DOCUMENT RESUME

ED 089 427 EA 006 014

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TITLE Industrialised Building Systems Educational Objectives and the Problem of Change. Programme on Educational Building 5.
INSTITUTION Organisation for Economic Cooperation and Development, Paris (France).
PUB DATE Mar 74
NOTE 29p.; Includes a paper entitled, "Industrialised Building Methods for Educational Purposes: Activity Outline"; Related documents are ED 081 078-079, ED 081 120, and EA 006 013
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EDRS PRICE MF-$0.75 HC-$1.85 PLUS POSTAGE
DESCRIPTORS Construction Costs; Educational Environment; *Educational Objectives; Educational Technology; Facility Planning; *Flexible Facilities; Industrial Technology; Information Dissemination; *Prefabrication; School Construction; *School Design; School Industry Relationship; *Systems Approach
IDENTIFIERS Adaptability; *Industrialized Building Systems

ABSTRACT

In 1972, the author was asked to join a small team of experts to help implement one of the activities underway in the Programme on Educational Building (PEB). The activity was entitled, "Industrialised Building Methods for Educational Purposes," and its major objective was to identify for policymakers the considerations involved in using to the best advantage industrialized building methods for the construction of schools. In the course of the activity, the team, which consisted of an architect, an engineer, an economist, and the author, visited a number of countries looking at many different types of school building systems. The visits and discussions of school building problems with educationists, architects, and others of many nationalities prompted the author to write down his own personal reflections on three related issues which appear to preoccupy a great many of those charged with the responsibility of school building provision: industrialized building systems, educational objectives, and the problem of change. In the first part of this paper, the author analyzes these three general concepts in terms of their application to the practical problems in the educational design of schools and explores their relationship to each other, inquiring in particular whether they can be reconciled. Ultimately, the author attempts to define more precisely the problems inherent in an acceptance of these concepts. The second part contains, in a separate paper, the outline on the objectives, content, and method of the activity referred to, which is used by the author as the starting point for his argument. (Author)

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- to facilitate the exchange of information and experience on aspects of educational building judged to be important by participating Member countries;

- to promote co-operation between such Member countries regarding the technical bases for improving the quality, speed and cost effectiveness of school construction.

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P R E F A C E

In 1972 Mr. C.W. Phillips, the Deputy Director of Education of Derbyshire, England was asked to join a small team of experts by O.E.C.D. to help implement one of the Activities underway in its Programme on Educational Building (P.E.B.). The Activity was entitled "Industrialised Building Methods for Educational Purposes" and its major objective was to identify for policy-makers the considerations involved in using industrialised building methods for school building to best advantage. In the course of the Activity the team, which consisted of an architect, an engineer and economist and Mr. Phillips himself, visited a number of countries looking at many different types of school building systems. The visits and discussions of school building problems with educationists, architects and others of many nationalities prompted Mr. Phillips to write down his own personal reflections on three related issues which appear to preoccupy a great many of those charged with the responsibility of school building provision: industrialised building systems; educational objectives; and the problem of change.

This information leaflet presents those reflections in the first part. The second part contains the outline, prepared by Professor Guy Oddie, senior adviser to P.E.B., on the objectives, content and method of the Activity referred to above, which is used by Mr. Phillips in his opening paragraph as the starting point for his argument.

INDUSTRIALISED BUILDING SYSTEMS
EDUCATIONAL OBJECTIVES
AND
THE PROBLEM OF CHANGE

by

C.W. PHILLIPS

In a study of industrialised building systems to be used for school building an essential criterion must be the capacity of a system to meet defined educational objectives. The terms of reference, therefore, which seek to define the nature of the relationship which ought to exist between the elements of the system and educational aims in terms of design, assume a special significance. In Professor Guy Oddie's paper which contains the objectives, content and method of the O.E.C.D. Programme on Educational Building Activity "Industrialised Building Methods for Educational Purposes", there are three coordinates defining the way in which this relationship might be expressed. Firstly, the paper says, the paramount consideration for any pre-fabricated building system must be "its potential for providing the kind of facilities needed in the educational circumstances of the country concerned". To this dimension is then added another: the system must not only be capable of meeting educational needs defined and recognised at a moment of time but also of "maximising the pace of educational advance". Finally, there is a third, which on one interpretation, might be considered as an extension of the second but which, on another, might stand as a separate objective and in contradistinction to it. This relates to the statement that a consideration of potential must also take account of the increasingly recognised need for adaptation for "unforeseeable future change".

The purpose of this paper is to analyse these three general concepts in terms of their application to the practical problems in the educational design of schools and to explore their relationship to each other, enquiring in particular whether they can be reconciled. Its object is not to find solutions, if indeed they exist, but to try to define more precisely the problems inherent in an acceptance of these concepts.

The starting point must be, as always, an analysis of educational function for, in a sense, a school is no more than a treatment and definition of space in terms of activities which can be defined as

educational. Activities is the word to be emphasised; in a generic sense it embraces not only the nature of the activities themselves but their inter-relationship and the sequence in which they are performed. An elementary, but effective and intelligible, way of examplifying these activities is to define them by categories. In practice the categories are closely inter-twined and indeed recent changes in the approach to learning have only served to emphasise the complexity of their inter-action.

The first category - and this is indeed merely a starting point - might be defined as a subject category: mathematics, mother tongue, languages, art and craft, handicraft, physical education and drama - a list which is illustrative rather than comprehensive. This category, traditional in definition, is itself in process of change. Certain new trends are already discernible: individual subject areas are being replaced by inter-disciplinary studies and there is a growing advocacy of a core curriculum comprising over-lapping areas of subject-based activity, involving the development of conceptual understanding rather than the acquisition of factual knowledge. The second category can be said to include the educational content of each subject or disciplinary area and the teaching methods and approach which are in vogue from time to time. Over-lapping both categories is the question of how the pupils' studies should be organised; how much time should be spent on individual assignments; how much in group studies and how much in teaching groups of varying sizes. The third category might be said to embrace the way in which a school might be organised as a community both for social purposes and to meet the individual pupil's welfare.

These are the fundamental educational activities which govern, or should govern, the way in which a school should be designed. But a number of these considerations are variables, not only in the sense that educational practice varies from one time to another but also from one country to another, as the educational needs reflect differing social, cultural and economic conditions. One of the most striking examples is the stress laid on corporate activities in schools in the United Kingdom, as compared with other European

countries, an emphasis which expresses itself on the importance in school design given to Assembly Halls, and spaces for music and drama. In terms of the educational content of the disciplines taught, the greater the emphasis on practical enquiry and observation, the larger the number and the greater the variety of practical spaces which need to be provided and suitably equipped. The breakdown of the isolation of subject areas, and the development of inter-disciplinary studies add to the complexity of school design. When the old concept of one teacher having charge of one group of 30 or 40 children gives way to one in which teachers work together as a team with larger numbers of children, then the postulates of school design are changed in a significant way. Likewise, they are forced to be changed the more the organisation of a school is directed towards activities that strive to stimulate the curiosity of the pupils and the more the curriculum of a school is built round centres of interest that call for direct investigation by the pupils themselves. Between these categories and within them there is constant change and re-interpretation. The task of making educational ideas precise in the context of school design becomes more complex if the relationship between these three categories needs to be expressed in an increasing number of ways or if the concepts of thought behind each category are significantly amended. An educational plan of a school represents an equilibrium at a given moment of time between these activities and their relationship to each other.

Nor can mention be omitted of developments in educational technology, for these too can have a bearing on the complex activities embraced within a school's life. An illustrative list is simple enough: television including video-tape recording and closed circuit television, cassette tape machines, projectors of various kinds, language laboratories, computer terminal facilities, programmed learning machines and so on. Changing educational technology inevitably makes demands on the types of space to be provided in which these technical aids can be used and in the accessible storage areas which they require. But it can have a far greater impact than this; the ways in which these aids are used, particularly in combination with each other, can modify in some degree the more general approaches to

learning. The current phrase "educational resources centres" indeed may well be an inadequate and unimaginative shorthand to describe the impact of changing educational technology on the organisation and curriculum of schools.

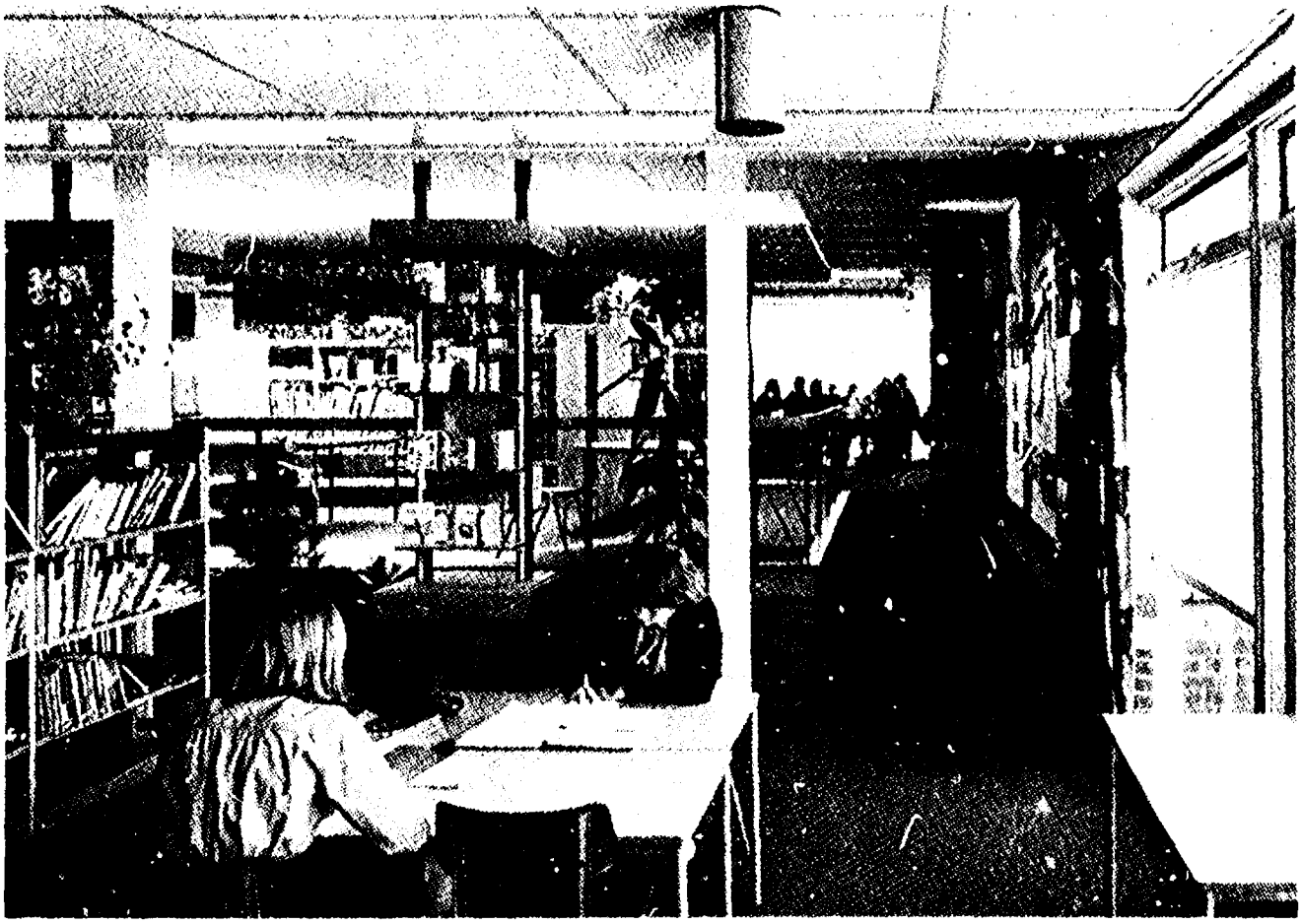


Figure 1: Educational resource centre: an expression of the impact of changing technology on the organisation and curriculum of schools?

There is one general factor which embraces the more specific activities so far mentioned. This is that of the nature of the general environment in which pupils learn and so arise the recurring questions of heating, lighting, ventilation and noise. It is generally agreed that a number of recently built schools fall short of standards recognised as acceptable and more attention is now being paid to these technical problems in order to improve the general environment. Within these general concepts there are more specialised concepts of

educational environment. These refer to differing educational environments for children of different ages. Thus a school for small children should have a different atmosphere from one for older children; the scale should be different, the spaces more domestic, the furnishings more in keeping with their stage of development. Likewise each space for different educational activities has its own specialised requirements in terms of atmosphere and functional efficiency.

These are then the educational components which need to be translated, as it were, into physical building components, no matter what form of building method is adopted though in the present context, industrialised building systems are the subject of investigation. An ideal

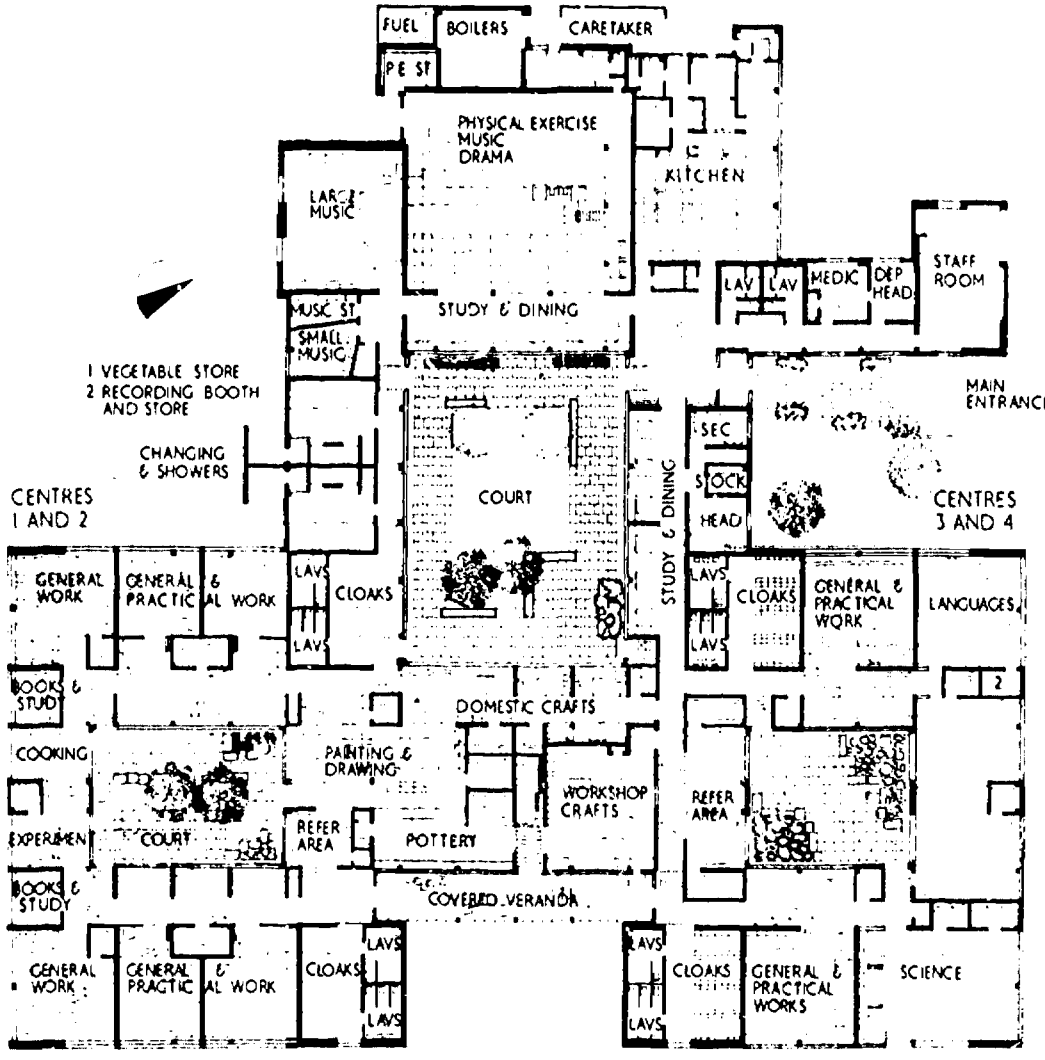


Figure 2: Plan of a school: a translation of the educational components into physical building components.

combination for any particular kind of school is perhaps unattainable for reasons which will vary from one place to another and from one time to another. Sometimes it will be cost; at other times lack of time for development; the pressure of demands upon resources; lack of definition in the educational requirements. The process of designing and building a school presents its own limitations. For a large school three to four years can easily elapse between the initial design of the school and its occupation by staff and pupils. Yet during this period there could well have been some changes in the concepts of curriculum or school organisation which affect design.

If there is to be discussion of the ways in which these components are put together and if there is to be discussion about the scope for future changes in educational design, it is necessary to be specific about vocabulary. Two words constantly recur: "flexibility" and "adaptability" and indeed one can almost give them whatever meaning seems appropriate at a moment in time. But it is proposed here to use the phrase "the flexibility of a system" as the method of describing the number of choices the system will allow one to make to meet educational requirements. "Adaptability" will be used as indicating the ways in which the system allows a school to be extended economically and efficiently when built and, in addition, as enabling the interior of the building to be re-designed with ease and economy to meet changing educational requirements. Within both meanings of the word it will be assumed that an acceptable general environment can be provided.

It is not difficult to determine the essential ingredients in a system to which the epithet "flexible" could be applied. An exploratory list might run as follows: a planning module which is not too large, in particular for internal partitions, (one can accept a rather larger structural module though there are disadvantages); spans wide enough for specialised activities; a range of ceiling heights; wall, ceiling and floor finishes that meet both acoustic and other educational requirements; effective ways of accommodating and providing the services required; the ability to construct buildings several storeys high; a system that can take advantage of sloping sites in the

interests of educational design. The list could easily be extended to include more sophisticated variations in both the external and internal treatment of buildings.

It has been observed that a different method of building has been used where exceptional ceiling heights or large spans have been required.

Figure 3: Gymnasium: an instance where exceptional ceiling heights and large spans are required.

The same technique might also apply in other circumstances, as for example, if exceptional floor loadings were needed for heavy machinery or equipment. These requirements arise from the nature of the educational activities to be undertaken, obvious examples of which are Sports Halls, Gymnasia or Swimming Baths. But the same principle can be extended to Dining Halls or to any area where a large space is required, as for example, for drama, movement or dancing. There is no one common tradition of education which places equal emphasis

on these activities and a system could well meet current educational practice in an individual country without these particular features needing to be an integral part of the system.

The question has been asked as to whether there is any particular disadvantage in terms of a given school's efficiency as an educational institution if different techniques of building are used for the purposes which have been described. The answer can only be a guarded one. If more than a minimal amount of accommodation is constructed in a different system - and this area in itself is a matter for debate - then certain consequences would seem to follow. The school would most certainly have to be built in detached blocks, linked by covered ways which in themselves are acceptable in some climates but not in others. The indirect consequence of this, while more important, is not so obvious. If the right ethos in a school is to be formed, a concept which is social as well as more specifically educational, then its establishment will certainly be helped by the juxtaposition of accommodation which establishes relationships between two sets of spaces and gives nuance to the design pattern. The ultimate harmony in education is in some ways akin to aesthetic feeling and can in part be engendered by the instinctive appreciation which young people form from their movement through the buildings. There should undoubtedly be flow between one subject area and another and it is at least arguable that a variety of systems on one educational campus might prove to be an obstacle to this aspect of educational synthesis.

Thus the conclusion emerges that the flexibility of a building system can best be defined in terms of the number of options which it affords the client; the greater the number, the greater the contribution which the building can make to the achievement of the educational objectives as specified by the client. The building itself should enable educational activities so specified to be successfully carried out and should help to create the particular ethos of a school community which the educationists have in mind.

Logically one can extend this as a concept and consider the options

to be taken in educational building as a shopping list from whioh a choice can be made. But the reality is rather different for the shopping list is never the same. A country may require a particular building system to satisfy urgent, defined educational needs, whioh will, in their turn, reflect socio-economic demand at the time. The number of options needed might not need to be large nor the economic circumstances of the country such that a sophisticated system was required or could be afforded. Only certain essentials, however defined, of an industrialised building system might be required. In the second place, the development of an industrialised building system is empirical; it does not spring fully developed, as it were, from the brow of Zeus but evolves as the educationists and architects demand more from it in terms of educational objectives.

There are, therefore, always likely to be practical limitations on the range of options of which advantage can be taken at any given moment of time. One of the most severe could be that of cost, whether this operates as a conscious and known limit or whether it operates merely as a general background to the building enterprise as a whole. The problem of priorities is always present in one form or another; and the balance of advantage will swing as educational change takes place. There is never really a constant position in the evolution of educational building, so that the choice to be made is hardly ever from the same list. The points of stability are, therefore, probably fewer than might appear at first sight. Yet at the same time, essential ingredients in terms of basic structure must permit development and it is not difficult to define what these should be. Certain types of structure suffer from such obvious disadvantages that they are not likely to permit development.

This approach to the question of building systems might be described in a sense as proceeding by way of negative definition, a concept particularly of value in considering the requirements of a system "to maximise the pace of educational advance". Under this concept the degree of flexibility of a system would consist in the number of options which were available to be taken up to meet this or that educational objective. This approach to flexibility would seem to imply

certain pre-suppositions. The introduction of more and improved options in any industrialised building system assumes a continuing development of the system over a period of time. It is not likely to be realised in any system adopted merely to meet a short-term need nor will it easily be achieved without a permanent organisation specifically established to develop and improve the system. As a corollary, there must be in existence a market large enough, or potentially large enough, to justify in economic terms the introduction of a large number of options; the smaller the market the more limited and limiting is any particular industrialised building system likely to be.

The problem of adaptability raises different questions. By definition, it is not logically possible to provide for unforeseeable educational change for this implies a dimension of thought different from that which is current. Nevertheless, certain possibilities can be foreseen. Extensions to a school arise for a number of reasons. The school may need to grow to a size larger than that for which it was planned or educational standards themselves may change so much that for the same number of pupils additional facilities need to be provided. These constitute the two most frequent reasons for extensions being built to a school and, in carrying them out, the opportunity is frequently taken to incorporate new ideas in educational thinking in general or educational method in particular. Very often large-scale extensions are constructed in separate blocks but they can be linked to existing accommodation in a variety of ways which are satisfactory and effective in preserving an educational unity. There may, however, be situations in which, because educational ideas have changed, a room needs to be extended in length or width or extensions actually linked to existing buildings. To meet these requirements, any industrialised system of building should ideally permit junctions of this kind to be made and rooms to be extended in both directions. In saying this, however, allowance should be made for the fact that with the passage of time the components of any industrialised system tend to change and even the structural module may be modified to improve the flexibility of the system. However, in circumstances such as these, there are methods available to overcome the problems involved in joining systems which to a degree are incompatible with each

other. The adaptation should be capable of being achieved as economically as possible.

These are alterations, so to speak, to the envelope of the building. There remains the more formidable question of the degree to which, within the envelope it is possible to provide for change of use to meet changes in the areas of knowledge studied (and the time devoted to them), or their relationships to each other, and also in teaching methods. Extensions to a building for the reasons given in the previous paragraph may well make necessary a change of use in some of the accommodation of the existing building. The main limitations in economical adaptation form a trilogy: structural, technical in the sense of environmental problems, technical in the location and provision of services. Indeed in considering these problems there is a proposition worth examination: namely the extent to which it is true to assert that the wider the range of options used in an industrialised building system to create a specific educational environment, the more difficult it may be for adaptations to be made economically in the future. There is here a question of reconciling one objective with another.

Nevertheless, in considering adaptability in this sense, one is led almost inevitably in planning towards several concepts which may be described broadly as "strategic". The first is that it is desirable to keep the use of space as flexible as possible by using mobile furniture and equipment to define the educational activities that are to be undertaken in any given area at a particular time. One of the main advantages of the use of mobile furniture and equipment is that it enables areas within limits to be re-designed to meet changes in the methods of teaching. Furthermore, a range of well-designed mobile furniture can always be increased and the re-arrangement of general work areas can be achieved most effectively in this way. In the same way equipment should be designed to be as mobile as possible.

The second is that partitions should be able to be moved relatively easily and re-erected in new positions. This is a more complex problem than may appear at first sight, for its successful solution is

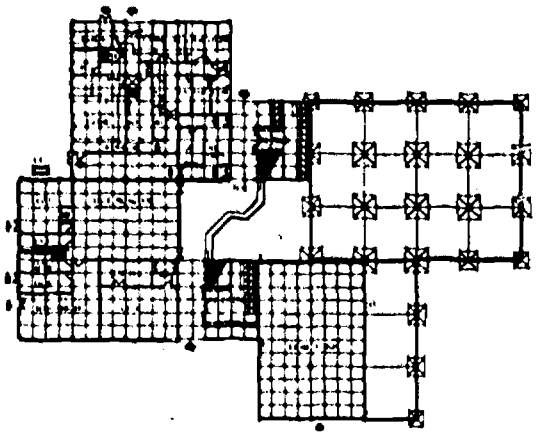
Figure 4: Range of mobile furniture and equipment (used, in this instance, for a resource centre): the area depicted can be easily re-designed to meet changes in the methods of teaching.

tied up with the general environmental problems described in succeeding paragraphs. One specific problem is that of sound insulation. It is not always necessary to have complete sound insulation and the treatment of floors and ceilings can reinforce the effects provided by the partitions. In this way the transmission of sound can be deadened effectively enough to enable a number of school activities to be carried on. There will, however, always be required certain spaces in the school where educational activities are such that there must be effective sound insulation between one area and another. Another problem is that of the effect which a change in the location of partitions can have on the movement of pupils through the school. What needs to be undertaken is a feasibility study of the number of spaces of differing sizes which can be created by the movement of partitions and yet, in a complex organisation such as a secondary school tends to be, can still enable pupils to move freely from one part of the school to another.

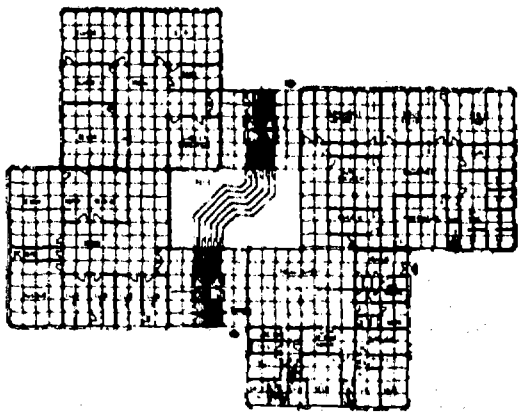
In any scheme of adaptation, one of the most expensive aspects is

that of re-routing the services. Services fall broadly into two categories: those which serve teaching requirements such as gas, water, electricity and secondly those such as heating and lighting which contribute to the general environment. With the latter should also be included ventilation. With reference to the services in the first category, there are two approaches to the problem of adaptation. The first is to concentrate those adaptable elements such as moveable partitions in areas where no specialised requirements for services are likely to be needed. The second is to ensure that services are provided round the perimeter of the areas, and, where required, brought in overhead. Several successful examples of this can be cited.

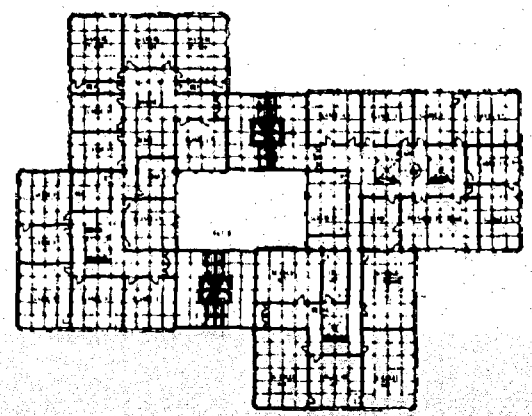
It is also a corollary of this approach that those blocks of accommodation in a building, such as cloakrooms and toilets, should be kept separate from the main teaching areas or interspersed in such a way that they will not seriously interfere with changes in internal layout. In using the words "blocks" and "separate" it is not meant to imply that they should be built in large units, since these can be criticised in terms of social organisation. Nevertheless, the



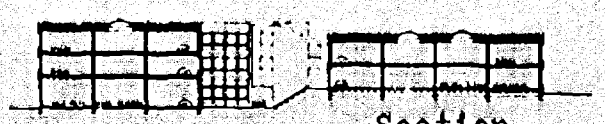
Lower Level



Ground Floor



1st Floor



Section

Figure 5: Plans and section of a school building showing the separation of "fixed" and "adaptable" areas.

warning must be sounded that too much may be sacrificed in the initial design of the school in the interests of adaptations at a later stage. In this, as with so many other elements in school design, there is always a balance to be struck.

One of the most formidable problems in the provision of adaptability and in subsequent adaptation seems to be the problem of preserving the essentials of the environment provided by heating, lighting and ventilation. The heating can be provided in a number of ways, some more costly than others but there would appear to be no seemingly insuperable obstacle to providing heating in ways which will not seriously interfere with internal adaptations. The problem of lighting and ventilation is more complex and without more evidence available from feasibility studies, it would be wise not to be dogmatic. However, to make adaptation as economical and as easy as possible, it is difficult to avoid the tentative conclusion that it may be neoessary to veer towards adopting the principle of a controlled environment as is already being done with "deep plans" in school design. This method of approach places an emphasis on air conditioning and reliance, at least in part, on artificial, as distinct from natural, lighting; but then further problems arise, for example, the acceptability of such environments to users, or increased running and maintenance costs.

The introduction to this short paper stated that one of the objectives would be to define the problem and to thrust the more fundamental questions to the surface. So appropriately enough the conclusion is in the same questioning spirit. The analysis of flexibility and adaptability as defined raises the question of how far they are completely reconcilable. On the one hand, ease and economy in the interests of adaptability would seem to suggest that the initial plan should be utilitarian in design and execution; on the other hand, increasing flexibility might appear to point in a different direction. One must doubt whether as yet any designer, architect or educationist, has set out consciously to explore the complexities involved in attempting to reconcile these two approaches or to define the practical limitations which may be involved.

There is also the important question of cost, to which only oblique references have been made in this paper. Cost itself in this context has many facets. There may be additional capital cost inourred in providing for adaptability in the building when it is initially designed and this will have to be measured and set against the cost of adapting the building at a later date. In addition, there has to be taken into account the inconvenience to the user if substantial adaptations are carried out when the building is in use: an inconvenience related in turn to the frequency with which changes in use are made. There are costs which are indirect as well as direct. However, further analysis of costs is obviously necessary, and until such a review is undertaken, one cannot exclude the possibility that limitations on cost may make it difficult to apply any solutions which may be found to meet the technical requirements involved.

INDUSTRIALISED BUILDING METHODS
FOR EDUCATIONAL PURPOSES
Activity Outline

by

G.B. ODDIE

OBJECTIVES

The successful use of prefabricated or industrialised building systems in some countries leaves no doubt that they have important advantages to offer. An increasing number of countries are therefore seeking in such systems solutions to problems of cost, erection time, and scarcity of professional and constructional manpower. Each is thus faced with the choice either of an existing system or with developing one of its own.

But what is the nature of the advantages? How closely do they respond or run counter to educational objectives, how specifically can they be described or quantified, do they depend on circumstances other than the intrinsic merits of the system used, and how far are such circumstances in turn peculiar to the financial, administrative or other features of the countries where the advantages obtain? Choice must be preceded by such questions and this Activity is directed towards answering them and indicating how they inter-relate.

The Activity does not imply a comprehensive review of all available systems with a view to establishing some order of merit - such an objective would be inconsistent with known national differences as well as with the resources available for the Activity. The objective of the Activity is to clarify for policy-makers the considerations involved in using prefabricated or industrialised building methods to best advantage with respect to educational objectives and to national financial and administrative requirements.

The tangible product of the Activity will be an illustrated report and commentary on experience in the use of industrialised systems with reference to the issues raised in the following section.

CONTENT

Building form

The outline for the Activity on the Multi-option School emphasises that "ultimately no policy is successful which fails to provide the right kind of school building". Thus the paramount consideration in any

prefabricated building system is its potential for providing the kind of facilities needed in the educational circumstances of the country concerned. This potential may be expressed in terms of the complexity of plan and section which the system permits, its limits of structural span and permissible loadings; its implications for natural and artificial lighting, heating and ventilation, and noise control; the provision of electricity, gas and water services; its resistance to fire or other hazards and its durability. Consideration of potential must also take account of the increasingly recognised need for adaptation to unforeseeable future change coupled with the ever-present and overriding need for a congenial educational environment. (It must, however, be recognised that congeniality is impossible to assess objectively and that the question of adaptability for change and growth is so complex as to merit a separate activity on its own account.)

The range of potential offered by different prefabricated systems is considerable; but so is the range of educational circumstances found in different countries. Thus, for policy-makers the first problem is to choose a system which, subject to current financial and manpower constraints, will not only meet the present needs of teachers and pupils, but also maximise the pace of educational advance. The study will, therefore, illustrate by reference to selected examples the range of potential which prefabricated systems offer in respect of building form.

Savings in cost, manpower and time

Given that policy-makers have "the right kind of building" as their paramount objective, their next most important question is "which of those systems capable of meeting this major objective promises the biggest saving in cost, time and scarce manpower?". Direct answers appropriate to every situation in each country are clearly beyond the scope of the Activity. It will, however, indicate in general the various ways in which the question has been approached.

Savings in cost, time and manpower are, of course, relative to the "traditional" alternatives against which industrialised or prefabricated systems are compared. The cost, etc., characterising these

alternatives varies from one country or one region to another depending on local conditions, such as the size, number and diversity of manufacturing and construction firms, the degree to which the building industry is already capital intensive, or the nature of incentives resulting from, say, taxation policies. Thus, the Activity will not attempt to assess whether a system used in country A is better than one used in country B. Instead, the Activity will attempt to identify the local conditions which have affected savings in any system examined, and the steps taken to increase the savings. Conversely, examples will be examined of systems which have been conceived to meet the specific requirements of differing localities or regions. If any system has been used in more than one country, the Activity will attempt to assess how far similar advantages have been obtained and how far different local conditions have imposed modifications on the system. In these ways, the Activity will provide an indication of how local factors affect choice of system.

The cost of a building system can only be expressed with reference to buildings constructed in that system. The reason is that all sub-systems (floors, walls, roofs, etc.) comprising the total system have their individual unit costs and are used in different proportions in different buildings. Thus, the cost of a particular building depends in general terms on the designer's skill in balancing the more expensive with the less expensive sub-systems in the most effective proportion. The exercise of this skill depends on the range of choice which the system allows the designer in striking this balance and on the precision with which the cost of assembled sub-systems can be forecast when alternative choices are being considered. Thus, examples of systems will be selected so as to reveal the measures which can be taken to enable designers to control the cost of buildings.

Prefabrication can certainly produce very cheap buildings, but usually at the expense of lower standards of performance. Real cost benefits only appear when prefabricated production reaches a certain level of output. Economies of scale are clearly linked to the size of market which any system is able to command. Bearing in mind the geographical extent over which prefabricated components can be

economically distributed and the importance attached to stimulating competition, the Activity will attempt to identify measures which have been taken to increase the size of market and the threshold at which an increase has shown significant economies of scale.

The period over which time is of consequence lies between the point when finance is earmarked for a specific building or series of buildings and the point when it or they must be ready for occupation. Within this period time is needed (1) for design, (2) for tendering, (3) for pre-construction preparation by the contractor, and (4) for the construction, fitting out and furnishing of the building. The amount of manpower that can be effectively concentrated on any one of these activities is in practice limited. Therefore, savings in time are virtually synonymous with savings in manpower - professional man/hours spent on decision-making in the first three activities and industrial man/hours spent on assembly in the fourth.

Savings in professional manpower result from the simplification or limitation of decisions that have to be made. Savings in construction manpower depend on what proportion of the total building is prefabricated or susceptible to capital-intensive construction. But with respect to both considerations systems vary widely in scope. Those which concentrate too hard on simplifying decisions run the risk of producing standardised uniform buildings. Over-concentration on prefabication or capital-intensive production can, on the other hand, raise unit costs. Thus, the Activity will examine with reference to examples of different scope what measures can be taken to reconcile time and manpower savings with overall cost and quality of buildings produced.

Development and management of building systems

The majority of industrialised building systems have been originated by the commercial enterprises which manage their production, sales and distribution, and direct any subsequent modification or development of the system. Some public education agencies have been unable, however, to find any commercial system sufficiently suited to their

requirements, have therefore originated and developed systems of their own and have themselves undertaken the management of production and distribution. Some of these agencies have made their systems available for use by others, either by accepting other agencies into partnership or by licensing a commercial organisation to market the system and develop it to meet the requirements of a wider market.

Subject only to the institutional arrangements open to it, any education agency therefore has a choice between:

(a) originating, managing and developing its own system;

(b) sharing development and management responsibility with an agency or consortium of agencies which have already originated a system;

(c) purchasing a publicly-originated system from a commercial licensee;

(d) purchasing a system which is commercially marketed and controlled.

By examination of appropriate examples, the Activity will report on the advantages and limitations of each alternative which policy-makers will need to balance in making the choice best suited to their circumstances.

METHOD

A consultant team of architects, building economists and educationists will select, from four or five countries, seven to ten building systems which have been widely used for school construction and which between them illustrate the issues raised above. In proposing this number of examples the following considerations have been taken into account.

The O.E.C.D. publication of 1966, "School Building Resources and their Effective Use" made a major distinction between <u>linear</u> and <u>multi-rectangular</u> systems (see Chapter XIV, paras. 8 to 14). Linear systems can only produce buildings of separate (although linkable) oblong

blocks which may vary (by standard increments) in length but not in width. A multi-rectangular system is one which can produce any building whose plan is made up of a combination of rectangles, each of which may vary by standard increments in width as well as length. In the more sophisticated systems, the floor to ceiling height may vary from one rectangle to another and several storeys may be superimposed on each rectangle.

Despite the limitations of linear systems, in many countries no alternative yet exists, and in any case, having been produced for general purposes other than school building, many linear systems are available, vigorously advertised by their promoters. It therefore seems desirable that at least one, and possibly two, examples of commercially-produced linear systems should be included in the study in order to indicate the limits of their potential; but the remaining examples will all be multi-rectangular, some commercial and others public in origin.

In order to ensure full coverage of the field of interest it seems useful to differentiate examples according to the prime objectives of their originators, which experience suggests could be tabulated as shown in the table on page 27.

It is expected that these examples will cover between them the various possibilities for the development and management of building systems referred to above.

A report on the Activity will be produced, illustrated with diagrams and photographs, analysing and commenting on the issues raised in this outline. It is envisaged that the report will be available early in 1975.

Originator	Originators' Objectives	Class (L or MR)*	Example N°
Commercial	Promotion of originator's staple product (e.g. steel, concrete, timber)	L MR	1 2
	Exploitation of originator's design, management fabrication or construction skills	L MR	3 4
Public	Prefabrication of maximum number of sub-systems	MR	5
	Maximum use of capital-intensive assembly methods	MR	6
	Maximum use of small-scale construction firms	MR	7
	Use of heavy construction for accoustic or thermal reasons	MR	8
	Desire to maximise produoers' responsibility for design of sub-systems	MR	9

* L = Linear MR = Multi-reotangular

ACKNOWLEDGEMENTS

Figure 1 - Project : Keyworth lower school, Nottinghamshire, England.
Architects : Nottinghamshire County Architect's Deparment
Photograph : Courtesy of Architects Journal, London.

Figure 2 - Project : Delf Hill Middle School, Bradford, England
Architects : Bradford Architects Department in association with the Department of Education and Science (D.E.S.) Architects and Building Branch, London.
Drawing : Courtesy of Architects Journal, London.

Figure 3 - Project : "Centre éducatif et culturel", Val d'Yerres, France.
Architects : Messrs. Levordashky, Chémétov and Deroche.
Photograph : Jean-Pierre LE BIHAN

Fiture 4 - Project : Humewood Junior Public School Borough of York, Toronto, Canada.
Architects : Pentland and Baker, Toronto.
Photograph : Cameron-McIndoo

Figure 5 - Project : Plan-type of Collège d'Enseignement secondaire (C.E.S.) for 900 in the Ballot system, France.
Architects : Groupement d'Architects Robert Joly, Paris.

P.E.B. INFORMATION LEAFLETS

Issued by the O.E.C.D. Programme on Educational Building (P.E.B.), the leaflets are an attempt to circulate up-to-date information on interesting examples of innovatory school building activity. It is hoped they will serve to stimulate those engaged in the provision of school building facilities in their search for new solutions to new problems. Leaflets available to date (English and French versions) are:

1. School Building Today and Tomorrow
2. Maiden Erlegh : an English Secondary School Development Project
3. C.R.O.C.S. : a Swiss Industrialised School Building System
4. f.f.f. : a Canadian "casework", or furniture and equipment system for schools
5. Industrialised Building Systems, Educational Objectives and the Problem of Change

To ensure that future leaflets are related as closely as possible to the interests and preoccupations of the readers, the Secretariat would welcome comments and suggestions for further topics. These, and also requests for additional copies of available leaflets, should be addressed directly to the P.E.B. Secretariat, or alternatively, if from a participating country, to the national representative or correspondent to the Programme.

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