the system initially, which means oversized ductwork, oversized heating, and cooling, coils, and excess fan capacity. Needless to say, this represents dollars which most programmes can ill afford. Furthermore, is this added cost justified as it may never be used? It therefore is quite apparent that such excess capacity cannot be justified and in fact is not justified. The end result is an environmental control system which is rather inflexible.

E. ECONOMY OF DESIGN AND FLEXIBILITY OF MECHANICAL SERVICES

What is the effect of a flexible mechanical system on the budget of the project? The degree of flexibility has been reviewed and was found to be somewhat limited. This degree of flexibility which can be provided undoubtedly will increase its cost accordingly. If cost is no major consideration, there is no problem. Unfortunately all of us, including the academic staff of a College of Applied Arts and Technology, must accept the fact that this is a major consideration. In this day of rising construction costs, the emphasis is on economical design. What is an economical design?

F. ECONOMICAL DESIGN

An economical design involves all design descriptions. The building must be well conceived and carefully planned. Activities requiring common services must be grouped so that the cost of providing mechanical services can be reduced to a minimum. Flexibility of space must be carefully studied, particularly by the user service, who also must appreciate and accept the limitations of mechanical services previously outlined. In light of this fact, all who form a part of the design team must appreciate this limitation when attempting to create a flexible building.

G. CONCLUSION

Two questions previously have been asked - "how much flexibility is required?" and "how much flexibility is economically justified?" The battle of the budget, which the entire construction industry and the design profession in particular is fighting, makes the answer to the latter question quite obvious - very little, if any. To the former question, it is my contention that with thoughtful planning, and careful design, very little flexibility is in fact required.